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TO STUDY GREEN BUILDING TO ENHANCE THE QUALITY OF LIVING-CASE STUDY

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Abstract: ***There is great potential for quality improvement in the construction process. A study of the literature and of surveys conducted in the USA indicated that management commitment to quality and to continuous quality improvement is very important; construction industry professionals are well aware of the importance of quality training; partnering agreements among the parties in the construction process constitute an important step in securing a high quality product; a feedback loop could upgrade the original quality standards used in the industry; the clarity of project scope and requirements as well as of drawings and specifications is a prerequisite for high process quality. Theory and practice have proven that the cost of building materials accounts for a significant proportion in construction. The material saving is very cost-effective method for the enterprise, strengthen the material procurement management, timely, adequate, appropriate quality, suitable price to complete the procurement task is the goal of each enterprise; At present, resting on the building materials management by Project, this article focuses on the actual construction material purchasing pattern of current construction market and the analysis of the modern purchasing skill's merit and demerit. To promote the development of modern project management and improve the enterprise economic benefit, the "One Body Two Wings" materials procurement management; system model and the system function analysis are presented in this paper, which starting from procurement process management of the construction materials, based on the system Engineering theory, project management criteria and IT technical aids.***

Keywords—*Quality Management System, Construction Industry, Construction Industry, Costs, Benefits, Contractor*

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I INTRODUCTION

What is total quality management?

Total quality management is a set of management practices throughout the organization, geared to ensure the organization consistently meets or exceeds customer requirements. Total quality management places strong focus on process measurement and controls as means of continuous improvement

Quality is one of the critical factors in the success of construction projects. Quality of construction projects, as well as project success, can be regarded as the fulfilment of expectations (i.e. the satisfaction) of the project participants. The construction industry in India has been struggling with quality issues for many years. A significant amount of the budget is spent each year on infrastructure and other development projects. Since the quality outcomes of the

projects are not according to required standards, faulty construction takes place. Consequently additional investments are required for removal of defects and maintenance work.

A construction project in its life span goes through different phases. The main phases of a project can be described as: conceptual planning, feasibility study, design, procurement, construction, acceptance, operation and maintenance. Quality of construction projects is linked with proper quality management in all the phases of project life cycle

Implementing QMS principles in construction industry is particularly difficult because of the many parties involved. In this thesis I first present a short review of the literature on quality management in construction industry. Secondly, we focus on the problem defining quality in construction. I use data from my studies on quality in construction industry to illustrate the problem of defining quality and also discuss with some contractors. Third, we focus on problems with implementing quality management in construction industry.

Using those data, I form some the questionnaire for quality survey. Fourth, form the survey i can easily predict the major factor affecting the quality of construction. Fifth, the founded major factor affects the organization in terms time, cost and reputation. Finally the research result shows the cost and time for insufficient quality. Then conclude the research with giving some suggestion to the organization.

Benefits of Quality Management Systems

- Defining, improving, and controlling processes
- Reducing waste
- Preventing mistakes
- Lowering costs
- Facilitating and identifying training opportunities
- Engaging staff
- Setting organization-wide direction
- Communicating a readiness to produce consistent results

Elements and Requirements of A QMS

- The organization's quality policy and quality objectives
- Quality manual
- Procedures, instructions, and records
- Data management
- Internal processes
- Customer satisfaction from product quality
- Improvement opportunities
- Quality analysis

ISO 8402 defines quality as the degree of excellence in a competitive sense, such as reliability, serviceability, maintainability or even individual characteristics. We usually think of "quality" in terms of an excellent product or service that fulfills or exceeds our expectations. These expectations are based on the intended use and its cost. According Dale Bester field (Quality Control, A Practical Approach, 7th edition, 2004), Quality can be expressed as:

Q = P / E

Where,

- Q = Quality
- P = Performance
- E = Expectation

If Q is greater than 1.0, then the customer has a feeling of great satisfaction about the product or service rendered. The determination of Q is based on perception, with the contractor determining performance and the customer determining expectations. The customer expectations are continually becoming more demanding.

Quality Control (QC) in construction is the process of verifying that the project is built to plan, that the tolerances allowable by industry standard and engineering practices have been met or bettered, and that the finished project (and all phases to get there) meet with the quality standards of the architect, engineer, owner, and general contractor. On construction projects there are dozens of subcontractors, all of which have specific responsibilities.

Elements of quality in Construction

Leadership and Top Management Commitment

- Customer Management
- Training and Education
- Teamwork
- People Management and Empowerment
- Supplier Partnership
- Quality Policy and Strategy
- Process Management
- Rewards and Recognition
- Effective Communication

HISTORY OF FERROCEMENT

The history of quality management can be traced the way back to The Middle Ages. Work finished by understudies and disciples were assessed and reviewed by the specialist to guarantee that quality standards were met in all parts of the completed product to ensure fulfilment of the purchaser. And keeping in mind that the history of quality management has experienced various changes since that time but the end goal is the same.

ISO 9001 is the world's most popular and most generally utilized standard for quality management systems. A standard is not a law, however an agreement or best practice that an organization can adapt voluntarily. A standard reflects a decent level of professionalism. A quality management system is an instrument which an organization can decide how it can meet the necessities of its clients and the other invested parties that are engaged with its activities. There is a lot of benefit that ISO 9001 QMS will gives to the company when they adapt to their organization such as

- Shows that the products and services of reliable quality
- Shows that the products and services that meet the client's necessities, follow the law and enactment, and meet the Organization's own prerequisites;
- Enable to streamline the business forms and persistently enhance them.
- ISO 9001 can increase customer needs;
- ISO 9001 can reflect that organization is conforming to internationally recognized quality standards.

The ISO 9001 have recently updated their framework every seven (7) years. For instance, for QMS there are ISO 9001:2008 & ISO 9001:2015 which both frameworks serves the same purpose to have a standard in implementing the QMS in organization. Below is the difference between both frameworks that have been highlighted in the clause:

Table 1: Difference between ISO 9001:2008 & ISO 9001:2015

ISO 9001:2008	ISO 9001:2015
Introduction	Introduction
Scope	Scope
Normative reference	Normative reference
Terms and definitions	Terms and definitions
Quality management system	Context of the organisation
Management responsibility	Leadership
	Planning
Resource management	Support
Product realisation	Operation
Measurement, analysis and improvement	Performance evaluation
	Improvement

1.2 Problem Statement

"The construction industry suffers from several problems such as low productivity, poor health and safety, inferior working conditions, and inadequate quality. TQM can be a solution to these problems. However, there are several barriers to the extensive deployment of TQM in the construction industry. To study investigated the potential benefits and barriers to the extensive implementation of TQM in the construction industry through a questionnaire survey. The survey results revealed that contractors are aware of the benefits of TQM implementation but there are still several barriers to implementation. Lack of top management's support, commitment and leadership are the three most important barriers."

