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Impact of Quality Management in Construction on its Productivity-Case Study

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ABSTRACT- Construction Professionals have not yet realized the importance of Quality management System in construction. The Quality Management System (QMS) in construction industry refers to quality planning, quality assurance, quality control. The main goal of construction industry is to ensure that construction projects are successfully completed within the constraints of best quality, stated period and at minimum possible cost.

This study is an exploratory research conducted primarily to give insight about quality practices, tools, techniques, management commitment towards quality implementation in construction projects. It also explores the issues faced during the implementation of Quality Management Systems. The research uses a qualitative questionnaire approach to gather data. A case study which substantiates the questionnaire is conducted using content analysis method. Conclusions are drawn based on the results of the analysis and the case study data. Suitable suggestions on how to overcome the issues of implementation of QMS has been made by consulting the experts through an unstructured interview.

KEYWORDS: Quality Management System (QMS), Management Responsibility, Relative Importance Index (RII), Productivity.

I. INTRODUCTION

1.1 General:

The Construction industry has a great influence on the economy of all countries. It is one of the parts that provide vital factors for the development of any economy. According to World Bank, the share of construction industry in developing countries is approximately between 6-9% of the Gross Domestic Product (GDP). (Unit, South Asia Sustainable Development, 2007)

The construction industry is an important part of the economy and has a considerable impact on the efficiency and output of other industries. It is not possible having extensive investment in manufacturing, agriculture, or service sectors without construction of infrastructure facilities in place. Residential projects make up 85% of the Indian real estate market. Between 2015 and 2020, we expect demand to grow from approximately 880 million square feet to 1.35 billion square feet. While we also expect demand for hospitality, retail and commercial real estate to increase, residential real estate will continue to represent the bulk of the demand. The Reasons for high demand for residential real estate in Pune, include a continuing urbanization trend and reduced household sizes due to the rise of nuclear families

1.2 Research problem:

The real estate sector is one of the most recognized sectors across the world. In India it is next to agriculture sector i.e. second largest sector in terms of employment generation. The growth rate of this sector is expected at 30 % over next decade. Real estate sector can be categorized into four sub-sectors i.e. - housing, retail, hospitality, and commercial. The Indian real estate market is expected to touch US\$ 180 billion by 2020. (Christopher Crowe et al, 2012). The housing sector alone contributes 5-6 % to the country's Gross Domestic Product (GDP). In the period FY2008-2020, the market size of this sector is expected to increase at a Compound Annual Growth Rate (CAGR) of 11.2 %. Retail, hospitality and commercial real estate are also growing significantly, providing the much-needed infrastructure for India's growing needs.

1.3 Research aim and objectives:

The main aim of this research is to help organizations to establish the standards of quality management system, and form it to document, implementing and maintaining it, and continually improving its effectiveness. To fulfil this aim the following objectives will be achieved:

- To identify the processes needed for Quality Management System and its application in the construction organization.
- To determine the sequence and interaction of these processes.
- To determine the necessary criteria and methods to ensure the effective operation and control of these processes.
- To ensure the prevailing quality practices followed in the local construction projects and management commitment towards quality implementation.

1.4 Limitations of the study:

The work for evaluation of the impact of quality on construction projects is carried out only in the construction industry of Pune. The work is limited to the residential real estate sector only and the results will depend on the data obtained after pursuing interviews with the professionals engaged in this industry.

1.5 Need for study:

1. Quality is one of the critical factors in the success of construction projects. Quality of construction projects is linked with proper quality management in all the phases of project life cycle
2. Quality of construction projects is linked with proper quality management in all the phases of project life cycle.
3. Design and construction are the two important phases of project life cycle which affect the quality outcome of construction projects significantly
4. Further, quality of construction projects can be regarded as the fulfillment of expectations of the project participants by optimizing their satisfaction
5. Since the quality outcomes of the projects are not according to required standards, faulty construction takes place.
6. 6-15% of construction cost is found to be wasted due to rework of defective components detected late during construction and 5% of construction cost is wasted due to rework of defective components detected during maintenance
7. Hence, quality has become one of the most important competitive strategic tools which many construction organizations have realized

II. LITERATURE REVIEW

2.1 Overview of the literature:

Quality can be defined as meeting the legal, aesthetic and functional requirements of a project. Requirements may be simple or complex, or they may be stated in terms of the end result required or as a detailed description of what is to be done. However, the quality is obtained if the stated requirements are adequate, and if the completed project conforms to the requirement.

