

STUDY AND ANALYSIS OF QUALITY MANAGEMENT AND ISO STANDARD PRACTICES IN THE BUILDING CONSTRUCTION INDUSTRY

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Abstract - The construction industry in India has been struggling with quality issues for many years. Quality will have to be integrated into all aspects of a successful organization. Quality is a key driver of market share. Quality is generally used concerning the "end-use of the project". It can also be defined as "Perfection, fast delivery of the product, eliminating waste in the product, consistency in performance, and total customer service and satisfaction". Quality of construction project will be regarded as the fulfillment of expectations of project participants. A significant amount of the budget is spent each year on infrastructure and other development projects. During the last decade's construction industry has been heavily criticized for its performance and productivity in other industries. This study aims to provide a comprehensive analysis of the various standards and practices in the construction industry to help improve the quality of projects.

Key Words: Quality, Quality Management System, Building Construction, ISO Standards, Quality Control, Total Quality Management

1. INTRODUCTION

Quality is one of critical factors for the success of construction projects. Quality of a construction projects, as well as project success can be regarded as fulfillment of expectations of project participants. A significant amount of budget is spent each year on infrastructure development projects. Since the quality outcomes of the projects are not according to required standards, faulty construction takes place. So, consequently additional investments are required for removal of defects and maintenance work.

Quality management is progressively utilized by construction organizations as an activity to take care of value issues and to address the issues of the end client if at any point an industry should fuse the idea of QMS (Quality Management System) in the development segment. Nonetheless, actualizing QMS standards in the development division is especially troublesome because of the numerous gatherings included.

The point of value the quality management is to get things done at first time, taking out rework and waste. To accomplish this, it is vital spotlight on the "Processes". A process is nothing but task or also it can be task series. A

process may includes the drawing preparation, vibration of fresh concrete or the way in which the quality manager acts with a client and with other members of construction projects. Quality administration places accentuation on anticipation not on revision. The objective which works that is 100% free of blunders, free mishaps and 100% free of waste. The fundamental goal is to make the quality attention to the development organization particularly little scale enterprises.

1.1 Importance of Quality Control in Construction:

- Quality control (QC) in construction is the process of identifying and verifying the project is built to plan and the tolerances allowable by industry standard and engineering practices have been met or battered and 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 many subcontractors, all of which have specific responsibilities. Superintendents and project managers try to maintain high quality standards, but they can't everywhere at once.
- In addition, a great general contractual worker or designer will have on staff quality control individual, somebody who is in charge of experiencing the structure or venture, guaranteeing consistence, and keeping up an on-going rundown of restorative things that must be cultivated before the temporary worker who introduced it.
- QC technicians generally keep a very detailed binder, separated by rears/rooms/phases of the project with notes of items that must be either identified or corrected, with sign-off as each is accomplished. This binder becomes part of construction record and is an important element to construction on time with expected quality maintained.

1.2 Discussion

In this project, the recent study regarding quality management and ISO standards is reviewed through literature. To understand recent development in quality management techniques and ISO standards. Based on this study, formation of a questionnaire to find out the quality and standard practices in building construction industry of Kolhapur and Sangli region. The statistical data analysis using SPSS software will be helpful for set up the quality

and ISO standard measurements in the building construction industry. From this whole study we are suggesting best suitable measures and benefits for implementing quality management and ISO standard practices in building construction industry of Kolhapur and Sangli region.

1.3 Factors affecting quality of construction:

There are various factors which are affecting on quality of construction. Among these factors following are the major factors which affects majorly to the quality of construction. These factors are as follows:

1. Limitation of Finance
2. Limitation of Communication
3. Limitation of Labour and Wage
4. Limitation of Weather
5. Limitation of Building and Construction Detail
6. Limitation of Material and Equipment
7. Limitation of Time
8. Construction Methodology
9. Training Policies
10. Limitation of Rule or Regulation
11. Lack of co-ordination among departments

1.4 Objectives:

- To study the quality management system and ISO standard practices in Building construction industry.
- To identify the factors that affect quality of building construction.
- To analyze the quality management system and ISO standards practices in building construction industry by statistical analysis using SPSS software of Kolhapur and Sangli region.
- To suggesting and implementing quality management practices on actual site.

