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Name of Author : Amit Mohite (PG Student, PVPIT, Bavdhan)
amitmohite295@gmail.com

IMPACT OF QUALITY MANAGEMENT IN CONSTRUCTION ON ITS PRODUCTIVITY

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.

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

1. INTRODUCTION

1.1 General:

Quality Management System (QMS) is defined as “all task/activities of the overall management function that determine the quality policy, objectives and responsibilities and implement them by means such as quality planning, quality control, quality assurance and quality improvement with the quality system.” (MS ISO 8402, 1994). Project Quality in the mid-level construction projects in Pune are often taken for granted and inadequate attention is given to this parameter. Quality which has three constrains that is time, cost and scope. The cost and time is greatly wasted every year due to the high level uncertainties surrounding the definition of quality. Quality Management System (QMS) could be implemented at the organization level or project level itself. Quality Management System is continuing process of improvement involving all aspects of the business. The QMS which is being implemented are based on the ISO 9000 series of standards. ISO 9001 is one such standard .The important clauses in ISO 9001 for quality implementation are quality management system, management responsibility, resource management, product realization and measurement, analysis and improvement. Quality Management in construction project meansmaintaining the construction quality to the desired level of the customer.

1.2 Research problem:

Most of the construction projects in the Pune are characterized by inefficiencies, large variability and low performance and thus wasting time, money and other

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resources. In this thesis, we will show the expected benefits of using some tools and technique in Pune construction industry in order to reduce or eliminate waste and eventually satisfy customerneeds and increase quality and productivity.

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 using Questionnaire method
- To determine the necessary criteria and methods to ensure the effective operation and control of these processes by Questionnaire Approach.
- To ensure the prevailing quality practices followed in the local construction projects and management commitment towards quality implementation.

1.4 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. Design and construction are the two important phases of project life cycle which affect the quality outcome of construction projects significantly
3. Further, quality of construction projects can be regarded as the fulfilment of expectations of the project participants by optimizing their satisfaction
4. Since the quality outcomes of the projects are not according to required standards, faulty construction takes place.
5. 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
   Hence, quality has become one of the most important competitive strategic tools which many construction organizations have realized

CHAPTER 2
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

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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.

The quality of constructions will improved by investing in the construction products. And also thus improve the self-regulations system and insurance arms. Further is the figure showing the measures and actions in the management of international quality.