1.3 Need For Construction

- ✓ Expand the activities on disseminating information like explaining the importance, advantages and benefits of QMS for based construction firms.
- ✓ Giving incentives for the application of QMS, and even granting credit facilities for firms to set up the system will be encouraged.

- ✓ Government agencies involved in the construction industry should coordinate with private developers and construction firms to conduct seminars and trainings that will focus on the advantages and benefits in their organization.
- ✓ Encourage government agencies and private companies involved in construction activities to make as part of the requirements to qualify for bidding in construction projects.

1.4 Aims And Objectives

"To study in detail the concept of TQM & to collect the data by field survey and questionnaire"

- ✓ Adopting a holistic life cycle approach to planning, design and construction and maintenance;
- ✓ Maximizing the use of natural renewable resources and recycled/green building materials;
- ✓ Minimizing the consumption of energy, in particular those non-renewable types; and
- ✓ Reducing construction and demolition waste
- ✓ To increase the quality of living

MOTIVATION

- ➢ Contractors are companies engaged in building infrastructure projects.
- ➢ ISO- International Standard in Organization is an international standard to provide the generic core of a quality system standard applicable to a broad range of industry and economic sector.
- ➢ Quality Management System is comprised of activities of the overall management function that determine the quality policy, objectives, and responsibilities of the company. It is implemented through quality planning, quality control, quality assurance, and quality improvement

LITERATURE REVIEW

Quality Management System at Construction Project: A Questionnaire Survey, P. P. Mane, J .R . Patil, March 2015

The best quality, time and cost are the important aspects of successful construction project which fulfills the main goal of construction industry. The quality management has to provide the environment within which related tools, techniques and procedures can be deployed effectively leading to operational success for a construction project. The role of quality management for a construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the construction project. The quality management system (QMS) in construction industry refers to quality planning, quality assurance and quality control. The paper includes the outcome of the research methodology decided by authors based on interview of project participants and analysis of scrutinized interview data.

Probabilistic Segmented-linked Pavement Management Optimization Model, *by Adelino Ferreira et al, 2018*

This paper deals with PMSs Pavement management system together with genetic algorithm heuristic to solve the model, to reduce the total discounted total costs of pavement maintenance and rehabilitating actions over given timespan with quality.it assumes probabilistic pavement condition. This paper is divided into 5 sections. The test problems are described in the first part of the section second contains the results obtained through branch and bound. The third part contains results through genetic algorithm heuristic.

It consists of probabilistic segmented linked optimization model. The model is defined for specific segments of a road network thus overcoming drawback of widely used Arizona PMS general mixed integer optimization method was successful only on smallest test problem, hence lead to development of genetic algorithm heuristic. Model is able to handle 750km urban networks and 15000km state networks within computing effort. It has other future scope which can be used in other ways.

Importance of Quality for Construction Project Success H. Malla waarachchil and S. Senaratne2 December 2015

Construction projects are always expected to create a balance between cost, time and quality. It is possible to have high quality and low cost, but at the expense of time, and conversely to have high quality and a fast project, but at a cost. High quality is not always the primary objective for the client; however, it is extremely important to a successful project. An appropriate level of quality could be determined during all phases of the construction project. Specially, construction and commissioning are two critical phases where the project could impact by its operability, availability, reliability, and maintainability of a facility. Ultimately, a facility with a good construction quality program and minimal defects is more likely to have a smooth and trouble free transition into the commissioning and qualification phase of the project.

Study of Quality Management in Construction, Tan Chin Keng. August 2016

This research explores preliminarily the practices of quality management, management commitment in quality management, and quality management implementation problems in construction projects in the context of Malaysian construction industry. The research applies semi-structured interview approach with twelve project management practitioners. The findings of the study indicate that the state of quality management in construction projects in Malaysia needs to be strengthened and there are problems in relation to quality management implementation that require attention and further research. The paper provides an insight on the state of quality management in construction projects.

Safety Management Analysis In Construction Industry, for T. Subramanian, R. Lordsonmillar (, June 2014, IJERA)

The Indian society and economy have suffered human and financial losses as a result of the poor safety record in the construction industry. The purpose of this study is to examine safety management in the construction industry. The study will collects data from general contractors, who are involved in major types of construction. Collected data include information regarding organizational safety policy, safety training, safety meetings, safety equipment, safety inspections, safety incentives and penalties, workers' attitude towards safety, labor turnover rates and compliance with safety legislation.

Total quality managements in the construction process, for David arditi, H Murat Gunaydin (2018)

Great expenditures of time money and resources, both human and material, are wanted each year because of inefficient or non-existent quality management's process. The manufacturing industry has developed total quality managements (TQM) concepts.

Methodology

- Survey and collection of data related to issues of quality of pavement.
- Analysis of data by using statistical method i.e. focusing on critical parameter affecting road quality of rural area
- Development of TQM Evaluation Model for Road project
- Application of TQM Evaluation Model
- To maintain the quality and optimize the Cost.
- Analysis from the various people of construction industry, literature review.
- Methodology conducts the questionnaire survey in predefine.
- Find out the factors that affects the quality management in construction industry.
- Construction calculates the cost variance for quality defect.
- Conclusion

Figure: Methodology chart

V. Data Collection & Analysis

Data Collection

An integral part of successfully implementing an effective QMS is the need to identify, agree and use realistic criteria for routinely monitoring performance trends. These kinds of data are needed to support the Balanced Scorecard approach.

- Improvement initiatives on going and/or completed
- Quality failures e.g. cost of production failures per month
- Percentage on-time delivery to customer
- Failure costs per development project as % of project costs
- Controlled documents overdue for review
- Internal audit observation trends
- Customer complaints (numbers, response times)
- Recalls and other market withdrawals
- Laboratory errors and OOS results
- Process deviation frequency
- Staff training status
- Equipment breakdowns per month

SIX- Sigma:

The SIX -SIGMA approach for Quality management:

First, what it is not. It is not a secret society, a slogan or a cliché. Six-Sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect products and services. Why Sigma? The word is a statistical term that measures how far a given process deviates from perfection. The central idea behind Six Sigma is that if you can measure how many "defects" you have in a process, you can systematically figure out how to eliminate them and get as close to "zero defects" as possible

Key Concepts of Six-Sigma

At its core, Six Sigma revolves around a few key concepts.