1.5 Methodology:

The following methodology will be adopted -

- Collection of preliminary information through a literature survey.
- Identify the factors affecting to quality of building construction.
- Study of quality management systems such as Quality control tools, Total Quality Management (TQM), Inventory and Inventory control techniques, Dimensions of service quality, and Important ISO standards for building construction industry.
- Preparation of questionnaire for assessing current quality management and ISO standard practices in building construction industry.
- Analysis of questionnaire survey from data collected through construction site by statistical analysis using SPSS software.

- Suggesting and implementing best recommendations for quality improvement on actual site in building construction industry of Kolhapur and Sangli region.

2. Study of Quality Management and ISO Standards:

2.1 Quality Control Tools:

Japanese expert Professor Karou Ithikawaan developed the seven quality tools to improve the quality. The seven basic tools of quality is a designation given to a fixed set of graphical techniques identified as being most helpful in troubleshooting issues related to quality. They are called basic because they are suitable for people with little formal training in statistics and because they can be used to solve the vast majority of quality related issues. These tools are as follows:-

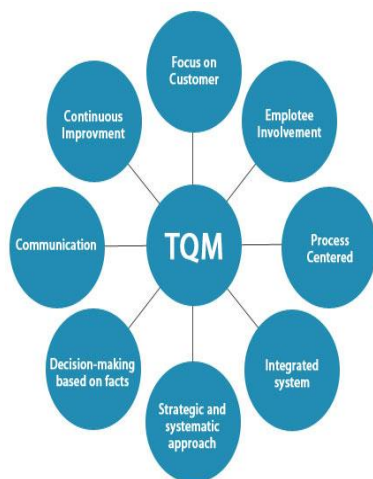
1. Histogram
2. Flow chart
3. Pareto analysis
4. Check sheet
5. Scatter diagram
6. Fishbone diagram
7. Control chart

2.2 Total Quality Management:

The concept of total quality management refers to nothing but one of the management approach for the success in long term basis through customer satisfaction. In a TQM effort, all candidates of an organization take part in improving culture, services, products, and the processes in which they work. TQM is nothing but the management approach through customer satisfaction to long-term success.

2.2.1 Total Quality Management Principles:

There are 8 basic principles of Total Quality Management. TQM can be elaborated as one of the management process in the view of customer-focused organization which involves all employees working in organization in continual improvement. To integrate quality discipline into the activities and culture of the organization TQM use of effective communications, data and strategy used in TQM. In modern quality management systems the successor to TQM, many of these conceptual management point are also present. TQM principles are set of fundamental rules or benefits for leading and obtaining an organization. These are aimed at continually improving performance over the long term, by focusing on customers and investors. It provides understanding and guidance on the application of quality management in organization. Following are the eight quality management principles which can facilitate the creation of quality work.



2.3 Inventory and Inventory control techniques:

Inventory is the array of finished goods or goods used in production held by a company. Inventory is classified as a current asset on a company's balance sheet, and it serves as a buffer between manufacturing and order fulfillment. When an inventory item is sold, its carrying cost transfers to the cost of goods sold (COGS) category on the income statement.

Types of Inventories:

1. Transit Inventory
2. Buffer Inventory
3. Anticipatory Inventory
4. Seasonal Inventory

2.3.1 Inventory Control Techniques:

Inventory management is an inborn piece of your organization that you totally would prefer not to upset. Following are some general inventory management techniques and best practices implemented by organizations.

1. Always Better Control (ABC) Analysis:
2. VED analysis
3. XYZ analysis
4. FNSD Analysis:

2.4 ISO Standards:

Introduction:

- ISO standards are sets of international standards on Quality development by International Organization for Standardization (ISO) based on Geneva, Switzerland. It represents in all industrialization nations.

- It's main objective to:
 - Achieve, maintain and improve product quality.
 - Improve quality of operation to continuously meet customer's and inventor's need.
 - Provide confidence to internal management and other employees that quality requirement are being fulfilled completely.