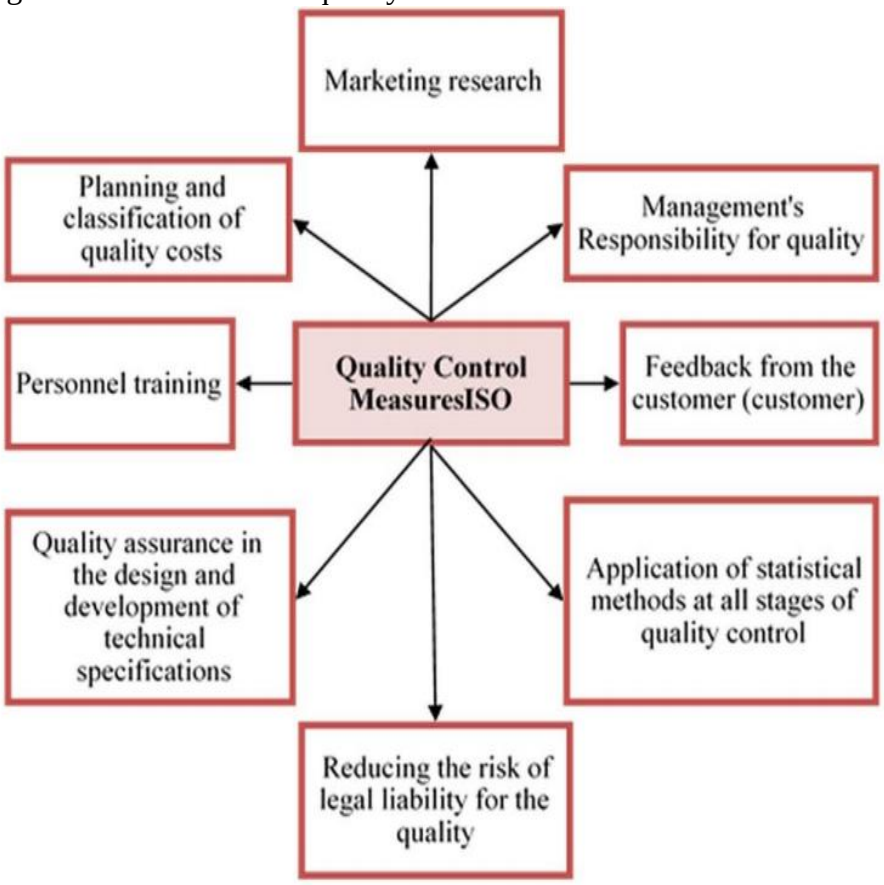

Fig 2.1: the measures and actions in the management of international quality

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2) **LI Qing, LIU Rengkui, ZHANG Jun, SUN Quanxin (2014), Quality risk management model for railway construction projects:**
The author mentioned about analysing 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 RCPQPMIS and creates a model for tracking the quality risk for providing pre warning. So this paper presents the functional modules of the RCPQRMIS 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.

2. 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 thestudy.

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.

There for the best type of research opted for by the researcher is descriptive approach(mixed approach) which helps the researcher draw assumption from both qualitative and quantitative approaches .This approached is picked because the research aims at describing the existing practice of construction equipment management of construction company and comparing it with conventional principles of managing construction quality control.

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To assess the practice of quality control practice in construction company , the researcher used mixed research approach the rationale for combining both quantitative and qualitative data is to better understand a research problem by combining both numeric values from quantitative research and the detail of qualitative research and to neutralize limitations of applying any of a single approach , the mixed research approach uses separate quantitative and qualitative methods as a means to offset the weaknesses inherent within one method with the strengths of the other method should be descriptiveresearch.

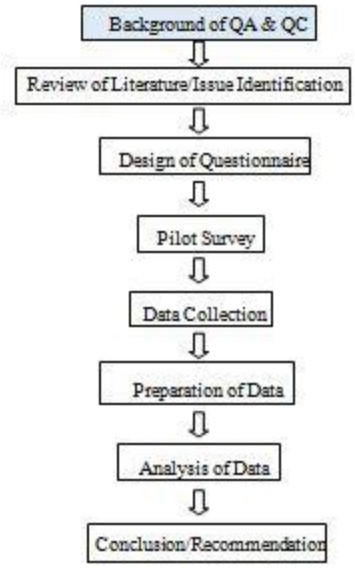

Figure 3.1. Flow Chart Showing Research Structure.

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 .

The populations considered in this study were the number of top middle management members, project managers, construction equipment administration and maintenance case team leaders of head office and projects, and senior technicians in which purposive non-probability sampling is adapted to rich evidence. According to the information obtained from human resource development and general service of construction company, there are 20 top and middle management, 13 road, dam and irrigation building and real- estate core process managers and 15 case team leaders of construction equipment administration and maintenance support process in projects and head office and 20 senior maintenance technicians a total of 52 sample population were selected.

The sampling technique that this research employed is sampling technique that allows the researcher pick informants based on the purpose of the study. Of the

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different types of non-probability sampling techniques, purposive sampling is taken as the most appropriate for the study. This is because of the context of the target enterprise. Therefore, naturally, its projects are widely dispersed across the country. This makes it very difficult to reach all the projects and complete the research project within a given period of time. Therefore, it is preferable to reach projects and offices of the enterprise based on purposive sampling in terms of transportation and other facilities.

In the case of this paper, of the employees working in the Company were selected as participants based on their involvement in construction equipment management practice and their availability.

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 cheek 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 relevantdocuments.