- ✓ **Critical to Quality**: Attributes most important to the customer
- ✓ **Defect**: Failing to deliver what the customer wants Process
- ✓ **Capability**: What your process can deliver
- ✓ **Variation**: What the customer sees and feels Stable
- ✓ **Operations**: Ensuring consistent, predictable processes to improve what the customer sees and feels

Design for Six-Sigma:

Designing to meet customer needs and process capability.

Six-Sigma Methodologies Six-Sigma has two key methods.

- **DMAIC process (Define, measure, analyze, improve, control).**
- **DFSS methodology (Design for Six Sigma)**
- DMAIC is for existing processes which requires significant improvement due to falling below expected quality specification (Forbes and Ahmed, 2009). DFSS as a systematic methodology is for designing new products and/or process at Six Sigma quality levels (Kwak and Anbari, 2006).
- DMAIC methodology and its main steps are explained by (Stamatis, 2003) and these steps are summarized below:

Define, first stages of DMAIC is for team forming, determining the responsibilities of team members, establishing team goals and review the process steps, basic steps are:

- Define the problem: Problem should be based on measurable data and specific
- Identify the customer: Identification of the customer includes the analyses of problem impacts and a detailed analysis of COPQ (Cost of poor quality).
- Identify CTQ characteristics: Identification of CTQ (Critical to quality) is the determination of the important issues for customers.
- Map the process: A visual representation of the existing process should be prepared in order to look beyond functional activities and core process.
- Scoping the project: Reduction of project scope is the main focus of this step. Determination of specific project issues, a problem statement and brainstorm session are the purposes of scoping the project.

Measure, second stage of DMAIC, is for having a plan for data collection, preparing a sufficient data sample and preliminary analysis of this sample. In this stage, Six Sigma team analyzes current performance through valid data in order to understand improvement opportunities and identify KPIV (Key process input variables) , basic steps are

- ✓ Identify measurement and variation: Types, sources, causes and detailed impacts of variation on process should be defined by the establishment of measurement.
- ✓ Determine data type: Six Sigma team should define data types that will be collected. The main focus is to decide what kind of data and knowledge required for process improvement.
- ✓ Develop a data collection plan: Data collection plan provides data collection responsible and data displaying formats.
- ✓ **Perform measurement system analysis:** Graphical and baseline analysis should be performed through MSA (Measurement System Analysis) in order to be sure that data collection plan works accurately and collected data are confidential.
- ✓ **Collect the data:** Collected data should be proper and provide enough information to Six Sigma team in order to determine root causes of the problem.

Analyze, thirds stages of DMAIC is for finding the root causes of defects, right approach styles to data and improvement opportunities.

Improve, fourth stages of DMAIC, is for designing, implementing and validating the improvements. This stage includes FMEA (Failure Mode and Effect

Analysis), a preliminary cost/benefit analysis and preparation of necessary actions.

- **Control**, last stage of DMAIC, is for the institutionalization of process/product improvements and following performance. This is a transition phase of process from Six Sigma team to original executers under detailed control plan.

Benefits of Six-Sigma:

- Financial aspect: an ideal process improvement method should decrease the cost and increase efficiency.
- Technical aspect: an ideal process improvement method may lead to more effective researches on engineering issues.
- Quality aspect: an ideal process improvement should make final product better and satisfy the customer expectations.
- Reducing of product cost (process cost)
- Increasing the quality of final products
- Increasing the quantity of site production

ATTRIBUTES

Sr.No.	Names of Attributes
1	Lack of understanding in the QMS
2	Lack of understanding in the process
3	Lack of awareness in benefits of QMS
4	Lack of support from the top management
5	Lack of available Quality System
6	Lack of documentation for suppliers materials and services
7	Lack of planning to implement QMS
8	Lack of continuous professional Development
9	Lack of QMS exposure among workers
10	High cost to implement QMS
11	Lack of time to implement QMS/Time Consuming
12	Lack of awareness in benefits of QMS
13	Lack of QMS exposure among workers
14	Lack of continuous professional development
15	Lack of understanding in the process requirement
16	High cost to implement QMS
17	Lack of time to implement QMS/Time Consuming
18	Lack of documentation for suppliers, materials and services
19	Lack of support from the top management
20	Lack of available Quality System documentation such as procedures, records construction period, work instruction 3.39 and record

Case Study Schedule of Work

Project Name: Savarakar Road.

Engineer Name: Ajit Landge (B.E. Civil)

Structure Type: Road Construction

Road Type: Cement Concrete Road.

Length of Road: 5.8 Km

Company: Shiva Infrastructures Pvt. Ltd.

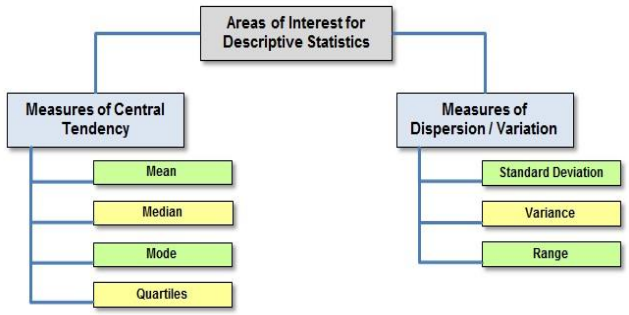
Vender: Taj Construction.

