

# APPLICATION OF TQM PRINCIPLES FOR BENCHMARKING PRODUCTION STANDARDS IN CONSTRUCTION

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## CHAPTER 1: INTRODUCTION

### 1.1 Theoretical background of the project

The work of Construction Companies involves a certain amount of risk when design projects are undertaken for buildings and other structures, as well as for other projects such as roads and runways, pipelines, sewerage- and water works and pump stations. Accepted levels of risk for these companies when accepting a particular appointment from a client are not always adequately quantified at the beginning of the project. This puts the company in a position where it may be subject to professional indemnity, claims from clients and from the public, should something go wrong during a particular project. The risk taken by the consulting engineer can to a large extent be quantified, and timeous mitigation measures can be taken to prevent certain things from occurring that may pose a threat to the successful construction and later use of the facility. As it is, the civil and structural engineering industry has a reputation that many projects run late and are over budget, not to mention the technical difficulties that might arise during the course of the project. This situation can to some extent be avoided by the introduction of a Quality Management System (QMS), which, if implemented and used correctly, should be able to identify and mitigate most of the risks that might arise from any project. Companies will therefore introduce a QMS into their company for this purpose, and will train their employees in the use of the QMS. This system must conform to the requirements of a recognised system

like the International Organization for Standardization (ISO). In this particular case ISO 9001 will be discussed, which is a model for quality insurance systems in design, development, production, installation and servicing. To be competitive in today's market, it is essential for construction companies to provide more consistent quality and value to their owners/customers. The time has indeed come, where it is imperative the construction stakeholders place aside the old adversarial approach to managing construction work. To develop better and more direct relationships with owners/customers, to initiate more teamwork at the jobsite, and to produce better quality work is the need of the hour. Such goals demand that a continuous improvement (CI) process be established within the company in order to provide quality management. Recently CI has been referred to as Total Quality Management (TQM).

## **1.2 Motivation and Causal factors to this study**

ISO 9001 was developed out of the British Standard of production line manufacturing quality (BS 5750), and has evolved considerably since 1987, when the BS 5750 name was dropped in favour of the international ISO standard. The use of the international standard then grew throughout many other industrialised countries, and was then also adopted by the civil engineering consultancy industry towards the end of the millennium. In its evolution over the last 20 years, the most recent update to ISO 9001 was in 2008, which is the current version (ISO 9001:2008) against which organizations are assessed (Mead, 2011:1, ISO 9001, 2008:vi).

The construction industry has always been too reluctant to adopt new approaches, due to the difficulty involved in applying them. As such, like many other innovative domains, TQM has arrived too late in the construction field, probably due to the tendency to easily brush aside anything in management that is new, or to dismiss TQM as a fad. But the implementation of TQM in other industries shows clearly that the TQM is not a fad and confirm the benefits of implementing this philosophy and how much it can improve the customer satisfaction as the measure of business quality.

Companies in manufacturing and service delivery have begun to realise that ISO certification was a necessity due to increasing demands by government departments and the private sector that their suppliers be ISO 9001 compliant and registered.

Productivity due to labor, capital, materials, information, environmental conditions, technology and equipment, and other intangible assets, such as the interaction of entrepreneurial

construction projects a complex issue. In addition, productivity is difficult because of the heterogeneity of industrial products and measuring its input. Typically, the productivity is said inputs, such as working time is divided into a constant value in place. Some experts believe that it is difficult to improve production efficiency, faster, or longer. In real practice, not only the speed and difficulty of the productivity of work, rather than adopt better working practices to achieve. The real productivity comes from identifying and implementing the most effective work processes to meet regulatory and customer requirements. Therefore, the establishment of mechanisms for continuous improvement that can drive consistent construction efficiency measurement and can promote the development and adoption of best practices in terms of management and process technology to enhance the economic output of construction activity is very important. Benchmarking is the process of a person's best practice business processes and performance indicators compare with other sectors of industry. In the benchmarking process, management determined the best performance and best practices in their industry, these targets are compared to their performance and processes. In this way, they learn how to project goals and corporate performance, and more importantly, explain the business process, why these companies are successful. "Construction Productivity continued to improve" the general mechanism of the reference system can provide. Destination matrix is composed of a single measurement method in which the direct and indirect measures of productivity for a group. An early application of the matrix method is carried out by Rodriguez (1986). Tactical deployment of a clean break from the traditional inspection productivity. It includes the impact of productivity does not necessarily measure the relationship between output and input of many different factors. Thus, the term is also good reason performance matrix. The quality system requirements of ISO 9001 are aimed at preventing non-conformity at all phases of the product life cycle from design and/or development to servicing. The aim is further for a company's QMS to be assessed against ISO 9001 by an independent certification body, then for the quality system to be registered, and then be used as evidence of quality assurance in tendering for contracts. Quality systems produced in accordance with these quality system requirements are subject to regular third-party assessment based on documented, objective evidence and compliance (ISO 9001, 2008:iii).

### **1.3 Concept of TQM**

Total Quality Management is a system of continuous improvement that involves all workers in a business from upper management to production line workers. The focus of the improvement program is to improve customer service and reduce waste in the business. Quality improvement teams use problem-solving techniques and analysis to identify and eliminate weaknesses in the company. To accomplish this topic, to indicate the summary of results and conclusions of three studies shows how we can benefit of using TQM tools in planning and design stage, and we will indicate the summary of results and conclusions of one study shows how we can benefit of using TQM tools in construction and implementation stage, and finally, a case study about improving the quality, saving time and reduce cost of an under construction project.

Total Quality Management (TQM) is an integrative management philosophy for continuous improvement of the quality of an organization's products and processes in order to meet or exceed customer expectations. There are several TQM strategies used to improve business management systems. TQM is a management approach that attempts focus more on problem solving as opposed to the traditional approach monitoring and inspection. This concept focuses on improving a process through elimination or reduction of defects and low value tasks. The goal is to strive for continuous improvement in a process through analysis and measurement, implementation of new ideas and procedures for improvement and the repeat of the analysis and measurement steps.

#### **1.3.1 Definition of Quality Inspection:**

Quality inspection are measures aimed at checking, measuring, or testing of one or more product characteristics and to relate the results to the requirements to confirm compliance. This task is usually performed by specialized personnel and does not fall within the responsibility of production workers.

#### **1.3.2 Quality Control:**

A system of maintaining standards in manufactured products by testing a sample of the output against the specification.

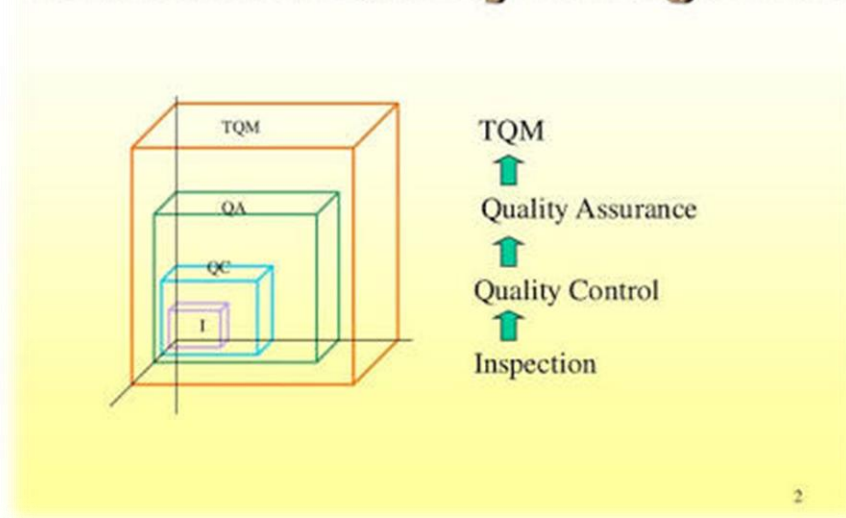
#### **1.3.3 Quality Assurance:**

The maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process of delivery or production.