Current Versions of ISO 9000:

- Presently, as per revised in 2015, Standards in ISO 9000 family are:
 ISO 9000: 2015 – Covers basic concept and language.
 ISO 9001: 2015 – Set out requirement of quality management system.
 ISO 9004: 2009 – Focus on how to make quality management systems more efficient and effective.
 ISO 19011: 2011 – Sets out guidance on internal and external audits of quality management system.

2.5 ISO 14000

- It is a family of standards that provides practical tool for companies and organizations to manage their environment responsibilities.
- Important standards of ISO 14000 series are:
 - ISO 14001- Specification of environment management systems
 - ISO 14004- Guideline standard
 - ISO 14010 to ISO 14015- Environmental auditing and related activity
 - ISO 14020 to ISO 14024- Environmental labeling
 - ISO 14031 to ISO 14032- Environmental performance evaluation
 - ISO 14040 to ISO 14043- Life cycle assessment
 - ISO 14050- Terms and definition

ISO 14001: 2015

- Expert revising ISO 14001 on Environmental management systems met in Tokyo in February, 2015 and for finalizing, next meeting held in London in April, 2015. February meeting was mainly based on carbon emission neutralization.
- ISO 14001: 2015- This popular standard belongs ISO 14000 family, which also contains standards like:
 - ❖ ISO 14004- This belongs to general guidelines on system, principle and support techniques.
 - ❖ ISO 14006- This contains guidelines that for incorporates of ecodesigns.
 - ❖ ISO 14015- Includes environmental assessment for sites and organizations.
 - ❖ ISO 14020- This ISO contains environmental labels and declarations.

- ❖ ISO 14031- It includes evaluation environmental performance.
- ❖ ISO 14040- It contains life cycle assessment.
- ❖ ISO 14050- This belongs to vocabulary.
- ❖ ISO 14063- This ISO helps in environmental communication.
- ❖ ISO 14064- Popularly provides guidelines regarding greenhouse gases.
- ❖ ISO 19011- Guidelines of auditing systems of management.

1. **Respect of human rights:** Services are arranged and conveyed in an issue that regards the person’s human rights, with regards to the United Nations Universal Declaration of Human Rights
2. **Social involvement:** Services are arranged and conveyed to elevate open doors for individuals to be incorporated into their community.
3. **Participation:** Individuals utilizing services are given the oen door for decision in regards to the services they get and where and how they get it, inside available resources.

2.6 OHSAS 18000

OHSAS (Occupational, Health and Safety management Standards) are international standard which provide a framework to identify, control and decrease the risks associated with health and safety within company. Implementing these standards gives a clear signal to investors that management view employee’s health and safety as a principle priority within company.

1. OHSAS 18001

- It is worldwide known as occupational, health and safety management system series standard. It is based on the similar ISO 9001 and ISO 14001 Plan-Do-Check-Act structure. To achieve certification to OHSAS 18001 an organization must have a healthy and safety management system compliment with the requirement of the OHSAS 18001 standard.
- It provides organizations with a framework of health and safety management helping them to:
 - Identify, minimize and control health and safety risks.
 - Conform to health and safety legislation.
 - Protect the well being of employees.
- It reduces accident and incident rates by reducing and eliminating workplace and participation process.

2.7 SERVICE QUALITY

- A service quality is satisfying a previously dissatisfied customer and making them a loyal customer, each customer contact is called moment of truth.
- Services Quality Framework (SQF) is supported by a promise to proficient and viable business tasks that outcome in quality results for clients. This framework system contains 6 quality services standards.
 1. Management and governance
 2. Service accessibility
 3. Responding to the need of individual
 4. Rights, Safety and wellbeing
 5. Complaints, Feedback and appeals
 6. Human resources
- The standards are so far developed to include the main component of standards and quality used in child safety, disability, community and community care services and belongs to following principles:



3. Case Study:

It is very important to check the implementation of above quality fctors on any construction project. The above quality factors are applicable to all type construction projects. Implementation of these quality factors leads to optimization of time and cost of project. It may also lead to safety of personnel working in the firm; also quality work can be achieved.