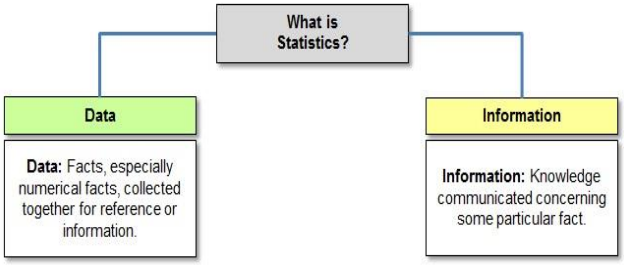
Unit of Analysis	General	Management Responsibility	Resource Allocation	Product Realization
Input	Quality policies and Objectives, PQP	Authorities, Objectives and communication	Training Plan and procedures, Awareness among employees, Competencies, Employment programmes	Planning and schedule records Quality designs and Customer requirements documents.
Mechanism/ Representative	Quality Manager, Steering committee, Process in charge	Cash flow technique, Senior Manager, Management Representative at site, Deputy General Managers	HR policies, Recruitment, Quality Manager, Planning Engineer	Schedule, Design of Experiments, Laboratory manual, QA/AC Engineer.
Control	Process mapping model, Minutes of Meeting, Control of records and document	Agenda and Minutes of Meeting of management review meeting	Skill sets, Evaluation records, Incentives, Variable pay	Monthly/Weekly quality statements, MIS, Test, certificates, Control and monitoring checklists
Output	Master list of quality records, Formats and controlled documents	Detailed Procedure, Work Programme, Standard Operating procedures and external audit.	Employee's records of training, qualification and skill records	Project Completion report, maintenance report, Delivery confirmation, Project manager's report, relevant checklists

What is Statistics?

Statistics is a tool for creating new understanding from a set of numbers. Statistics can be better understood under two branches:

1. Descriptive Statistics
2. Inferential Statistics





MEAN (Arithmetic Average):

Mean is the arithmetic average computed by summing all the values in the dataset and dividing the sum by the number of data values. For a finite set of dataset with measurement values X1, X2, …., Xn (a set of n numbers), it is defined by the formula:

$$\mu_x = \sum_{i=1}^{N} \frac{x_i}{N} = \frac{x_1 + x_2 + \ldots + x_N}{N}$$

MEDIAN

The middle number in the data set (n/2), when arranged in ascending order (small to large). If there are odd numbers of observations then median is the (n+1)/2th ordered value. If there are even numbers of observations then median is average of the two middle values.

MODE

Mode is the data point having the highest frequency (maximum occurrences).

QUARTILES

A quartile is any of the three values which divide the sorted data set into four equal parts, so that each part represents one fourth of the sampled population.

STANDARD DEVIATION

It can be interpreted as the average distance of the individual observations from the mean. Standard deviation of the population is represented as "σ". Standard deviation of the sample is represented as "s".

$$s_x = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n-1}}$$

Sx stands for standard deviation of the sample.
xi is the value of each variable in the data set.
x bar represents the mean.
n is the total sample size.
And Σ stands for summation i.e. it says that we need to take the sum of "xi – x bar" for all values of x.

VARIANCE:

Variance is defined as the square of standard deviation. Variance of the population is represented as σ times σ. Variance for the sample is represented as "times".

$$s_x^2 = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n-1}$$

Sx stands for standard deviation of the sample.
xi is the value of each variable in the data set.
x bar represents the mean.
n is the total sample size.
And Σ stands for summation i.e. it says that we need to take the sum of "xi – x bar" for all values of x.

RANGE:

Range is defined as the difference between largest value in a data set and the smallest value in a data set.

$$Range = Value_{Max} - Value_{Min}$$

ValueMax stands for the highest (maximum) value in the data set and ValueMin stands for the lowest (minimum) value in the data set.

CASE STUDY SITE DETAILS:

- ✓ **Project Name: Shubhankar Hights**
- ✓ Construction Type: RCC Frame Structure.
- ✓ No. of Floor: G+7 Floor
- ✓ Total Area of Building: 42157 Sq.ft.
- ✓ Plinth level: 0.55 m
- ✓ Walls: 230 mm thick brick masonry walls only at periphery.
- ✓ Steel: HYSD reinforcement of grade Fe 415.

Respected Faculty	Quality Assurance	Solution
Mr. Kamalesh Jaiswal Project Management	lodge a complaint on a builder from the Maharera regarding a property cancellation for giving the wrong information	The delay in builder projects in many projects have sparked a debate on getting refund with interest on the money already invested in the builder projects.
Mr. Kamalesh Jaiswal Project Management	Can you get refund with interest on the money invested in the builder project?	The delay in builder projects in many projects have sparked a debate on getting refund with interest on the money already invested in the builder projects.
Mr. Kamalesh Jaiswal Project Management	RERA affect the builders	Most of the builders think that the RERA will adversely affect them, but it is not correct. The RERA aim at regulating the real estate sector and anyone either it is a real estate developer, buyer or agent, who will not adhere to the rules of the RERA, may face consequences.
Mr. Vinayak Sable Jr. Site Engineer	De-shuttering of casted column or any other member on time	Fix the time for such kind of work on daily basis
Mr. Vinayak Sable Jr. Site Engineer	Curing for Slab and column	Put a date of casting on it so that give reminder to both of them
Mr. Vinayak Sable Jr. Site Engineer	Disputes on less no of labour on site	That should be consider for daily work on site for the given time period to complete on time without expanding.

- ✓ **Project Name: Sunrise City**
- ✓ Construction Type: RCC Frame Structure.
- ✓ No. of Floor: G+12Floor
- ✓ Total Area of Building: 35420 Sq.ft.
- ✓ Plinth level: 0.5 m
- ✓ Walls: 230 mm thick brick masonry walls only at periphery.
- ✓ Steel: HYSD reinforcement of grade Fe 415.

Respected Faculty	Quality Assurance	Solution
Mr. Shekhar Tadas Project Manager	Put a contractor on notice regarding?	A good contractor will have reasonable provisions to deal with these unexpected issues that don't leave them bearing the burden of the costs. The best thing is to avoid these problems by vetting the contractor properly in the first place and making sure that they have what I refer to as financial capacity
Mr. Satish Rathod Sr. Civil Engineer	Material which are used in slab shuttering	Slab casting is the most major part of building. if the props are not in possession in which they supposed to be it then the casting permission will not be granted.
Mr. Satish Rathod Sr. Civil Engineer	Work in rainy season as well as summer causes illness to the labour community	Provide adequate staff on site issued by contractors which might be the great prevention to disputes and health of workers.
Mr. Satish Rathod Sr. Civil Engineer	Electric supply on site during concrete work	This cause could be make huge dispute between contactors and engineer. Avoiding the dispute we should reserve the power in the form of generators.
Mr. Pawan Nimse Jr. Site Engineer	Adequate land for labour camp	The responsibility of labour camp is toward the management which gives them the rights to provide the adequate land for build the labour camp besides the working site.
Mr. Pawan Nimse Jr. Site Engineer	Allotment the proper scrap yard for all the scrap of contractor's material and company's steel scrap	These both things are provide at the site only. This not goes too far from working site. Which make things easy to contractors and client also