### 1.3.4 Total Quality Management:

A system of management based on the principle that every member of staff must be committed to maintaining high standards of work in every aspect of a company's operations.

## Evolution of Quality Management



### 1.4 Objectives of the project:

- Analyze the construction industry scenario in Mumbai w.r.t quality of work.
- Find out the key areas in TQM where maximum attention is required.
- Draft quality policies for construction companies which will ultimately lead to reduction of mistakes in all construction operations, hence preventing rework.

### 1.5 Outcomes of the project:

- Benchmarking construction activities, processes, hence avoidance of wastes,
- Reduction of the lead times, especially in routine construction activities like brickwork, plastering, painting, centering, shuttering, concreting, excavating, etc.
- Increase in the flexibility and profitability for a firm by diversifying its project
- Better capture and conversion of the customer's needs,
- Contented position of the customers

### **1.6 Benefits of Applying TQM in Construction Industry:**

In order to appreciate the importance of TQM and to have a feel for its impact, the benefit of TQM to the organization should be known. Bardoel and Sohal (1999) reported the benefits achieved adopting TQM in seven Australian construction organization based on case study research. The reported benefits are:

- Better control of processes resulting in consistency from design through the delivery.
- Reduced construction cycle time.
- A reduction in the quantity of goods damaged in transit and construction.
- Reduced delivery to the site.
- Decreased fallout of chemical
- Increased measurement of performance
- Improvement in customer perceptions of the company.

### **1.7 Problem statement:**

The ideal functioning of an engineering company will be where no mistakes are made during project execution, and where clients are always 100% satisfied with the service they pay for or the products they enjoy. If these perfect situations had been possible, quality management would have been unnecessary. The reality is that projects often encounter difficulties, caused by design and documentation errors or project management oversights, resulting in project difficulties and hence dissatisfied clients. These errors and oversights can to a large extent be avoided by total quality management principles, if the systems are applied correctly. Although certain quality mechanism is introduced by construction companies in their respective sites, they are reluctant to accept TQM in totality as they are not certain of what benefits they will accrue if TQM principles are followed strictly.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Need for literature review:

Literature review is absolutely essential for any work, as it gives guidance and direction to it. Apart from this, the present state of the field, any difficulties in its implementation, success stories can be highlighted based on a proper literature review.

In this study, the books explaining TQM philosophy have been extensively referred, and journal papers related to use of TQM and ISO 9001 in construction in different parts of the globe have been mostly referred to.

### 2.2 Literature Review from books:

**Dr. Seetharaman (2015)<sup>1</sup>** has highlighted the importance of TQM approach for improving the effectiveness and flexibility of business as a whole. It is essential a way of organizing and strategic overview of quality and focus on *prevention* rather than *inspection*. TQM can be viewed as the process, wherein the top management along with other people in and organization works to improve product quality and work environment continuously at all stages, at all level with the aim of improving customers and employees satisfaction. TQM is the application of scientific principles and artistic skills to improve the product and service supplies to an organization, all the processes within an organization and the degree to which the needs of the customer are met now and in the future. He has identifies **leadership, leadership commitment, customer orientation, team work, employee Empowerment and Statistical process control** as the key elements to TQM.

### **2.3 Literature Review from Thesis:**

Crosby et. al. (2012) have elaborated that the focal point about the total quality management for any company can be best described as the culture and attitude of the companies' employees to continuously provide their clients with products and services to satisfy their needs. The culture that is required is quality in all the activities of the company, which must result in a "first time right" way of conducting their operations, with minimum or no wastage of resources. In a construction company, as opposed to a manufacturing company, wastage will be extra time spent on work that was previously carried out unsatisfactorily. The end purpose and highest company priority in mind is always the client, who must be satisfied that he has received value for money, and has confidence in the end product. The company must believe that they can only be successful when their clients are satisfied. TQM will facilitate quality improvement of processes, products and services, as applicable in the civil engineering consultancy industry, whilst Six Sigma will assist in giving the improvements an edge and keep them more focused. As construction projects get bigger and more complex, clients are increasingly demanding higher levels of quality, efficiency, and delivery. Total Quality Management (TQM) has long been recognized as a successful management philosophy in the manufacturing and service industries. TQM can also be embraced in the construction industry to help raise quality and productivity. Their report attempts to introduce the basic elements of ISO 9000 and describes how each can be implemented in a wide array of construction-related companies, in order to achieve their goal of total quality. Numerous case studies were found which demonstrate the ability of ISO 9000 to improve a company's quality performance, avoid costly errors, and produce satisfied customers. For the purpose of their report, two case studies were discussed showing how construction companies can successfully implement TQM. The benefits experienced include reduction in quality costs, better employee job satisfaction because they do not need to attend to defects and client complaints, recognition by clients, work carried out correctly right from the start, subcontractors with proper quality management systems, and closer relationships with subcontractors and suppliers. TQM performance measures were also reflected through top management commitment, customer involvement and satisfaction, employee involvement and empowerment, customer– supplier relationships, and process improvement and management. Finally, a framework for implementing TQM in construction was recommended.



## **2.4 Literature Review from journal publications:**

**Parumasur (2013)** has given the result of increasing competition, organizations have realized the importance of using technological advances in bringing about continuous improvement in quality, thereby securing increased customer satisfaction and loyalty as well as sustainable development. Her study aims to assess managerial perceptions of the extent and nature of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) that takes place in the organization in efforts to achieve total quality management. Biographical influences on these managerial perceptions were also assessed. A sample of 202 managers (middle, senior, top) was drawn using a stratified random sampling technique. Data was collected using a precoded, self-developed questionnaire whose psychometric properties were assessed using Factor Analysis and Cronbach's Coefficient Alpha respectively. Data was analyzed using descriptive and inferential statistics. The findings reflect that managers believe that monitoring and controlling quality takes place at a moderate pace in the organization with the greatest focus being on competitive benchmarking, followed by continuous monitoring of sources of defects and lastly, on statistical quality control. Based on the empirical analysis, since all action plans for monitoring and controlling quality in the organization reflect areas for improvement in bringing about total quality management, strategies are recommended for enhanced monitoring and controlling of quality and the accomplishment of TQM.