Case study of my project is the ongoing construction sites in Kolhapur and Sangli region.

I have visited the construction sites about many times with my questionnaire prepared and collected the answer given by project manager of that site. Question are based on the quality factors which are we found in our project. After giving the answer by project manager I requested to project manager to give the rating to that answers given by him which are in the form of 5 point system as follows:

Rating	Poor	Average	Good	Very Good	Best

After that as per the suggestion of guide I have done questionnaire survey for the answers of case study from experts in the field of construction sector and marked out the rating to the rating to the answers to case study given by project manager. After that the results are tabulate for each answer which represents the quality achieved on site or not. Results are prepared on the basis of average of rating points from questionnaire survey.

The questionnaire is prepared by standard format which is mentioned above which reflects the quality factors related questions. The format of my questionnaire is as follows:

3.1 Questionnaire:

1. Quality control tool used on construction project site

	I	II	III	IV	V
I. Histogram					
II. Flow chart					
III. Pareto analysis					
IV. Check sheet					
V. Scatter Diagram					
VI. Fishbone Diagram					
VII. Control chart					

2. How the principle of Total Quality Management followed?

Rating	I	II	III	IV	V

3. Inventory control technique you are following

	Rating				
	I	II	III	IV	V
I. ABC					
II. VED					
III. XYZ					
IV. FNSD					

4. How ISO standards following for construction and management work

Rating	I	II	III	IV	V

5. Quality control measures on site-

I	II	III	IV	V

I. study duties and responsibilities					
II. Co-ordination with the project purchase department					
III. Doing proper sampling and testing					
IV. Follow the prescribed curing and deshuttering schedule					
V. Quality of workmanship in all construction activities					
VI. Maintain sequence of construction work					
VII. Site review meeting with staff					
VIII. Observe regular schedule					
IX. Motivation					

6. Quality of material, Material proportion and supply management

Rating	I	II	III	IV	V

7. Use of advanced and proper equipments for work

Rating	I	II	III	IV	V

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15. How much safety measures followed on site?

Rating	I	II	III	IV	V

8. How organization giving attention towards management regarding Time-cost effectiveness, efficient design, effective planning and workability

Rating	I	II	III	IV	V

16. How your organization followed guidelines to manage their environment responsibilities and waste management?

Rating	I	II	III	IV	V

9. How shuttering is provided and material used for shuttering?

Rating	I	II	III	IV	V

17. Which aspect is most important for maintaining Q.M.S. at construction project?

10. Measurements adopted for maintenance on site

Rating	I	II	III	IV	V

	Rating				
	I	II	III	IV	V
I. Competitive Markets					
II. Customer satisfaction					
III. client satisfaction					
IV. Stake holder satisfaction					
V. Management commitment					

11. Engagement of qualified persons for construction work

Rating	I	II	III	IV	V

12. How you are doing supervision of workers?

Rating	I	II	III	IV	V

4. SPSS SOFTWARE:

Analysis of the questionnaires survey was done using IBM SPSS Software. SPSS statistics is a software package used for statistical analysis. The software name originally stood for Statistical Package for the Social Sciences (SPSS), reflecting the original market. It is a windows based program that can be used to perform data entry and analysis and to create tables and graphs. It is capable of handling large amounts of data and can perform all of the analysis covered in the text and much more. It is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education, and others. All the responses obtained from the questionnaires are entered into the software. First, the variables or the questions are entered into the software from the various data entered into the software, frequency can be found which is used to determine the relative importance factor.

13. How you do Waste management on the site?

Rating	I	II	III	IV	V

14. How much your company followed any standard regarding risk associated with health and safety within company?

Rating	I	II	III	IV	V

SPSS Data View:

The questionnaire survey responses were reported in excel file. After opening data, SPSS displays them in spreadsheet-like fashion as shown I below figure 5.4. The excel file was export in data view and check the values and other information in spreadsheet.