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- ✓ **Project Name: Royal Park**
- ✓ Construction Type: RCC Frame Structure.
- ✓ No. of Floor: G+8Floor
- ✓ Total Area of Building: 45288 Sq.ft.
- ✓ Plinth level: 0.75 m
- ✓ Walls: 230 mm thick brick masonry walls only at periphery.
- ✓ Steel: HYSD reinforcement of grade Fe 415

Respected Faculty	Quality Assurance	Solution
Mr. Kamalesh Jaiswal Project Management	lodge a complaint on a builder from the Maharera regarding a property cancellation for giving the wrong information	The delay in builder projects in many projects have sparked a debate on getting refund with interest on the money already invested in the builder projects.
Mr. Kamalesh Jaiswal Project Management	Can you get refund with interest on the money invested in the builder project?	The delay in builder projects in many projects have sparked a debate on getting refund with interest on the money already invested in the builder projects.
Mr. Kamalesh Jaiswal Project Management	RERA affect the builders	Most of the builders think that the RERA will adversely affect them, but it is not correct. The RERA aim at regulating the real estate sector and anyone either it is a real estate developer, buyer or agent, who will not adhere to the rules of the RERA, may face consequences.
Mr. Vinayak Sable Jr. Site Engineer	De-shuttering of casted column or any other member on time	Fix the time for such kind of work on daily basis
Mr. Vinayak Sable Jr. Site Engineer	Curing for Slab and column	Put a date of casting on it so that give reminder to both of them
Mr. Vinayak Sable Jr. Site Engineer	Disputes on less no of labour on site	That should be consider for daily work on site for the given time period to complete on time without expanding.

Project Name: Golden Palm

- ✓ Construction Type: RCC Frame Structure.
- ✓ No. of Floor: G+6 Floor
- ✓ Total Area of Building: 28958 Sq.ft.
- ✓ Plinth level: 0.6 m
- ✓ Walls: 230 mm thick brick masonry walls only at periphery.
- ✓ Steel: HYSD reinforcement of grade Fe 415.

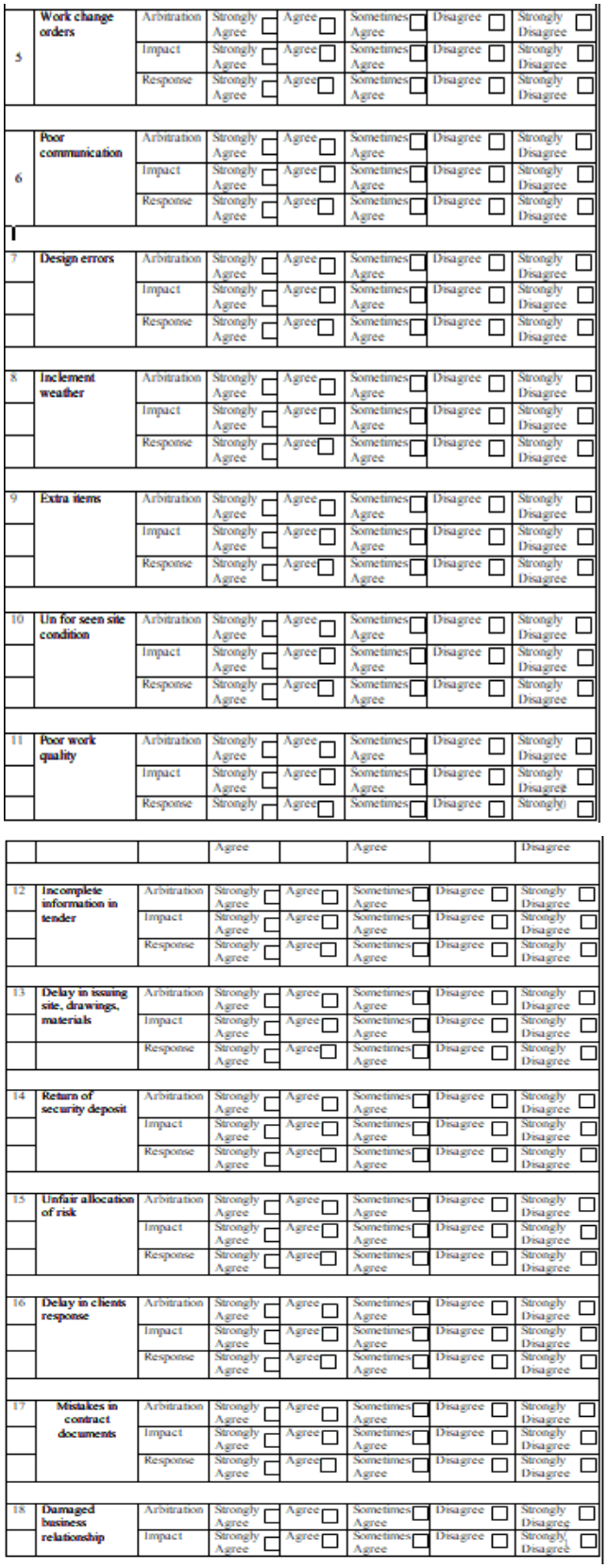
Respected Faculty	Quality Assurance	Solution
Mr. Sunil Chaudhary Project Manager	Construction projects frequently go over budget	1. Improve poor upfront conceptualization by the owner 2. Complete plans & spec's 3. Initial pursuit of lowest first quote costs and aggressive timeline 4. Full of contingency funding 5. Increase source of responsibility (individual) to manage the project, including the owner and the owner's expectations for the project.
Mr. Amol Satpute Quality Engineer	Inappropriate caring of sample	Engineer should take observation personally
Mr. Amol Satpute Quality Engineer	Excess use of water in concrete for easy handling	Charge a due if not gaining strength as per mix design.
Mr. Swapnil Godbole Sr. Civil Engineer	Fixing date for slab casting	Both engineer and contractor Should discuss whether the shuttering work is complete or not.
Mr. Gaurav Bhargav Safety Engineer	Not to follow safety instruction on working hours	Dismiss the particular worker for a day on site
Mr. Anand Bhosale Jr. Site Engineer	Low wages of labor affect efficiency	That could lead to disputes between contactor and labour which prevent by providing as per current market rate.