**Ashokkumar (2014)** has emphasized that the Construction industry plays an important role in the development of any country. The development of construction industry depends on the quality of construction projects. Quality is one of the critical factors in the success of construction projects. Improvement in the quality of construction projects is linked with quality management in the project life cycle. Although quality management at every stage of project life cycle is important but the quality management at the execution (construction) stage contributes significantly on final quality outcome of construction projects. His project mainly focuses the importance and factors that affects the quality management in the execution (construction) phase. The project also includes visiting of some construction companies and conducts the questionnaire survey, then analyse the difficulties (major factors) and the cost variance due to quality defect in quality management and suggests some proactive measures for the improvement of quality in the execution phase of construction projects. He further suggests that, although quality management at every stage of project life cycle is important but

the quality management at the execution (construction) stage contributes significantly on final quality outcome of construction projects.

**Erande & Pimplikar (2015)** in their paper highlight that due to the present policies of globalization, the scenario of economics is changed in past decade. Construction companies in India are facing tougher competition from their counterpart companies due to large trend of global bidding. To be ahead in the bidding process they need to show competitiveness in terms of quality, cost as well as time of a construction project. To lead this competition they need to strive for customer satisfaction and delight. Total quality management (TQM) is the philosophy which can transform Indian construction sector to surpass the global competition and match the global standards. TQM is an effort that improves overall performance of company and it focuses on customer satisfaction, training, teamwork, and process improvement. Their paper discusses the TQM concepts and practices adopted by construction companies & also aims at throwing light on problems related to implementation of TQM in construction. The study is carried out using questionnaire survey conducted across different companies in Pune and Nasik districts and also using face to face interview with managers & engineers & then subsequent analysis of the response from companies. For analysis purpose, importance index is used in this paper. The study is conducted in the quest of finding solutions for TQM implementation in construction industry.

**Pharne and Kande (2016)** have highlighted the importance of TQM. Productivity due to labor, capital, materials, information, environmental conditions, technology and equipment, and other intangible assets, such as the interaction of entrepreneurial construction projects a complex issue. They suggest that establishment of mechanisms for continuous improvement that can drive consistent construction efficiency measurement and can promote the development and adoption of best practices in terms of management and process technology to enhance the economic output of construction activity is very important. Benchmarking is the process of a person's best practice business processes and performance indicators compare with other sectors of industry.

## **CHAPTER 3: METHODOLOGY**

Total Quality Management (TQM) is an integrative management philosophy for continuous improvement of the quality of an organization's products and processes in order to meet or exceed customer expectations. It is imperative that the methodology of the work is well documented so that the project flow is smooth. Hence key areas requiring focus were identified and the methodology was designed. The data regarding the details of application of TQM in construction by surveying and analyzing different sites, construction firms, companies etc. for their opinion about the same was by meeting individually the company managers and project stake holders. A questionnaire was prepared to gauge the current scenario of TQM in construction industry in and around Mumbai.

### 3.1 Questionnaire:

The following questionnaire in the form of sheets and via google forms were given to various project stakeholders and their responses were documented

1) Your Age Group: (Tick in the appropriate box)

18 – 30       31-40       >40

2) Your qualification:

Graduate       Post Graduate       PhD

3) Your Post:

Manager       Engineer       Supervisor

4) According to you which words define Quality to its best? Rank them as per your choice (1 to 5)?

Sr. No.	Definition	Rank ( 1 to 5)
i)	Value of money	
ii)	Defect Elimination	
iii)	External customer satisfaction	
iv)	Increased Profit	
v)	Appearance	
vi)	Internal customer satisfaction	
vii)	Problem solving	

5) According to you what are the important factors for successful project? Rank them as per your choice?

Sr. No.	Factors	Rank ( 1 to 5)
i)	Time	
ii)	Quality	
iii)	Cost	
iv)	Safety	
v)	Scope	

6) What kind of program is arranged for quality Improvement?

General Inspection

Quality Control

Quality Assurance

TQM

7) Quality program objectives : ( Rank them as per your choice )

Sr. No.	Objectives	Rank ( 1 to 5)
i)	Productivity Hike	
ii)	Reduction in cost	
iii)	Customer Satisfaction	
iv)	Involvement of employees	
v)	Company with EHS	

8) Is data collection done to monitor performance of work?

YES

NO

9) What are the parameters used to ascertain performance measurement? (Tick any one)

Lesser complaints from customer.

Hike in work productivity.

Margin of profit.

Completion of work in stipulated time.

Other.

10) Is any kind of training related to TQM given? (Tick any one)

Formal Training given.

Some training given.

No training given.

11) Frequency of training Program? (Tick any one)

- Once in a year.
- Twice.
- More than twice.
- As & when needed.

12) Type of training given? (Tick any one)

- On site training.
- Seminar.
- Workshop.

13) Topic on which training is given (Tick any one)

- Customer satisfaction.
- Product Management.
- Process Management.
- Data collection & Documentation.
- Teamwork.

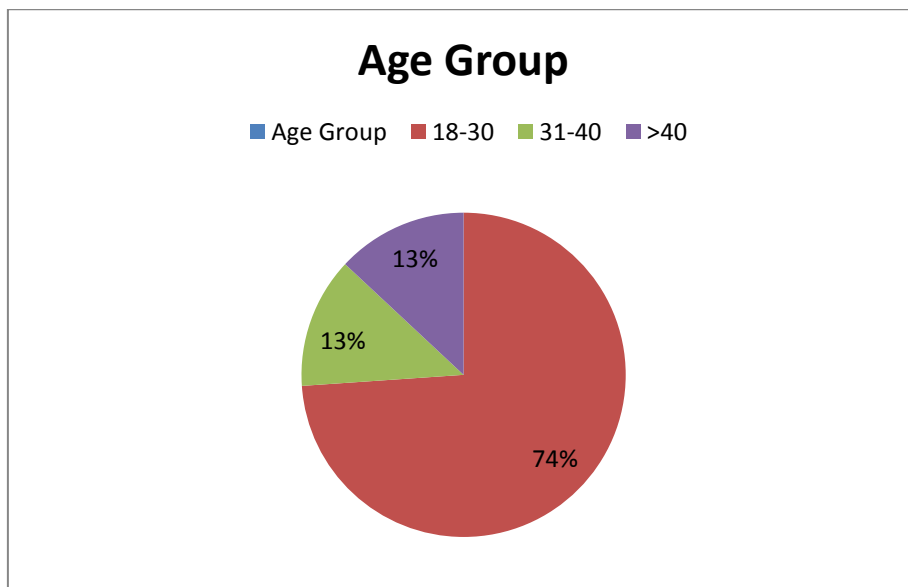
14) According to you what are the barriers in TQM implementation? (Rank them as per your choice )

Sr. No.	Barriers	Rank ( 1 to 5)
i)	Lack of management commitments	
ii)	Bad attitude and behavior	
iii)	No developed standard procedure	
iv)	Lack of expertise and resources	
v)	Excess documentations	
vi)	Lack of statistical & techniques.	
vii)	Difficulties in process making	