The concept of quality management is to ensure efforts to achieve the required level of quality for the product which are well planned and organized. However, in the construction industry, quality can be defined as meeting the requirements of the designer, constructor and regulatory agencies as well as the owner

In this chapter, Key research papers relating to quality, quality management, and quality management procedures in construction industry were reviewed in order to determine the importance of quality for construction project success.

2.2 The Research Carried Out by Various Researchers-

The extensive literature review was carried out by referring standard journals, reference books, I.S. Code and conference proceeding. The major work carried out by different researchers is summarized below:

1) A.I. Romanova (2016), Improving the Quality of Construction Works in Terms of the Self- Regulation:

The author researched on improving the Quality of Construction Works in Terms of the Self- Regulation. Author learned the concepts of implementing, managing the quality aspects in the construction management. The management related to quality will be researched by the self-regulatory organizations. As author study the existing

system of the construction quality control in the Republic of Tatarstan and the established self-regulation system to propose measures of improving the quality of construction products.

2) **LI Qing, LIU Rengkui, ZHANG Jun, SUN Quanxin (2014), Quality risk management model for railway construction projects:**

The author mentioned about analyzing the quality risk management model for railway construction projects to overcome increasing of risk in the system. The main focus of author was to manage the combined concepts and process of the AFFTM including information technology and implementation scheme of a new risk management system. The railway management quality management leads to design and develop workable information tools quality risk management. Further author analyzed the data standards of RCPQMIS and creates a model for tracking the quality risk for providing pre warning. So this paper presents the functional modules of the RCPQMIS and its practical applications. Where the applications reveals the unified management of risk source information and multi-level sharing. As author describes that in future we will investigate methods to improve the data quality and to achieve further integration of the system functions in the risk management of railway construction projects.

3) **TurgutAcikara, AynurKazaz, SerdarUlubeyli (2017), Evaluations of Construction Project Participants' Attitudes Toward Quality Management in Turkey:**

The author management the quality system related to construction in Turkey. The construction projects includes risk which author investigates to overcome the quality and risk issues by implementing or minimizing occurrence of risk at the construction sites. The quality management policy of project participants to quality management process will negatively affect the management of the project and competitiveness of the firms. Author make a questionnaire for 120 participants of construction projects in Turkey, which the feedback shows a positive response towards the need of quality in construction projects.

4) **Tao Yu , Qingpeng Man, Yaowu Wang, Geoffrey QipingShen ,Jingke Hong , Jiasheng Zhang , JiaZhong (2019), Evaluating different stakeholder impacts on the occurrence of quality defects in offsite construction projects: A Bayesian-network-based model:**

The author researched on the quality defects in offsite construction projects which impacts by the stakeholders. The author aimed to enhance quality defect management in offsite construction projects where it is important to evaluate the different stakeholder impacts on the occurrence of quality defect. An evaluation model using the Bayesian network approach to measure stakeholder impacts on defect occurrence in offsite construction projects.

5) **Javon Adams, Cassie Castorena, Y. Richard Kim (2019), Construction quality acceptance performance-related specifications for chip seals:**

The author describes the research on the construction quality on establishing framework for construction quality. The management will be categorized and author in this paper aim the objective to determine appropriate test methods to evaluate each defined AQC. The relationships that are established between the AQCs and chip seal performance are used to define performance ranges and threshold values for a particular performance measure.

6) **ArashHosseini, Ahmed Faheme , Hani Titi, Scot Schwandt , Evaluation of the long-term performance of flexible pavements with respect to production and construction quality control indicators:**

The author researched on Evaluation of the long-term performance of flexible pavements with respect to production and construction quality.

This paper describes by the author on details process to develop a framework for connecting pavement construction quality control indicators to long-term performance at the network level. To define the statistical correlation between quality during asphalt mix production and surface construction to in-service performance this paper demonstrates the ability of the developed system.

7) **NokulungaMashwama, Clinton Aigbayboa&DidiThwala (2017), An Assessment Of The Critical Success factor For The Reduction Of Cost Of Poor Quality In Construction Projects In Swaziland:**

The author mentioned the research on the assessment of the Critical Success factor For the Reduction of Cost of Poor Quality in Construction Projects. The poor quality of construction work deals with the 40% of revenues that is used for managing the quality of projects. Author research adopted quantitative research and 50 useable questionnaires were used as an instrument tool for the study. The Swaziland deals with the construction industry

that was impact with poor quality and due to cost effects to the construction companies needs funds to improve the quality of construction that is not getting tolerated by the system. As under-pricing the construction project and rectifying construction mistake it becomes a big problem for the contractor. Author revealed that are a lot of success factors such as the use of quality management system and the critical success factors can actually help eliminate poor quality in most construction projects of Swaziland.