Project Name: Ganesh Plaza

- ✓ Construction Type: RCC Frame Structure.
- ✓ No. of Floor: G+8 Floor
- ✓ Total Area of Building: 32268 Sq.ft.
- ✓ Plinth level: 0.6 m
- ✓ Walls: 230 mm thick brick masonry walls only at periphery.
- ✓ Steel: HYSD reinforcement of grade Fe 415

Respected Faculty	Quality Assurance	Solution
Mr. Venkatesh Baride Sr. Civil Engineer	Contractor's RA bills sanction	Up to date forward the bills to respective higher authority.
Mr. Venkatesh Baride Sr. Civil Engineer	Contractor's misuse of company's property	Keep the all record day to day of issued materials.
Mr. Sachin Patil Jr. Civil Engineer	Unsatisfied checking for daily concrete work	Supervisor on behalf of contractor should crosscheck the particular concrete work to be done.
Mr. Sachin Patil Jr. Civil Engineer	Negligible tolerance in shuttering work	Carpenter should keep it as per drawing provided or refer check list
Mr. Sachin Patil Jr. Civil Engineer	Permit to work in night	They should put a target for particular time period.
Mr. Sachin Patil Jr. Site Engineer	Water and electric supply to labour camp	Management should fixe a particular time period for this. Such as Water for 1:30 hr. day after day and electricity for night only.

Sr. No	Attributes	Rating Scale					
1	Finance and payment issue	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
2	Time overrun	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
3	Cost overrun	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
4	Price escalation	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐



5	Work change orders	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
6	Poor communication	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
7	Design errors	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
8	Inclement weather	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
9	Extra items	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
10	Un for seen site condition	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
11	Poor work quality	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly	Agree ☐	Sometimes	Disagree ☐	Strongly)
				Agree		Agree		Disagree
12	Incomplete information in tender	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
13	Delay in issuing site, drawings, materials	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
14	Return of security deposit	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
15	Unfair allocation of risk	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
16	Delay in clients response	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
17	Mistakes in contract documents	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Response	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
18	Damaged business relationship	Arbitration	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐
		Impact	Strongly Agree ☐	Agree ☐	Sometimes Agree ☐	Disagree ☐	Strongly Disagree ☐

RESULTS & DISCUSSION

Design of questionnaire sheet that essentially consists of

- ✓ Current status of QMSs implementation in Indian construction companies
- ✓ Implementation of ISO 9001 principles and elements
- ✓ Problems influencing effective QMS implementation
- ✓ Company performance in terms of major achievements during the implementation of QMS

Primary Analysis

A Descriptive statistical analysis

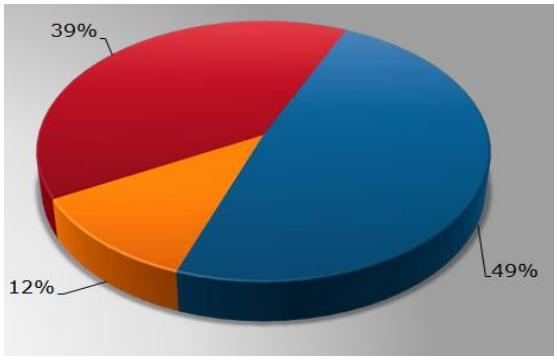
- Measurement of central tendency (Mean, Median, Mode)
- Measurement of variation (Standard deviation)

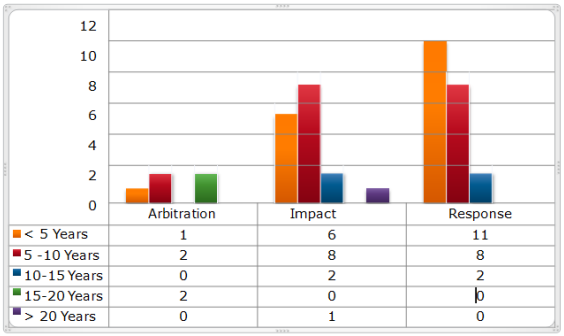
Secondary Analysis

To check whether different profiles of organizational culture variables have different influence on the QMS variable.

The Respondents can be classified into three groups:

- ✓ Quality Management Representatives (QMRs) – High level
- ✓ Managers (MRs) - middle level
- ✓ Project/Site Engineers (SEs) - Basic level
- ✓ Arbitration
- ✓ Impact
- ✓ Response
- ● Strongly Agree
- ● Agree
- ● Sometimes Agree
- ● Disagree
- ● Strongly Disagree





Total = 43

During Development of QMS

Development of QMS documentation	No of Respondents	%
QA team and the consultant developed the document	8	16.28
The consultant developed the document	6	9.30
QA team developed the Document	18	39.53
Every division prepared a draft of the document	11	34.88
Total	43	100

Strengths	Weakness	Opportunities	Threats
Opportunities in field of construction	Construction projects reduces business efficiency	Continuous private sector housing boom will create more construction opportunities	Current economic situation may have an adverse impact on construction industry.
Boom for housing and commercial building demands	Training itself has become a challenge	Renewable energy projects will offer opportunities to develop skills and capacity in new markets.	safety is a challenging task in construction industry
Availability of low cost skilled labours	Huge amount of money needs to be invested	Financial supports like loan and insurance and growth in income of people is in support of construction industry	Natural abnormal casualties such as earth quake and floods are uncertain and can prevent the construction boom
Availability of sufficent raw materials	Improvement in long-term career is highly required for new entrants	Government policies for low cost housing	Competitors are emerging in the industry by leaps and bounds
Implementation of RERA and GST	Corruption in the Industry		Local and Political Threats
The number of people living in urban areas is likely to grow significantly	As a result of the global financial weakness, cash flow management and debt levels will affect real estate development.	Tight liquidity in the current scenario can give new investors a great pricing advantage	Hindu nationalism is a growing threat to India's constitutionally enshrined secularism
100% foreign direct investment (FDI) is now allowed in construction	Low and falling participation of women in the labor market	Indian economy is growing in an uneven manner and the environment is unpredictable	Gap between Demand and Supply of River Sand

Higher agricultural output	High inflation rate has been pushing construction costs up	Demonetization has resulted in shortage of cash and low transactions in property market and leasing activity due to large involvement of cash component.	Market instability and uncertainty may create a slight flutter in this industry
Growing consumer and business confidence is a positive for long-term investment into Indian Real Estate Sector	Lack of infrastructure is another deterrent for the Indian Real Estate Sector		Continuous change in policies will tend to affect investment as well
Growing Urbanization and Economic Expansion open up potential for commercial real-estate market growth.			The Indian Real Estate Sector is still highly unorganized with lots of middle men