## CHAPTER 4: DATA COLLECTION AND ANALYSIS

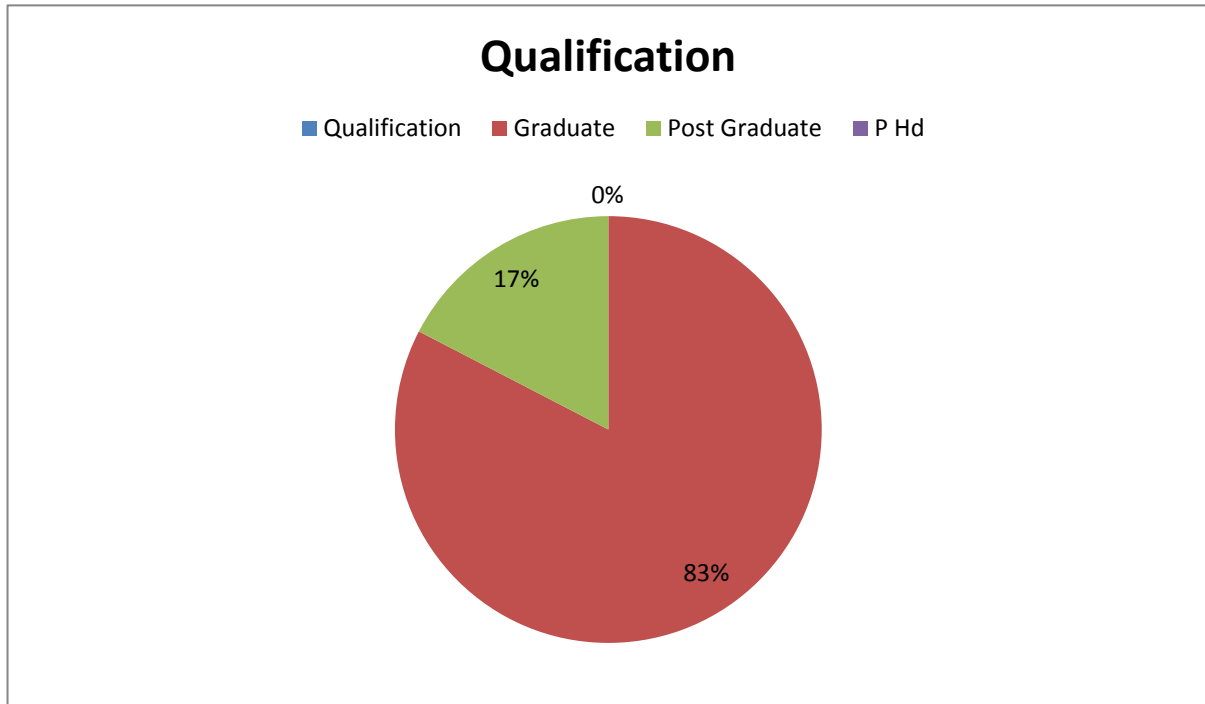
Based on the questionnaire survey from personal interview with project stakeholders and via google forms, the following analysis is done. It should be noted that personal interview was conducted with 23 project stakeholders, whereas google form received 22 responses.

### 4.1 Analysis of Data Collected through Personal interview with Project stakeholders:



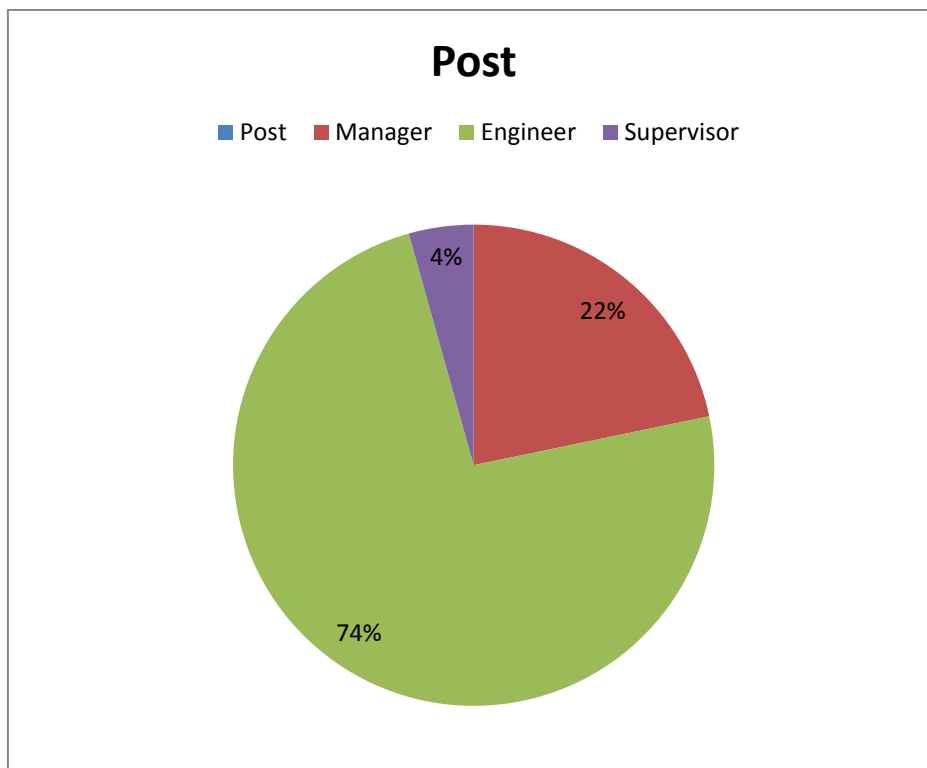
**Fig 4.1: Age group of respondents**

Maximum participants were below the age of 30 as can be seen from fig 4.1



**Figure 4.2: Qualification of Project Stakeholders interviewed**

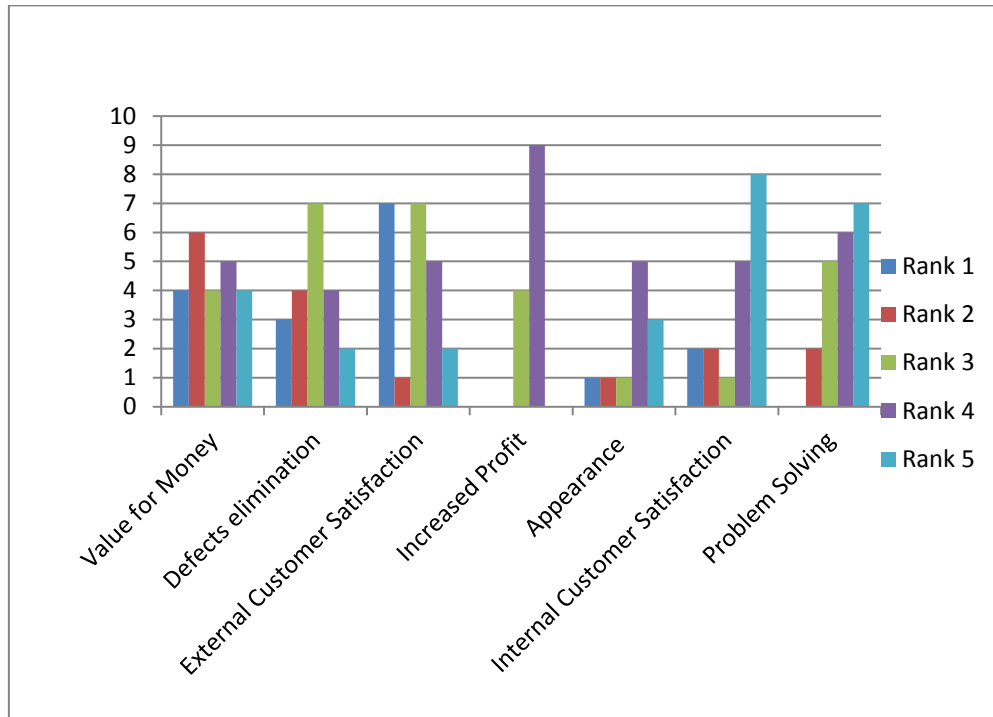
As can be seen from fig 4.2, maximum project stakeholders interviewed were having only graduation degree