III. METHODOLOGY

3.1 Introduction

Methodology refers to the total sum of techniques of data collection, tool and the methods of analysing data and theoretical perspective or orientation that govern research. This section provides an overview of research approach adopted in the study which lays within the mixed methods strategies. It discusses research approach adopted and survey design of the study.

3.2 Research Design

Research design is the blueprint for fulfilling research objectives and answering research questions, In other words, it is a master plan specifying the methods and procedures for collecting and analysing the needed information. This is to identify and analyse all the elements of phenomenon, processor system such as identification and recording will be done from a particular perspective and often for a specified purpose, However it should always be done as objectively and accurately. The three alternative approaches that can be used in conducting a given research. The alternative approaches they identify are quantitative, qualitative and mixed research approach. Quantitative research approach focuses primarily on the construction of quantitative data, and quantitative data is a systematic record that consists of numbers constructed by researcher utilizing the process of measurement and imposing structure. The quantitative research approach employ measurement that can be quantifiable while qualitative cannot be measured. In mixed research approach inquirers draw liberally from both qualitative and quantitative assumptions.

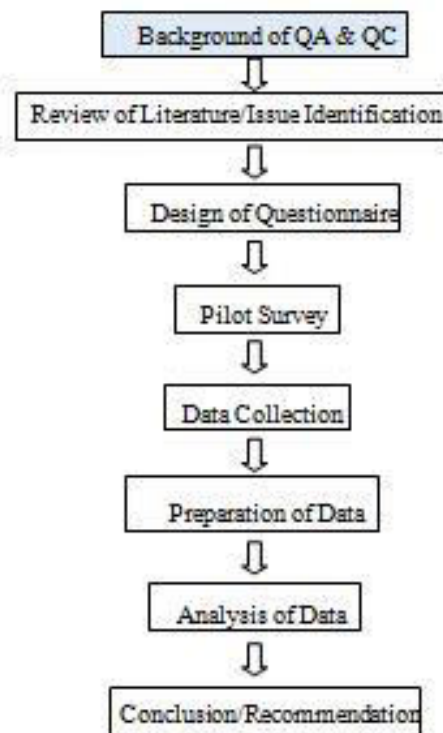


Figure 3.1. Flow Chart Showing Research Structure.

3.3 Population Technique

This study has intent to assess the practice of quality control management in Construction Company. To do this, the methods employed are survey design. Survey research of gathering information, usually through self-report using

questionnaires or interviews. Its purpose is to generalize from a sample to a population so that inferences can be made and it is also economical and rapid turnaround in data collection.

3.4 Type of data Collection and instrument tool

The study used both primary and secondary data. Here there are two basic sources of data sources namely, primarily and secondary source, in this study both primary and secondary sources of data was utilized through questionnaires, interview and literature review, observation check list & flows group discussion guide, etc. Primary sources of data include interview and questionnaire, these questionnaires and interview were composed of both open ended and closed ended items, whereas secondary sources data were generated through a review of relevant documents.

IV. RESULT AND DISCUSSION

4.1 Introduction

This chapter explains and discusses the results of findings based on the analysis done on the data collected. The results of the study are discussed by triangulating the different sources results: questionnaire results, interview and document review results. The discussion attempts to accomplish the objectives of the study and answer the research questions. A total of 68 questionnaires which dealt with construction equipment management practice and other aspects were distributed to the respondents of the company. However, only 52 questionnaires were collected and had usable responses (95.4% response rate), interview and relevant documents have been also reviewed. Considering the difficulty of collecting data in construction company projects, a (95.4%) response rate was reasonably very good.

An attempt has been made in the analysis to integrate and align the information obtained from questionnaire, interview, and other relevant document.

4.2 General Information about Respondent

Table 4.1 shows general information about sex, education qualification, work experience, and job position of respondents. Most (81.5%) of respondents are male and only 18.5% are of female respondents.