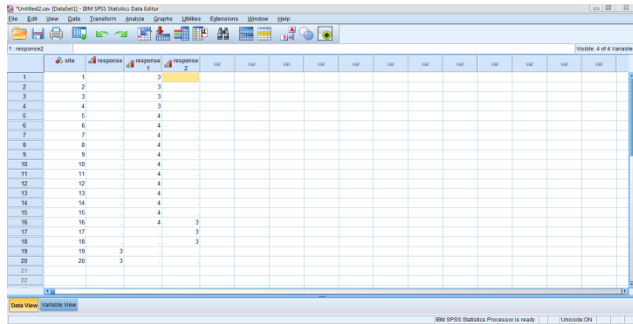


Figure: SPSS Data View

SPSS Variable View:

An SPSS data file always has a second sheet called variable view. It shows the meta-data associated with the data. Meta-data is information about the meaning of variables and data values. In variable view, different columns are displayed. Each line corresponds to a variable. A variable is simply a quantity of something, which varies and can be measured, such as height, weight, number of children, educational level, gender and so forth. Name of the variable it is your own choice, but make it understandable for particular research the name of variable was used as A B, C, D, etc. The variable view spreadsheet shown in the below figure

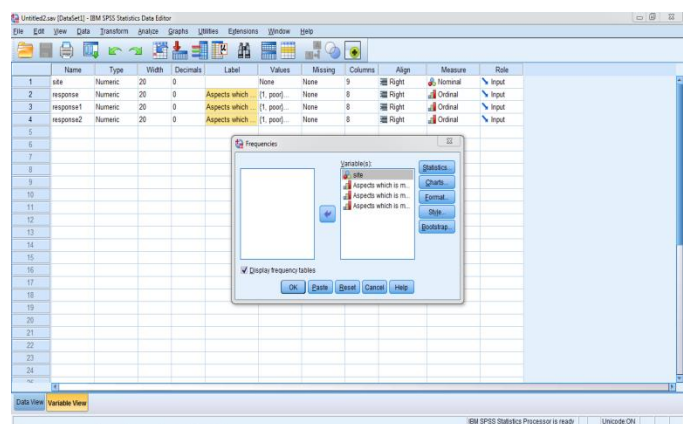
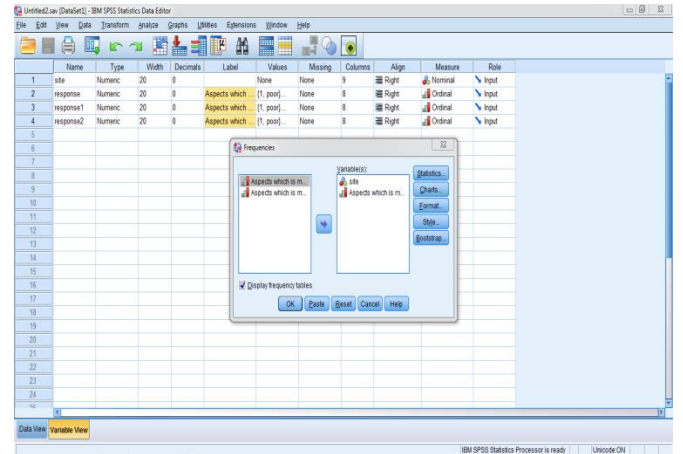


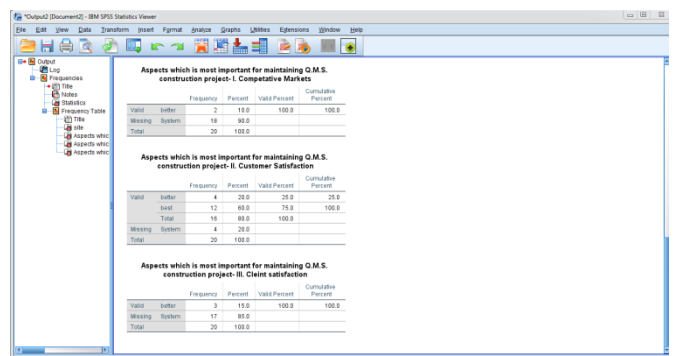
Figure: SPSS Variable View

SPSS Data Analysis:

SPSS can open all sorts of data and display them and their meta-data in two sheets in its Data Editor window. In our data contain variable holding respondents on Quality and ISO Standards Practices related question; we can compute the frequency by navigating to Descriptive Statistics as shown in below figure. For better understanding and detailed study pie charts option is also selected.