**Figure 4.3: Position of Project Stakeholders interviewed**

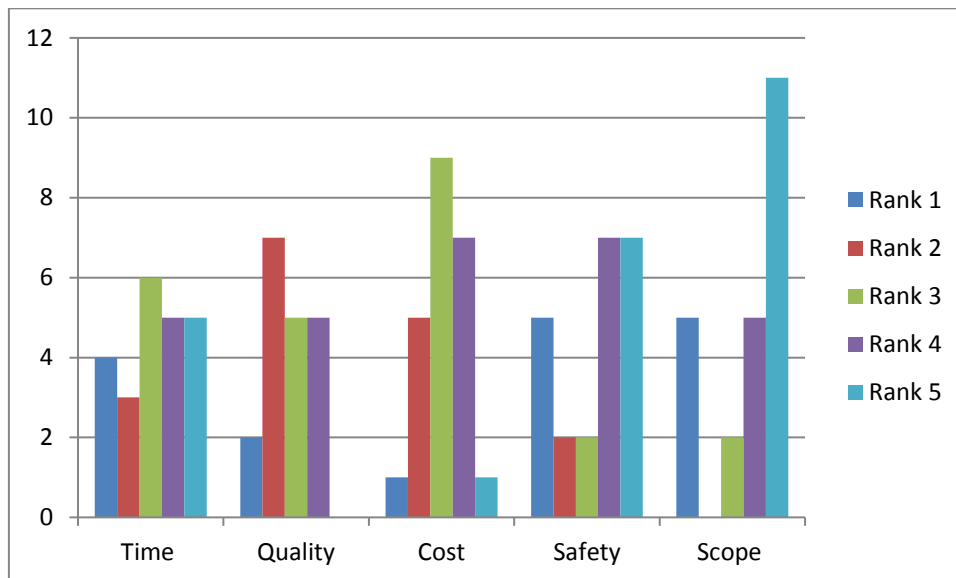
As can be seen from fig 4.3, maximum project stakeholders interviewed were appointed as engineers





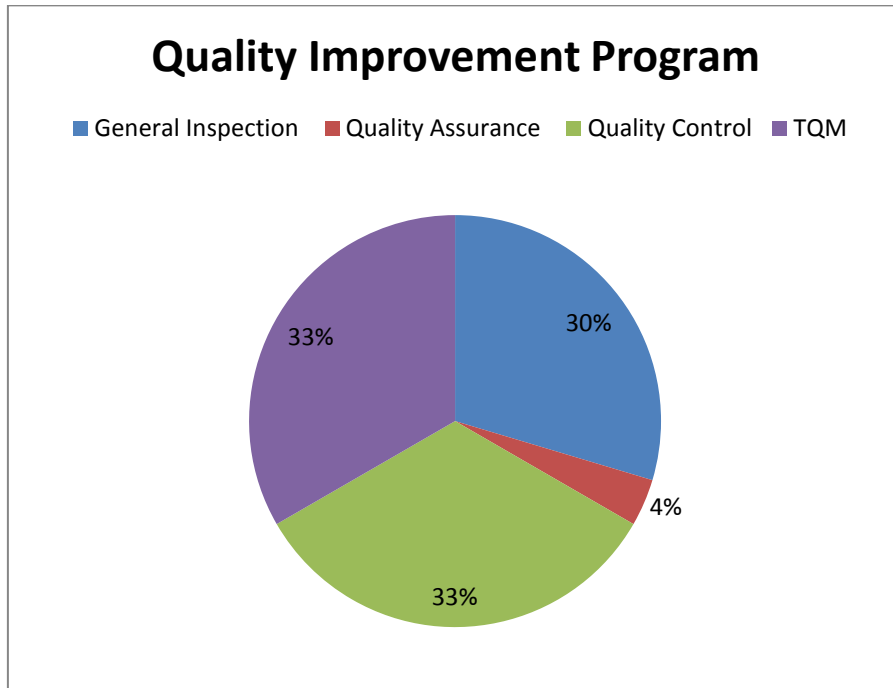
**Figure 4.4: Definition of quality**

As can be seen from fig 4.4, 7 of the total 23 interviewed were of the opinion that external customer satisfaction as the most appropriate definition of quality. 4 of the total said that value for money defines quality, whereas 3 said that quality means defects elimination.



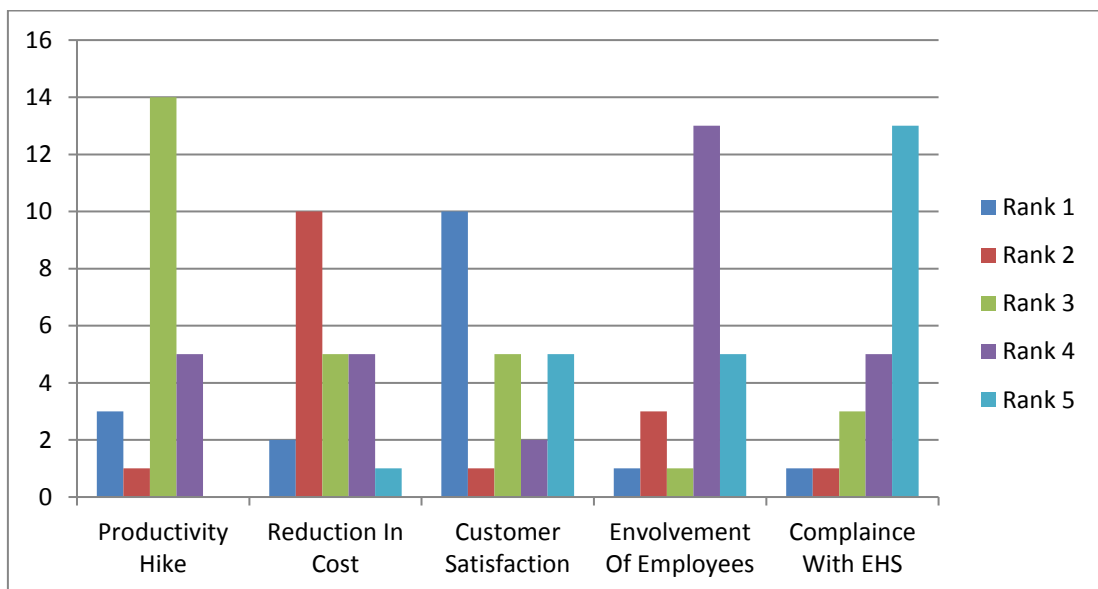
**Figure 4.5: Important factors for successful project**

As can be seen from fig 4.5, 5 of the total 23 interviewed were of the opinion that scope of the project and safety are the most important governing factors for successful project delivery. 4 of them said that time is important, whereas quality and cost were given least importance as regards to successful project completion