Table 4.1. General Information about Respondents

Variable	Frequency	Percentage
Sex		
Female	12	18.5
Male	53	81.5
Total	65	100
Educational qualification		
ME\ M.Tech	5	7.7
BE\ B.Tech	42	64.6
Diploma	16	24.6
Below diploma	2	3.1
Total	65	100
Work experience		
Less than 5 years	7	12.8
5-10 years	13	20
11-15 years	32	49.2
Above 15 years	13	20
Total	65	100
Job position		
Top management	5	7.7
Middle management	15	23.1
Project management	13	16.9
Equipment administration case team leaders and senior technicians	20	30.8
Total	65	100

Source: Own Calculation

Majority (64.6%) of respondents has an educational qualification of degree and followed by diploma holders which accounts 24.6%. only 7.7% and 3.1% are second degree and diploma holders respectively.

It can be seen from table 4.1 above that majority (69.2%) respondents have a work experience of more than ten years and the rest (32.8%) have a work experience of less than ten years.

Finally when we look at job position of respondents, most (30.8%) of respondents are senior technicians (electrical and mechanical), middle management (23.1%), and equipment administration and maintenance case team leaders (21.5%). It can also be seen from above table that 7.7% and 16.9% of respondents are top management and project managers respectively. Two project managers and one equipment administration and maintenance case team leader were unable to fill and return the questionnaire on time owing to the remoteness of projects location.

4.3 Column Work

A column work is a set of procedure for setting the framework for managing quality. it enhances and improves effective quality control within an organization.

Table 4.2: Descriptive Statistics

No	Variable	MN	SD	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Does the column marking is affect the quality	4.2	0.5	-	-	2(3.1%)	50(76.9%)	13(20%)
2	Is there any kind of problem arise due to insufficient reinforcement	1.9	0.7	19(29.2%)	37(56.9%)	8(12.3%)	1(1.5%)	-

Source: Own Calculation

4.4 Construction quality

From survey result (Table 4.3) majority (76.9%) of respondents agreed that Is there any kind of quality problem arise due to improper shuttering work . However, most of respondents (86.1 % with mean response 1.9 and standard deviation of 0.7) stress that the prevailing quality problem guideline, procedure and manuals are not clear and easily understandable. The interview result also suggested that existing Quality control manual did not cover various aspects of Quality management.

Budgeting (Planning)

Two important factors were set to check whether the company prepared annual budgeting and whether it uses standard forms for the capital budgeting purposes.

Table.4.3.Descriptive Statistics

No	Variable	MN	SD	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Is there any kind of quality problem arise due to poor design	4.1	0.7	-	2 (6.5%)	1(3.2%)	20 (64.5%)	8 (25.8%)
2	Is there any kind of quality problem arise due to improper shuttering work	3.23	0.9	1(3.2%)	5 (16.1%)	12(38.7%)	12 (38.7%)	1 (3.2%)

Source: Own Calculation

The majority (about 90%) of respondents agreed that the company agreed quality problem arise due to poor design prepares short and long range capital budgeting for acquiring construction quality control. It was revealed by the interview that the enterprise appreciates quality control for augmenting its capacity and become competitive in the construction sector. However, respondents neither agreed nor disagreed on the use of standard forms for quality control purpose by the construction company.

Table.4.4.Descriptive Statistics

NO	Variable	MN	SD	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Does the improper cover block placement affect the quality of column	4.39	0.8	-	2 (6.5%)	-	13 (42%)	16 (51.6%)
2	Is there any kind of quality problem arise due to manpower in site	3.16	1.5	2 (6.5%)	15 (48%)	1 (3.2%)	2 (6.5%)	11 (35.5%)
3	Is there any kind of quality problem arise due to equipment used in site	1.97	0.3	2 (6.5%)	28 (90%)	2 (3.2%)	-	-
4	Does the poor quality of concrete is affect the quality of column	1.81	0.8	11 (35.5%)	17 (55%)	3 (3.2%)	2 (6.5%)	-
5	Is there any kind of quality problem arise due to compaction of concrete	1.77	0.8	12 (39%)	16 (52%)	4 (3.2%)	2 (6.5%)	-

Source: Own Calculation

The quality management start with identification for its need somewhere in the organization and from above table 4.4 it follows that majority (94% with mean response 4.9 and standard deviation of 0.8) of respondents agreed the improper cover block placement affect the quality of column support process play a vital role as it is charged with responsibility of identifying and providing the needs of equipment to projects, and most (90%) of project managers have little to do with in the initiation of quality management.

Once the quality management initiation is approved the next is to identify alternatives to satisfy the identified needs. The survey result indicates that the majority (90% and 91%) of respondents disagreed as the company makes and adopts quantitative and qualitative method to analyse and select alternatives to proposals.