Questionnaire

In order to realize the target, the study used well-designed questionnaire as data collection instrument. Questionnaires were distributed top and middle management members, project managers, construction equipment administration and maintenance case team leaders of head office and projects, and senior technicians. They were selected as respondents because they are deemed to be knowledgeable about construction management practice and could provide important perspective on its adoption. The response is expected to help understand the factors that could explain the practice of construction equipment management as case of Construction Company. The research evidence was gathered by using both close-ended and open-ended questionnaires. Mixed questionnaires have many merits; the most important of this advantage is its considerable flexibility.With regard to the close- ended questions, the respondents were asked to indicate their level of agreement on a five point Likert scale with the following ratings. Strongly agree (SA; or 5), agree (A; or4),neutral(N;or3),disagree(D;or2),andstronglydisagree(SD;or1).Onthisscale a score of 5 or 4 indicates that the item is perceived to be essential while a score of 3 or 2 indicates that the item is perceived to be fairly important, but not essential, while a score of 1 indicates that the item could be disregarded for being unimportant and were found suitable. With respect to the open ended questionnaires the respondents were asked to provide open ended responses to the questions that require opinion and if they have opinions they feel the researcher would finduseful.

Interview

Semi structured interview with middle management members, project managers, construction equipment administration and maintenance case team leaders were conducted. It allowed the investigator some degree of flexibility at the time of interviewing for the pursuit of unexpected line of inquiry which was arising at the study progresses. Questions in the interview checklist were constructed based on the review of literature. In the process of preparing, testing and using the instruments, the following procedures have been followed.

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The questionnaires and the interview guides were developed based on literature review relevant to the issue and the specificobjectives both tools were judged for their validity using professionals in thearea. In the final study, the questionnaires and interview were administered both by the researcher.

Document Review

The review of documents helped the researcher to understand the key facts of the organizations. The documents were reviewed by referring most recent information from authorized documents and different reports. Annual performance reports and other documents related to the equipment management were used. The document reviews were used to triangulate the data collected by the questionnaires and interviews.

3.5 Procedure Of Data Collection

In order to assess quality mangement practices in the Company data was collected from primary and secondary resources. In case of primary resources, first we select & categorize target groupsand preparing survey questionnaires & submit interview /discuss with the target group & finally collect the filled questionnaires from the respondents, on the other hand in the secondary data, we collected data from writer reports & publication ofproject reports, documents, articles, journals, books, internet sources & other related sources by selecting the document we will useit.

3.6 Method Data Processing and Analysis

As explained in the preceding part, the research is designed to follow a mixed method. To this end, both qualitative and quantitative analyses were used. Data collected using questionnaire was analyzed through descriptive statistics, frequency distribution using Statistical Package for the Social Scientists (SPSS). It helps to describe what the data look like, where there centre (mean) is, how broadly they are spread in terms of one aspect to the other aspect of the same data. The SPSS version 21 is used to find out percentages, mean values, frequencies, correlations, etc. as main means for summarizing the data. Data collected from the interview and reviews of documents are interpreted qualitatively. In analysing the data from interviews, narrative approaches including quotations from respondents have been used.

CHAPTER 4
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.

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Considering the difficulty of collecting data in construction company projects, a (95.4%) response rate was reasonably verygood.

The questionnaire contains variables which include issues such as construction equipment policy, guidelines and procedures, budgeting, investment, selection, purchasing decision ,maintenance, record keeping, replacement and rent determination and disposal options. All items in the questionnaire are arranged in a form of Likert items to capture the feelings of respondents in scales ranging from 1 to 5.Five being the strongest possible feeling and 1 being the strongest possible negative feeling. All the data has been include in the SPSS so that the accuracy of the information is maintained.

In additions to this, interview was conducted among the top and middle level managers. The contents of the interview are manipulated in a way that it would prove or disprove the feeling exposed by the participants who responded to questionnaire. All the interview questions were structured so that they match the contents of the items enlisted in the questionnaire.

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

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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	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
1	Does the column marking affect the quality	-	-	2(3.1%)	50(76.9%)	13(20%)
2	Is there any kind of problem arise due to insufficient reinforcement	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

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respondents (86.1 %) 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.

Remedial Measures:

Column marking and sufficient reinforcement are required as per the design. Column being the structural member, one cannot construct a column without its marking. One of the check from many that is, X-axis and Y-axis are required in order to construct a column in place. To avoid and dislocation of any column or to avoid the shearing of any column we have to make sure the checklist is strictly followed and the no of bars and its diameter are strictly followed as per the structural drawing.