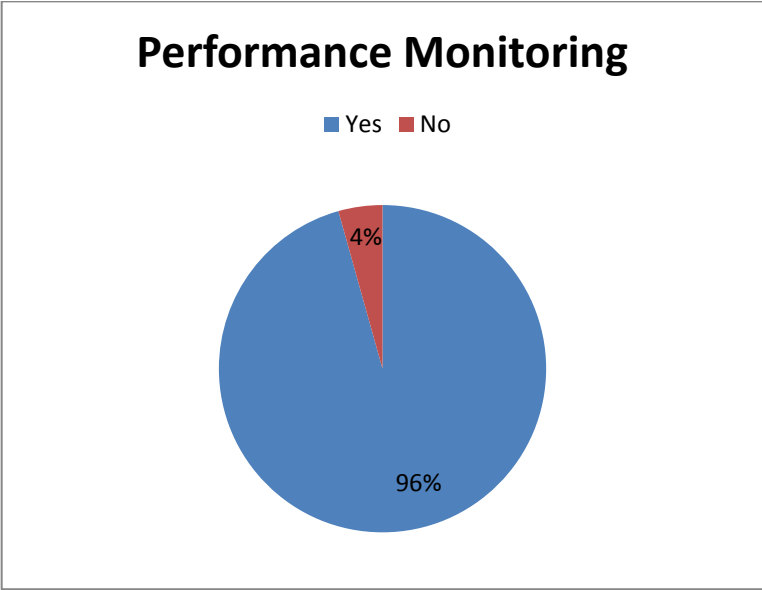
**Figure 4.6: Program for quality improvement**

As can be seen from fig 4.6, almost all companies had some kind of quality improvement program for general inspection, quality control and TQM, but they were unaware of the term quality assurance.



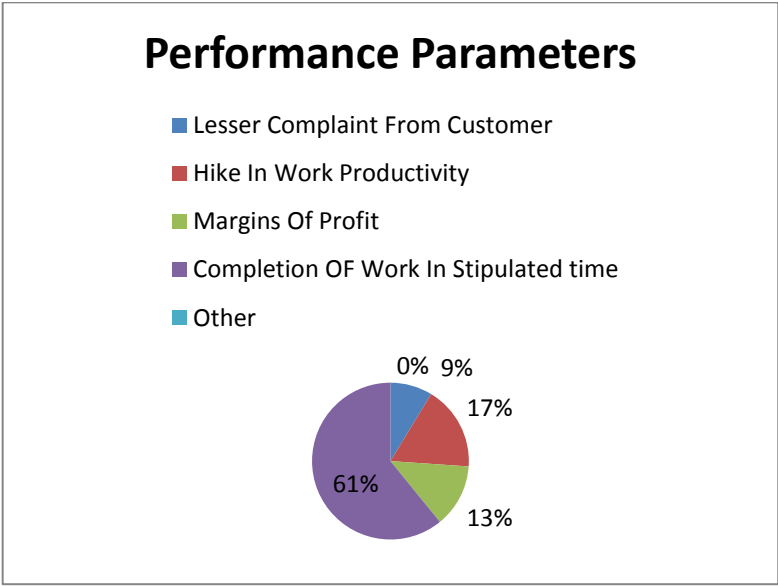
**Figure 4.7: Quality Program Objectives**

As can be seen from fig 4.7, almost 50% of the stakeholders thought that customer satisfaction is the main objective of the quality program, whereas there were very few takers for productivity hike, reduction in cost, involvement of employees and compliance with environment, health and safety as their quality program objectives.



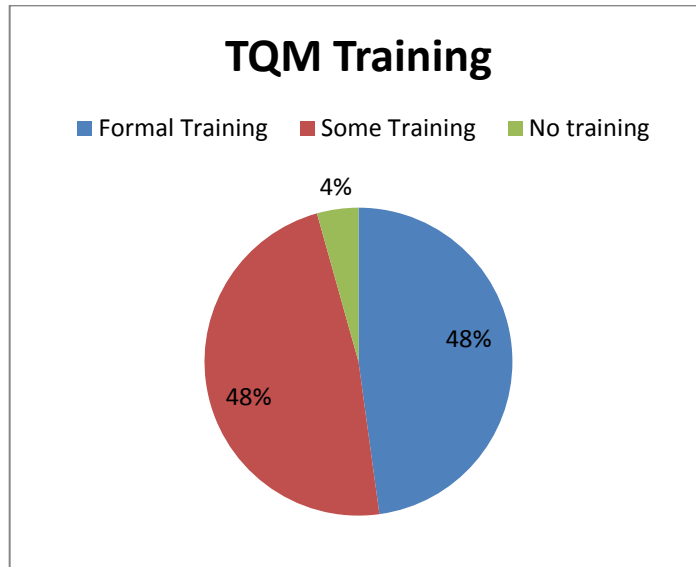
**Figure 4.8: Data collection for performance monitoring**

As can be seen from fig 4.8, almost all companies were some kind of data for monitoring the performance of various activities and processes on site.



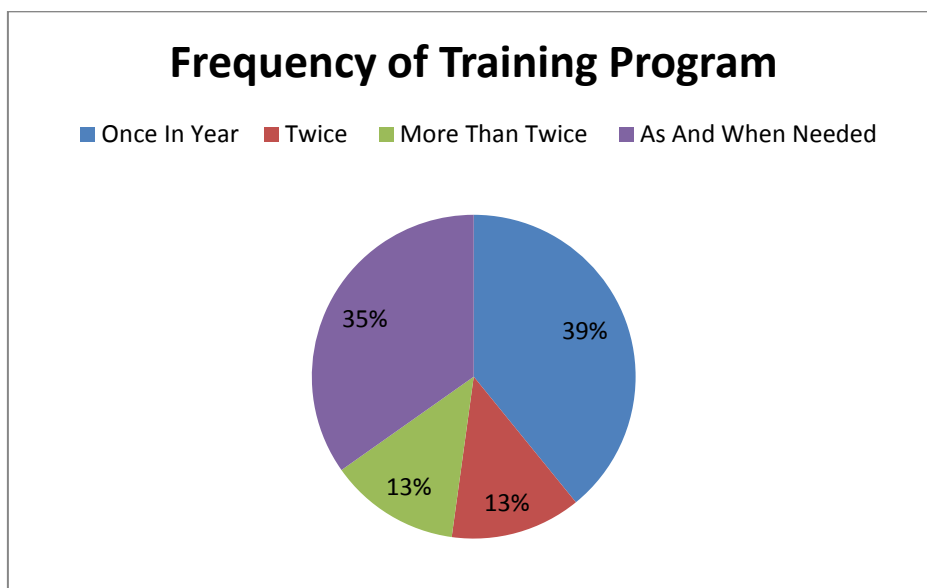
**Fig 4.9: Parameters to ascertain performance measurement**

As can be seen from fig 4.9, maximum project stakeholders consider the completion of work in stipulated time as the most important parameter to ascertain performance measurement.