Table.4.5. Descriptive Statistics Construction Equipment Selection

NO	Variable	MN	SD	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Is there any kind of problem arise due to insufficient reinforcement	3.71	1.3	3 (9.7%)	4 (12.9%)	1 (3.2%)	14 (45.2%)	9 (29%)
2	Is there any kind of quality problem arise due to shuttering	3.32	1.0	1 (3.2%)	7 (22.6%)	5 (16.1%)	17 (54.8%)	1 (3.2%)

	work							
3	Does the poor cover block placement is affect the quality of beam	3.68	1.0	-	6 (19.4%)	5 (16.1%)	13 (41.9%)	7 (22.6%)
4	Is there any kind of quality problem arise due to manpower in site	3.1	1.0	1 (3.2%)	10 (32.3)	5 (16.1%)	15 (48.4%)	-
5	Is there any kind of quality problem arise due to equipment used in site	2.68	1.2	7 (22.6%)	7 (22.6%)	6 (19.4%)	11 (35.5%)	-

Source: Own Calculation

Survey result shown (table 4.5) reveals that most (74% with mean response 3.7 and SD 1.3) of respondents agreed as the problem arise due to insufficient reinforcement. This was confirmed by findings of that several quantitative and qualitative techniques to select the most economical from different alternatives available in the market. Once the decision has been made by top management to control a particular type of work the next step should be to carry out an problem arise due to insufficient reinforcement economic evaluation etc.

It could also, however, be seen that respondents (with mean response 2.68 and SD 1.2) neither disagreed nor agreed on the utilizations of past experience and information of other users by the company while selecting quality management.

Table 4.6 Descriptive Statistics

NO	Variable	MN	SD	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Does the poor quality of concrete is affect the quality of beam	2.6	1.3	9 (29%)	7 (22.6%)	2 (6.5%)	13 (41.9%)	-
2	Is there any kind of quality problem arise due to compaction of concrete	4.0	1.0	1 (3.2%)	8 (25.8%)	1 (3.2%)	20 (64.5%)	-
3	Is there any kind of quality issue arise due to curing of beam	2.1	1.0	4 (12.9%)	18 (58.1%)	3 (9.7%)	4 (12.9%)	
4	Quality control	3.7	1.1	-	8 (25.8%)	-	16 (51.6%)	7 (22.6%)
5	Others methods	2.8	1.3	7 (22.6%)	8 (25.8%)	-	16 (51.6%)	-

Source: Own Calculation

Table 4.6 below indicates purchase options that can be applied in equipment purchase decision. Most (64.5% with mean 3.7 and standard deviation 1) of respondents agreed that the company quality control.

V. CONCLUSION

This study examined the construction quality management practices and challenges that arise at construction Company. Three research questions were developed and tested in this study. The first question is to understand the practice of

construction quality control management. The second question is to understand the challenges faced by the company in the process of practicing quality management in construction. The last question is to assess the different factors issues that are related to impact of quality management in construction. The result of the study reveals the existence of construction quality control policy at Construction Company but affirms also that it lacks clarity and simplicity. Moreover, the construction policy manual does not cover various aspects of quality management. It has been also seen in the study result as Construction Company prepares short and long range construction quality management which is primarily made to augment its capacity and competitiveness in the construction sector of the country. Quality control proposal is assumed to be initiated from head office and equipment administration and maintenance unit of the company play a vital role in the initiation process. It was also found to be as the company did not adopt quantitative and qualitative method to analyse and select quality control proposal alternatives. An internally developed technical and financial criterion is adopted by the company to select construction management. Least price, standardization and management decision are the three major criteria used in the quality management selection process. It was revealed in the study that Construction Company did not have well organized and integrated quality management maintenance system. Corrective and unscheduled type of maintenance is mostly practice in the construction company. As a result of limited practice of corrective type of maintenance in the construction company, construction projects are not accomplished as per their contractual schedule. It was revealed in the survey as there was no appropriate ways such as Construction Company own database and formally organized use of other company experience upon which construction quality is determined in the construction company. Quality standardization is believed to improve the overall performance of equipment management activity. It plays an important role by increasing the availability of spare part, lowering maintenance cost, improving safety and supplier relationship in the process of equipment maintenance activity. Survey result reveals as construction quality management record keeping is weak in the construction company. Because of lack of continuous monitoring, controlling and timely action to adjustments by the enterprise, equipment utilization, daily report by operator, timely equipment utilization report, equipment costs and maintenance data and costs records are not properly undertaken in appropriate manner. Moreover, the existence of manual based method of quality control record keeping makes quality activity more difficult.

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