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 of column

NO	Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Does the improper cover block placement affect the quality of column	-	**2 (6.5%)**	-	**13 (42%)**	**16 (51.6%)**
2	Is there any kind of quality problem arise du to manpower in site	**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	-	-	**2 (3.2%)**	**28 (90%)**	**2 (6.5%)**
4	Does the poor quality of concrete is affect the quality of column	-	**2 (6.5%)**	**3 (3.2%)**	**17 (55%)**	**11(35.5%)**

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5	Is there any kind of quality problem arise due to compaction of concrete	**-**	**2 (6.5%)**	**4 (3.2%)**	**16 (52%)**	**12 (39%)**

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%) 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 tosatisfytheidentifiedneeds.Thesurveyresultindicatesthatthemajority(90%and 91%) of respondents disagreed as the company makes and adopts quantitative and qualitative method to analyse and select alternatives to proposals.

Remedial Measures:

1. In order to maintain the cover, cover blocks has to be made on site (25mm 50mm…) in a large quantity and it has to be checked and verified by the site supervisor.
2. Since 42% of the respondents has agreed the problem arise due to less manpower, increasing manpower is mandatory. It enhances the speed of work and to make sure it does not deteriorate your quality work the number of supervisors shall also be increased.
3. Faulty equipment shall not be used. Before using any kind of equipment for ex., compactor, vibrator etc a day before its usage has to be checked and verified if they are in a working condition. If not replacing it with working one would not affect the quality of your work
4. Maintaining the ratio as per specified design mix of concrete mix will attain the quality of concrete.
5. If compaction is properly done then there are less of chances of having a honey comb structure.

Table 4.4 Descriptive Statistics

NO	Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

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1	Does the poor quality of concrete is affect the quality of beam	**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	**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	**4 (12.9%)**	**18 (58.1%)**	**3 (9.7%)**	**4 (12.9 %)**	
4	Quality control	**-**	**8 (25.8%)**	**-**	**16 (51.6 %)**	**7 (22.6%)**
5	Others methods	**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 deviation1) of respondents agreed that the company quality control.

Remedial Measures:

1. Maintaining the design mix of concrete for beam is mandatory in order to maintain the quality.
2. Compaction fills the air voids (Not completely) avoiding any honey comb structure. Proper compaction at every layer must done.
3. Curing of beam is required for at least 21 days for any RCC structure to attain its full strength.

Table 4.5.Descriptive Statistics

No	Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Does poor paver block placement affect the quality	**7 (10.8%)**	**4 (6.2%)**	**1 (1.5%)**	**38 (55.8%)**	**15(23.1%)**
2	Is there any kind of problem arise related to electrical lining		**1 (1.5%)**		**51 (78.5%)**	**13 (20%)**
3	Is there any kind of quality	**10 (15.4%)**	**17 (26.2%)**	**11(16.9 %)**	**27 (41.5%)**	**-**

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	problem arise due to manpower in site					
4	Is there any kind of quality problem due to equipment used in site	**9 (13.9%)**	**27 (41.5%)**	**19(29.2 %)**	**10 (15.4%)**	-
5	Does the quality of concrete is affect the quality of slab	**14 (21.5%)**	**35 (53.8%)**	**2 (3.1%)**	**14 (21.5%)**	-

Source: ***Own Calculation***

The survey result (shown in table 4.8) indicated that majority of the respondents agreed any kind of problem arise related to electrical lining (78%), cover block placement affect the quality problem due to improper drawing study (55.8%) and the right angle marking affect the quality of block work (with mean 4.2 and standard deviation 0.8) were identified as major factors in influencing equipment replacement decision.

Remedial Measures:

1. Proper drawing study is required. The plan, elevation and section must be thoroughly studied to understand the layer required for the blocks in order to avoid any settlements of any paver blocks.
2. Proper study of electrical drawings is must. During the casting of slab the electrical conduits are placed in-situ as per drawings.
3. Maintaining the mix design required for slab, maintaining the cover required for slab, the well-fixed shuttering will help gaining the required quality of slab.