During Development of QMS

Period	No of Respondents	%
< 6 Months	18	41.86
6 – 12 Months	15	34.88
13 – 18 Months	6	13.95
19 – 24 Months	4	9.30
Total	43	100

During Development of QMS

The development of company's QMS under ISO 9001	Mode	Median	Mean	SD
To effectively and efficiently control project activities	1	2	2.24324	1.40249
To minimise poor quality of construction processes and products	2	2	2.48649	3.53553
For the betterment of the company's overall management system	3	3	3.91892	2.24076
To fulfil clients' requests as part of the bidding process	5	5	5.10811	1.62931
To improve business performance	6	5	5.16216	1.46275
To improve the company's prestige (e.g. image, reputation)	8	5	5.43243	2.08887
To enter the international construction market	4	5	5.51351	2.25612
As a requirement from the Ministry of Public Works	6	6	6.13514	1.60143

Levels of quality management system implementation

Levels of quality management system implementation

Rank	QMS-ISO 9001 Elements	Mean	SD	LoI
1	Process control	3.488	0.593	3
2	Control of a nonconforming product	3.349	0.686	3
3	Contract review	3.326	0.566	3
4	Inspection, measuring and test equipment	3.279	0.934	3
5	Purchasing	3.256	0.621	3
6	Inspection and testing	3.256	0.693	3
7	Design control	3.256	0.727	3
8	Document and data control	3.233	0.751	3
9	Management responsibility	3.209	0.675	3
10	Inspection and test status	3.209	0.804	3

Levels of quality management system implementation

Rank	QMS-ISO 9001 Elements	Mean	SD	LoI
11	Control of customer-supplied product	3.186	0.764	3
12	Corrective and preventive action	3.116	0.731	3
13	Product identification and traceability	3.116	0.763	3
14	Control of quality records	3.116	0.879	3
15	Quality system	3.023	0.740	3
16	Servicing	2.930	0.910	3
17	Handling, storage, packaging, preservation and delivery	2.907	0.718	3
18	Training	2.814	0.795	3
19	Internal quality audits	2.814	0.907	3
20	Statistical techniques (20th E)	2.767	0.718	3
	Total QMS-ISO 9001 Elements	3.133	0.778	3

Levels of quality management system implementation

Position of Respondent		QMS element 5	QMS element 14	QMS element 17
High Level	Mean	4		3.6
	Std. Deviation	0	3.2	0.8
			0.7	
Middle Level	Mean		3.471	2.235
	Std. Deviation	3.253	0.265	0.691
		0.441		
Low Level	Mean		2.810	3.095
	Std. Deviation	3.048	0.562	0.491
Total	Mean		3.116	2.816
	Std. Deviation	3.233	0.751	0.907

Problems affecting effective QMS implementation

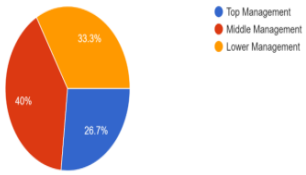
Rank	Barriers	Mean	SD	LoB
1	Lack of a well-design reward system	2.674	0.778	3
2	Misleading QMS purposes	2.442	0.666	2
3	Uncertainty with sub-contractors and supplier quality systems	2.233	0.782	2
4	Lack of effective internal communication	2.209	0.833	2
5	ISO 9001is a matter of fulfilling audit requirements	2.186	0.907	2
6	Lack of effective management response	2.140	0.676	2
7	Lack of strong motivation	2.116	0.625	2
8	Lack of corporate commitment	2.070	0.856	2
9	Resistance to QMS implementation	2	0.756	2
10	Failure in disseminating QMS	1.977	0.707	2
11	Lack of funding for QMS implementation	1.977	0.740	2
12	ISO 9001 is a documentation matter instead of opportunity to make a change	1.907	0.684	2
13	Difficulty in understanding terminology	1.884	0.586	2
14	Poor external communication	1.884	0.731	2
	Total	2.121	0.766	2

SPSS RESULTS

Simple descriptive statistics such as averages ranges and percentages were used to analysis primary data from the construction site. Among 50 questions only 15questions were considered for survey. The questionnaires were distributed through various electronic media platform to a variety of respondent working around the construction projects. About 50 people have responded to the questionnaire survey.

The respondents were asked to indicate the positions they held in the respective companies and the duration for which the company is in operation. They were provided with options to choose from. About 26.7% of the respondents who participated in the study are from Top management background, 40% were from middle management, while 33.3% were serving as a lower management as shown in the Figure these respondents are well conversant with effect of quality management.

General questions



1. Name
2. Mobile no.
3. Mail id
4. Age
5. Occupation
6. Organizational/college name
7. Position in organization
8. Working experience
9. Location
10. Any other information

The construction Technique is increase productivity Compared to conventional techniques?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	2.5	2.5	2.5
	4	4	10.0	10.0	12.5
	5	35	87.5	87.5	100.0
	Total	40	100.0	100.0	

Do you think new construction technique shall be apply on your site?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	2.5	2.5	2.5
	4	3	7.5	7.5	10.0
	5	36	90.0	90.0	100.0
	Total	40	100.0	100.0	

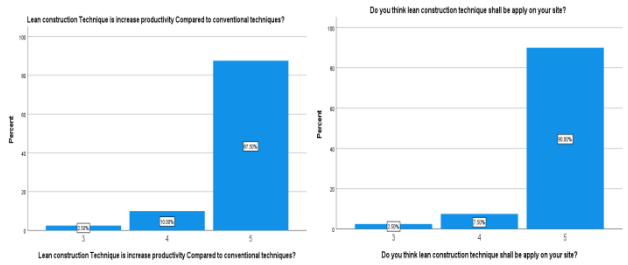
Friendly attitudes of project team affect the construction productivity?