SPSS Output Window:

After clicking OK, a new window opens up, SPSS output viewer window. It holds a nice table with all statistics on all variables we chose. The screenshot below shows what it looks like. As we see, the Output Viewer window has a different layout and structure than the Data Editor window we saw earlier. Creating output in SPSS does not change our data in any way; unlike Excel, SPSS uses different windows for data and research outcomes based on those data.



5. Result and Discussion:

Results are nothing but outcome of our Project. From studying and analyzing all above collected data we come

to result that quality management in any organization company and construction sector is very important. For talking about results we come across following points

4. The most commonly used quality control tool in Kolhapur and Sangli region is Check Sheet. Some organizations are using Control chart also.
5. ABC Inventory control technique is most followed inventory control technique by construction firms, while some are using VED and XYZ techniques.
6. Organizations follow ISO Standards practices for construction work.
7. Supply and quality of material is good. Advanced equipments and safety measurements are more used and maintain on large scale building projects than the small building projects.
8. Qualified persons are engaging for construction and management works.
9. Customer satisfaction is most important aspect for maintaining Quality Management System to Building Construction organizations.

Questions Number	No. of Responses	Ratings				
		(I)	(II)	(III)	(IV)	(V)
1(IV)	31	-	-	06	16	09
1(VII)	07	-	-	03	03	01
2	40	02	11	15	08	04
3(I)	24	-	04	12	06	02
3(II)	04	-	-	03	01	-
3(III)	07	-	02	03	01	01
4	40	04	05	18	09	04
5(I)	40	06	08	15	07	04
5(II)	40	-	04	20	09	03
5(III)	36	05	07	11	06	06
5(IV)	40	-	07	21	08	04
5(V)	40	03	09	13	09	06
5(VI)	40	02	08	10	11	09
5(VII)	38	-	05	15	15	05
5(VIII)	40	03	07	16	04	10
5(IX)	40	-	02	16	10	12
6	40	-	06	12	12	10
7	40	-	05	18	10	07
8	40	02	06	16	07	09
9	40	-	02	19	10	09
10	40	03	08	17	06	06
11	40	-	05	09	16	10
12	40	-	02	13	17	08
13	40	05	10	11	09	05
14	40	04	06	15	10	05
15	40	03	09	14	08	06
16	37	03	12	18	04	03
17(II)	32	-	-	10	10	12
17(III)	08	-	-	02	03	03

Suggestions:

- The organization should develop the importance of QMS, training and awareness within the organization.
- Proper training should be provided to staff and labours and the importance of implementation of QMS has to be communicated to the lower in order to change their perception about quality.
- Proper communication and coordination between departments regarding the quality failures has to be made to the top management.
- A monitor and control model should be set up during the planning and execution phase which has to be followed by the quality representatives.
- The QMS practices in small towns of Kolhapur and Sangli region is require to give more attention and use these practices in there construction and management work.
- Follow the ISO Standard practices for environmental management and waste management in construction management.
- Implementation of above suggestions on actual site gives the more reliability of work, qualitative and successful completion of construction project.

6. Conclusions:

After studying all the above mentioned points and factors we come to conclusion that,

- For the successful performance of any organization, the quality management should be implemented. For the success of construction projects one of the critical factors is nothing but Quality.
- Project success as well as quality of construction projects can be regarded as the fulfillment of the expectations of the project participants. Implementation of standards and quality practices in any organization and construction sector leads to time and cost optimization, increased efficiency in performance and optimum use of resource.
- Standards and quality practices in construction maintenance and services also leads to minimization of the indirect cost belonging to project and also leads to reduction in the time, wastage of materials, manpower etc.
- There are various important standards and quality factors which affect the quality and these are required to give sincere attention to follow these factors to improve the quality of product, work, and service. They will raise the overall level of quality management.
- To know the impact of each factor, the study of these factors should be given due consideration for forecasting the performance level of a Major Construction project before it commences in order to gain desired quality levels and achieve project success.

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