Table.4.6.DescriptiveStatistics

NO	Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Is there any kind of quality problem due to compaction of concrete	**19 (29.2%)**	**36 (55.4%)**	**7 (10.8%)**	**3(4.6%)**	-
2	Is there any kind of quality issue due	**4(6.2%)**	**7 (10.8%)**	**11(16.9%)**	**13(20%)**	**30(46.2%)**

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	to curing of slab					
3	Does any kind of quality problem due to improper drawing study	**13(20%)**	**32(49.2%)**	**7 (10.8%)**	**13(20 %)**	**-**
4	Does the right angle marking is affect the quality of block work	**18(27.7%)**	**36 (55.4%)**	**8(12.3%)**	**3(4.6%)**	**-**
5	Does the starter course lying is affect the quality of block work	**1(1.5%)**	**22(33.8%)**	**2(3.1%)**	**26(40 %)**	**14(21%)**
6	Does the proportion of mortar mix is affect the quality	**18(27.7%)**	**45(69.2%)**	**-**	**2(3.1%)**	**-**
7	Is there any kind of problem due to poor quality of brick or block	**24(39.9%)**	**39(60%)**	**-**	**2(3.1%)**	**-**
8	Is there any kind of problem arise due to not wetting the brick or block before lying	**29(44.6%)**	**-**	**-**	**16(24. 6%)**	**20(30.8%)**

Source: *Own Calculation*

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Respondents were asked when the enterprise would make the actual decision to quality. A majority (60%) of respondents said that the enterprise starter course lying is affect the quality of block work and problem arise due to not wetting the brick or block before lying.

Remedial Measures:

1. In order to attain proper bonding between the mother slab and brickwork/ACC block work it is important to first wet the surface of slab.
2. It is also important to wet the red brick before the placement of brick in-situ so that it will not absorb the water from the mortar and weaken the mortar.
3. After wetting the surface of brickwork it is important to cross verify the right angle in order to avoid over plastering.
4. Proper curing of slab is required in order to attain its full strength.

4. 7 Rent Determination

An attempt was made to solicit information through survey concerning the mechanism how quality management is determined in the enterprise. Hence, respondents disagreed with the enterprise determination equipment rent based on own data base (with meanresponse 2.5 and SD 1.3) and government rate (with mean response 2.2 and SD 1.1), According to interview result, respondents indicated that the enterprise did not have responsible unit that can organize and use internal and external updated information regarding quality control. It is also suggested as there is no responsible government body that can determine construction quality a management only market itself determines the level of quality the construction sector.

Table.4.7. Descriptive Statistics

NO	Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Is there any kind of problem arise due to not hacking the surface before plastering	10(32.3%)	12 (38.7)	3(9.7%)	6 (19.4%)	-
2	Is there any kind of fault due to improper button marking fixing	14(45.2%)	3 (9.7%)	12(38.7%)	1 (3.2%)	-
3	Does thickness of plastering affect the quality	-	12 (38.7)	8 (25.8%)	11 (35.5%)	-

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Source: ***Own Calculation***

Also, as in table 4.12, respondents neither agreed nor disagreed weather the enterprise thickness of plastering affect the quality. This was confirmed with interview result; respondents indicated as there was no formally organized and integrated mechanism to use other similar construction company experience to determine quality control in the enterprise.

Remedial Measures:

1. The thickness of plastering does not matter only if it is done step by step with proper chicken mesh work along with curing. But the plaster thickness of more than 2" should be avoided.

Table.Factors in Construction Equipment Downtime

Sr.No	Factors	Very low	Low	High	Very high
1	Lack of experienced operators	**9 (13.8%)**	**8(12.3 %)**	**21(32.3 %)**	**27(41.5%)**
2	Improper utilization	**7(10.8%)**	**3(4.6%)**	**30(46.2 %)**	**25(38%)**
3	Lack of spare parts	**5(7.7%)**	**8(12.3 %)**	**11(16.9 %)**	**41(63.3%)**
4	Lack of proper management	**-**	**5(7.7%)**	**10(15.4 %)**	**50(76.9%)**

Source: ***Own Calculation***

Four questions were distributed respondents to examine the extent of factors that account for quality downtime in the enterprise. It was found (in table 4.20 below) as lack of spare part availability(63.3% with mean response and SD respondents 0.9)was the major factor contributing for equipment downtime in the enterprise and followed by lack experienced operator and proper management respectively. Improper utilization of equipment by user was identified as least factor contributing for downtime

The interview result also indicated that lack of spare part availability increase the downtime of equipment. It was also revealed creating strong relationship with key and strategic spare part suppliers, hiring experience operators, continuous capacity development to operators could minimize the risk of equipment downtime.