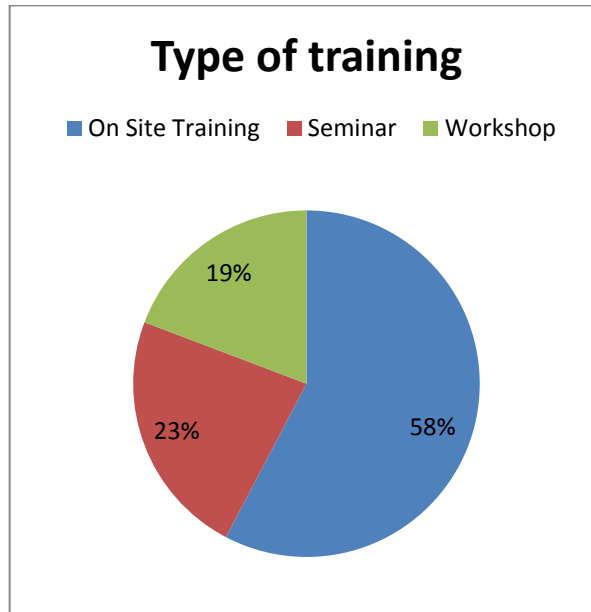
**Fig 4.10: Parameters to ascertain performance measurement**

As can be seen from fig 4.10, almost all stakeholders are of the view that some training, either formal or informal is given for TQM.



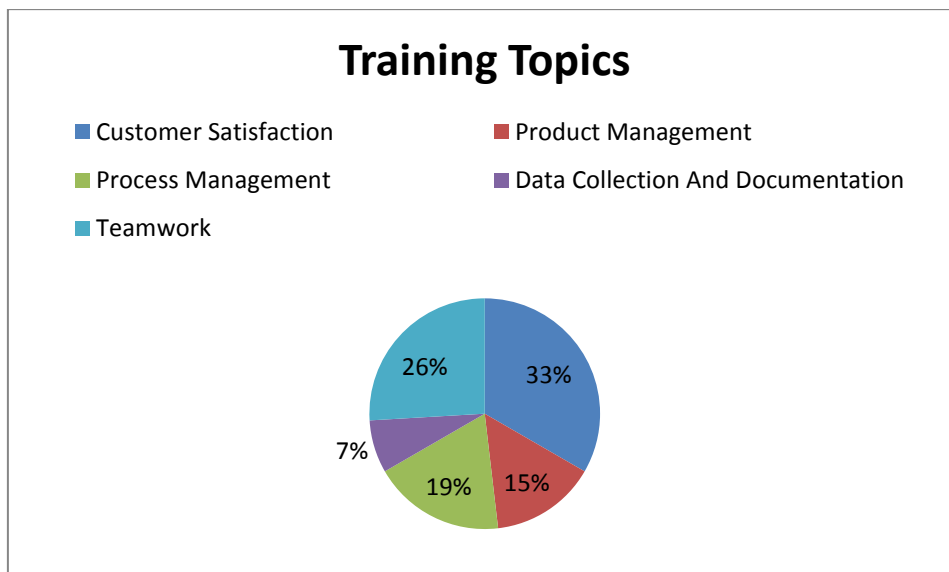
**Fig 4.11: Frequency of Training Program**

As can be seen from fig 4.11, almost all stakeholders say that the training program for TQM is conducted atleast once in a year or as and when desired.



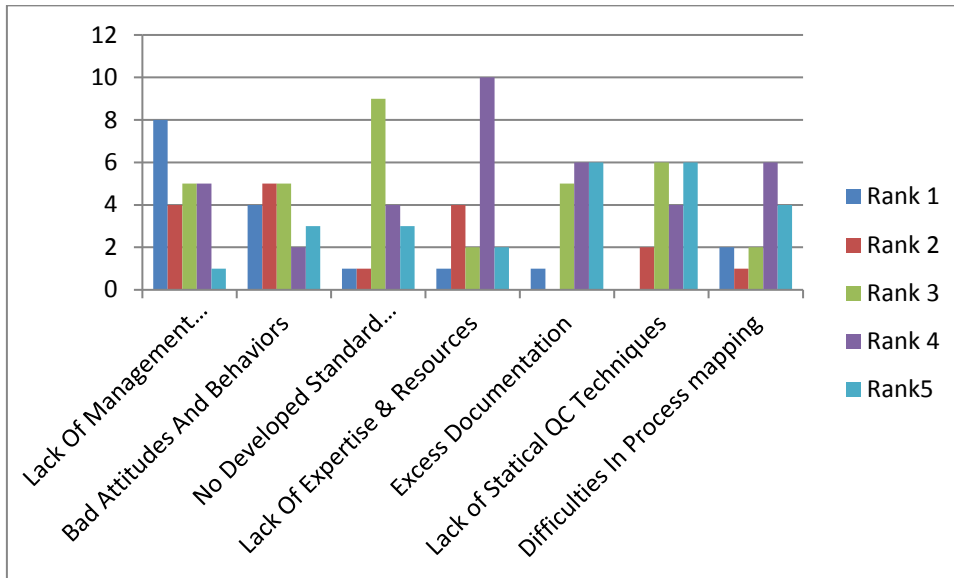
**Fig 4.11: Type of training**

As can be seen from fig 4.11, it can be said that maximum sites have on-site training for TQM



**Fig 4.13: Parameters to ascertain performance measurement**

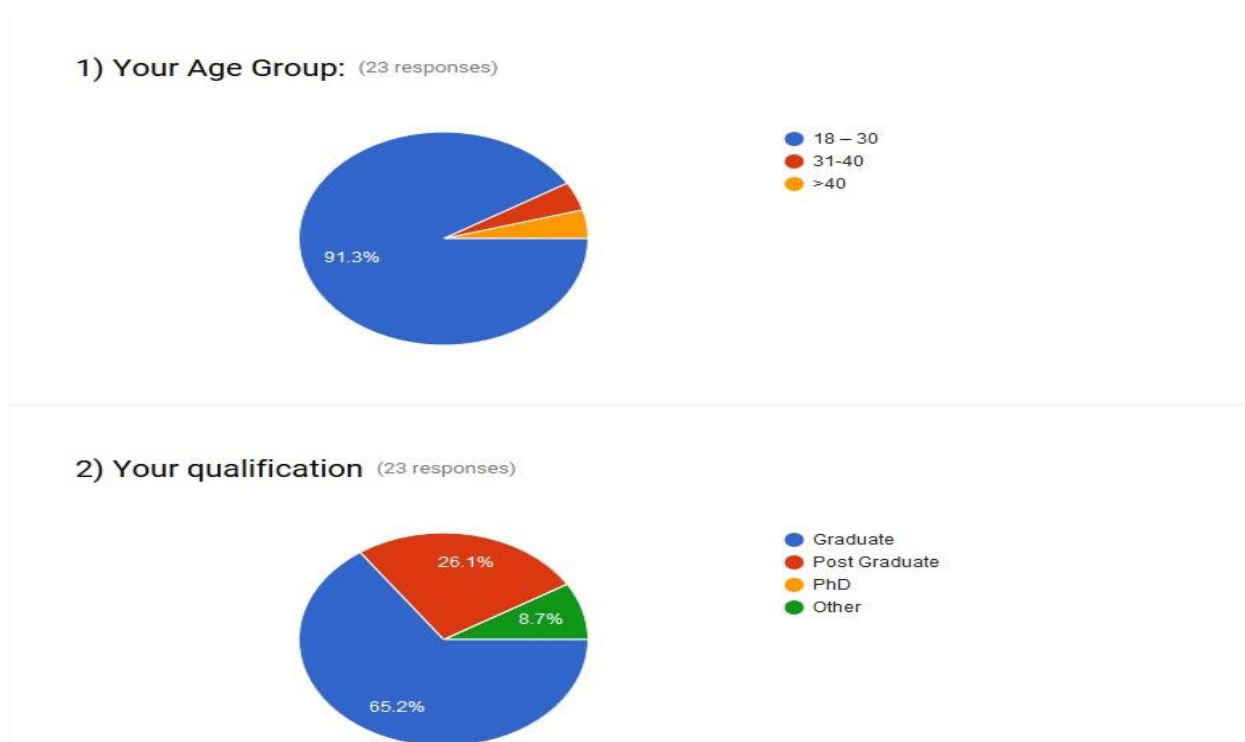
As can be seen from fig 4.13, there are diverse areas in which training is given on different sites.