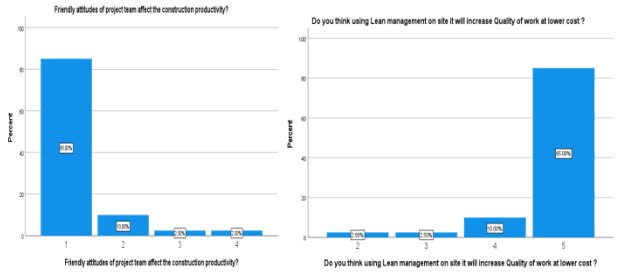
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	34	85.0	85.0	85.0
	2	4	10.0	10.0	95.0
	3	1	2.5	2.5	97.5
	4	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

Do you think using Quality management on site it will increase Quality of work at lower cost

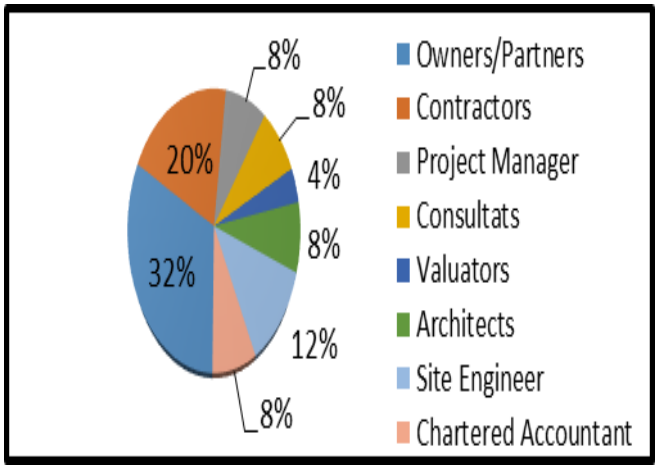
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	2.5	2.5	2.5
	3	1	2.5	2.5	5.0
	4	4	10.0	10.0	15.0
	5	34	85.0	85.0	100.0
	Total	40	100.0	100.0	

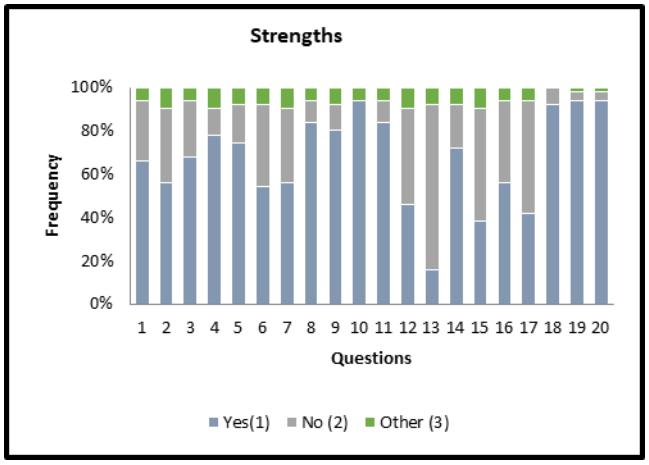
Bar Chart

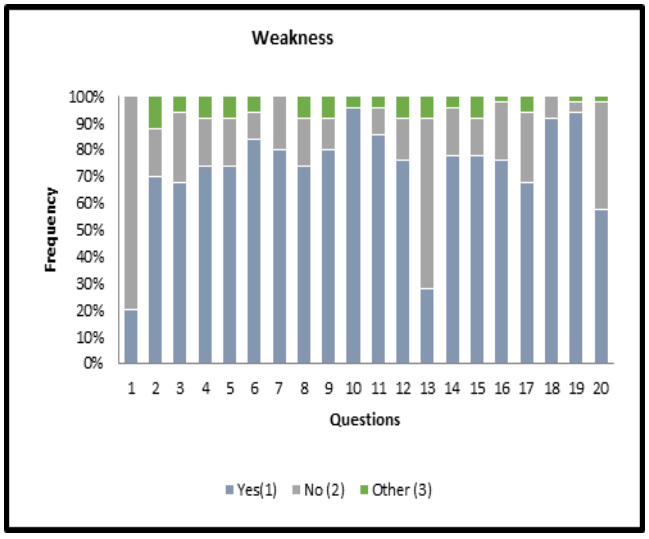


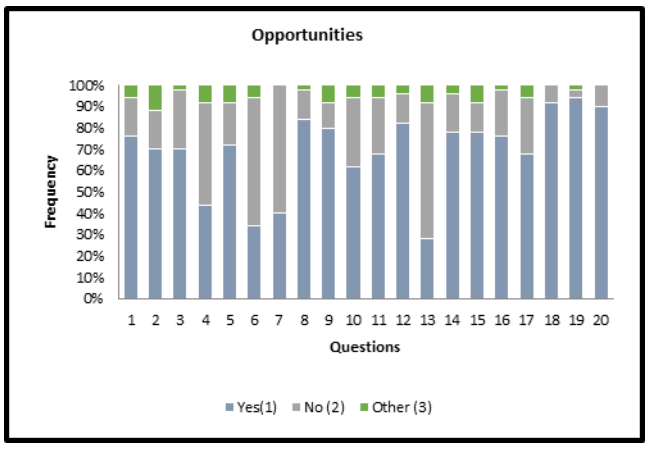


1	Owners/Partners	32%
2	Contractors	20%
3	Project Manager	8%
4	Consultants	8%
5	Valuators	4%
6	Architects	8%
7	Site Engineer	12%
8	Chartered Accountant	8%









CONCLUSION

- The findings indicate a lack of use of 'cause and effect diagrams' and 'statistical process control' as typical tools.
- Some studies report that effective decisions on quality processes are made mainly on the use of data analysis and information with the assistance of some statistical tools.
- Construction industry efforts to improve quality have been slow and fragmented as well as being fraught with difficulties in implementing.
- This also due to the characteristics of the construction industry and its dynamic project processes. For QMS implementation and an approach such as to be a real solution, all levels of a company's structure need to be bound by a strong commitment towards it
- People concede the purpose of implementation of TQM in construction companies must be in line with the company's Organizational culture.
- In the construction quality systems and Organizational culture area endorse this view by revealing that quality culture and corporate culture are considered to be determinant factors in contributing to the successful or unsuccessful implementation and maintenance of a quality system.
- Studies examining the effects of QMS implementation in the construction industry show that not only do customers benefit substantially from it, but so does the construction company.
- The aim was achieved through the collection and analysis of data, combined with the incorporation of extant literature to address issues relating to the effectiveness and continual improvement of the implementation of quality management systems, within the context of the Indian construction.
- This study provides empirical evidence in support of the notion that problematic issues associated with the implementation of QMS can have an impact on the effective implementation of the QMS

Future scope of the work

Green building reduces the impact on environment and indirectly helps to reduce the global warming effects. Green buildings and the concept of smarter living offers tremendous opportunity for changing an average Indian's lifestyle. As the general public becomes more aware of the benefits of green buildings, developers will get creative and find new ways to

brand, market and sell green buildings, hence creating a conductive atmosphere for the sector to grow exponentially.

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