Remedial Measures:

1. Experienced operators are required for the earth movers works, lifting cranes.
2. Spare parts required for these cranes should be made available in order to not delay the work.

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3. If the rented earth mover machines are not properly utilized then there is a huge waste in the amount which directly affects the finance of the project.

4.8. Chapter Summary

In this chapter the results of findings has been explained and discussed 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 Data collected using questionnaires were analyzed through descriptive statistics, frequency distribution. The discussion attempted to accomplish the objectives of the study, answer the research questions.

CONCLUSION

5.1 Introduction

This chapter has two sections. The first section presents the conclusion of the research derived from findings and the second section deals with recommendation that were made on the basis of the findings.

5.2 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 study used document analysis (annual performance reports and other documents), interview with top and middle management members and self-administered questionnaire to top and middle management, project manager's construction equipment administration and maintenance case team leaders of head office and projects, and senior technicians. Questionnaire data were analyzed using descriptive statistics and data from interview and document reviews were interpretedqualitatively.Equipment management remains a critical competency for the success of construction firms. Even though there are best quality control management methods available theoretically those aids in equipment management process, most equipment managers still use their subjective and potentially inadequate judgments in most of the equipment management decisions.Generally, as the result obtained from the study and based on its specific objectives the following conclusion are drawn. The current trend of construction quality management practice in the company is not satisfactory. Unless, it result ineffective management of material and will contribute its negative impact to successful accomplishment of the construction projects in construction company ontime. 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

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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 Companydid 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 contractualschedule.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 maintenanceactivity.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,timelyequipmentutilizationreport,equipmentcostsandmaintenancedata 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.

5.3 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.

5.4 Recommendation

Based on the result of the study and conclusion reached together with lesson drawn from literature on experience of other countries to mitigate the major practice of construction quality management practice and hence achieve sustainable construction quality management, the following important remarks are recommended.

1. The construction company needs to strength a construction quality management policy and develops clear guidelines and procedure on construction equipment management. This should govern the managing practice from selection to final disposal aspects of construction quality management. The policy should give each user of construction equipment a clearly defined right and responsibility in the process.
2. It is necessary for the construction company to establish a system to keep a tracking record for construction quality management data’s and costs as well as allowing the staff to acquire necessary knowledge to understand the budget plan and to evaluate it.
3. It is very important to do construction company wide base line

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assessment of the existing practice and challenges of construction quality management as it is a spring board for the following out come in doing so the enterprise should facilitate the financial, personnel and other requirements of the study and successive interventions.

4. The head office and all project members need to focus on creating awareness to all employees throughout the enterprise about construction quality management and update operating and utilizing of construction quality management.
5. As indicated in the summary and conclusion of the study, the construction company has poor maintenance practice, to alleviate the poor performance, the construction quality management administration and support process should try to work hardly by integrating maintains staff and fulfil all maintenance resources by giving skill development training and updating the current construction quality management practice to information technology assisted management practice
6. The construction company need to facilitate training to all construction quality management support process on economically efficient use of construction quality management in the Construction Company and projects.
7. The management should develop institutional construction equipment mechanisms that can enable the construction company members to make direct participation and provide information to the construction company in the way that can be easily accessible by concerned body inexpensively. In addition to these it would be more helpful if the construction quality management support process develop construction quality management data base.
8. The construction company, in consultation with construction quality management support process prepare construction quality management plan for their construction, which incorporate with the construction company strategic plan.
9. The enterprise should develop a single fixed asset register, using standard classification to describe the construction management and specified details of the equipment, which is linked to the key end user within the construction company projects and regularly determine the condition of their construction quality management using a standard assessment system.
10. Finally, in order to achieve the goal and target of Construction Company, the management bodies are expected to perform and assess construction quality management practice and solve the main challenges that affect the construction company, construction quality management practice.

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