**Fig 4.14: Barriers to TQM implementation**

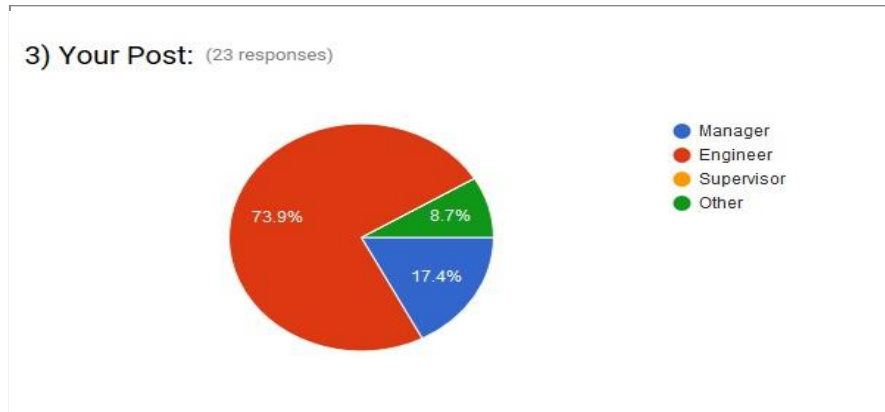
As can be seen from fig 4.14,. maximum stakeholders believe that lack of management commitments and bad attitude and behavior of employees are the major Barriers to TQM implementation

#### 4.2 Analysis of Data Collected through Google forms:



**Fig 4.15: Age group and qualification of respondents (through google form)**

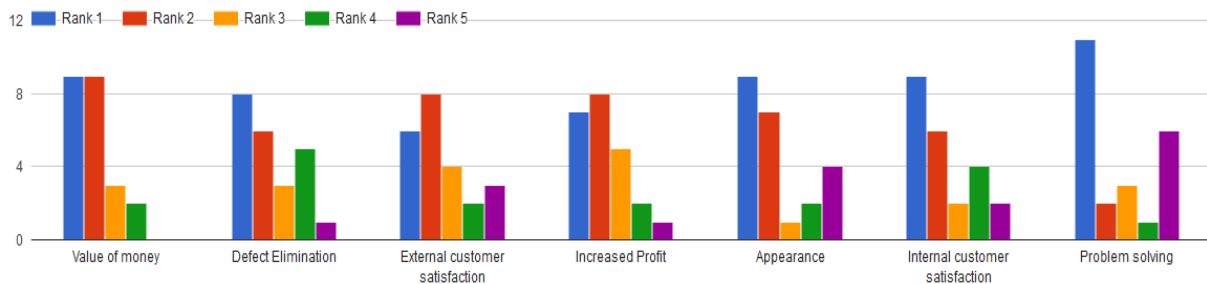
Maximum participants were below the age of 30 as can be seen from fig 4.15



**Figure 4.16: Position of Project Stakeholders (through Google form)**

As can be seen from fig 4.16, maximum project stakeholders interviewed were appointed as engineers

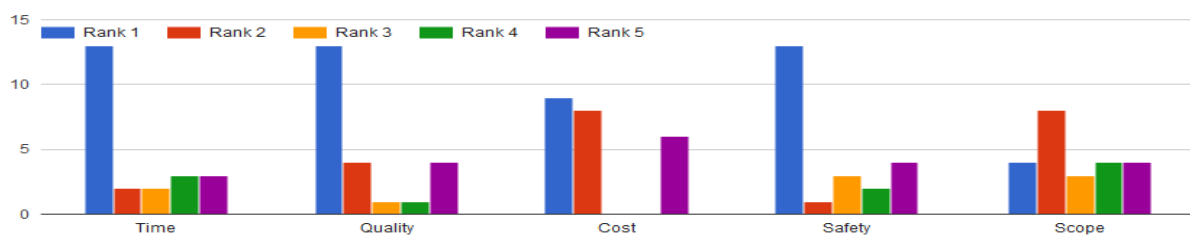
4) According to you which words define Quality to its best? Rank them as per your choice (1 to 5) ?



**Figure 4.17: Definition of quality (through google form)**

As can be seen from fig 4.17, 11 of the total 22 respondents were of the opinion that problem solving as the most appropriate definition of quality, whereas others thought that value for money, defect elimination internal customer satisfaction and appearance is paramount.

5) According to you what are the important factors for successful project? Rank them as per your choice?



**Figure 4.18: Important factors for successful project (through google form)**

As can be seen from fig 4.18, it can be seen that quality, safety and time are equally important for successful project

6) What kind of program is arranged for quality Improvement? (23 responses)

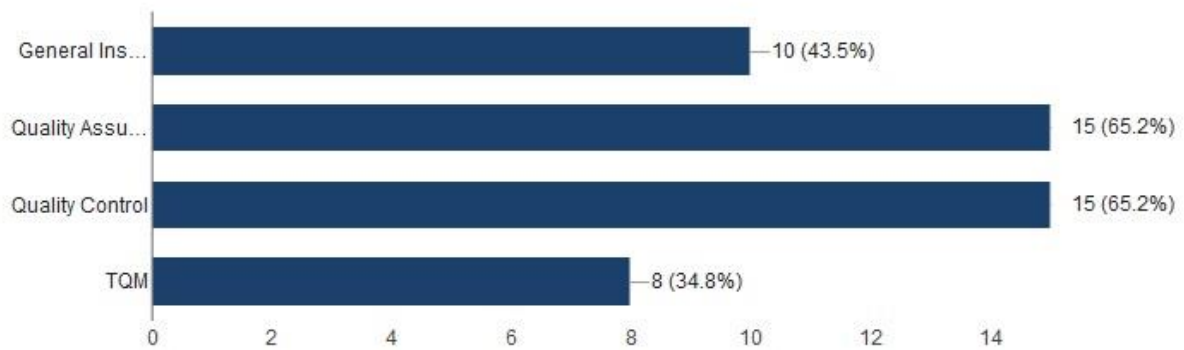


Figure 4.19: Program for quality improvement (through google form)

As can be seen from fig 4.19, almost all companies had some kind of quality improvement program for quality control and quality assurance, but few were training their employees on inspection

7) Quality program objectives : ( Rank them as per your choice )

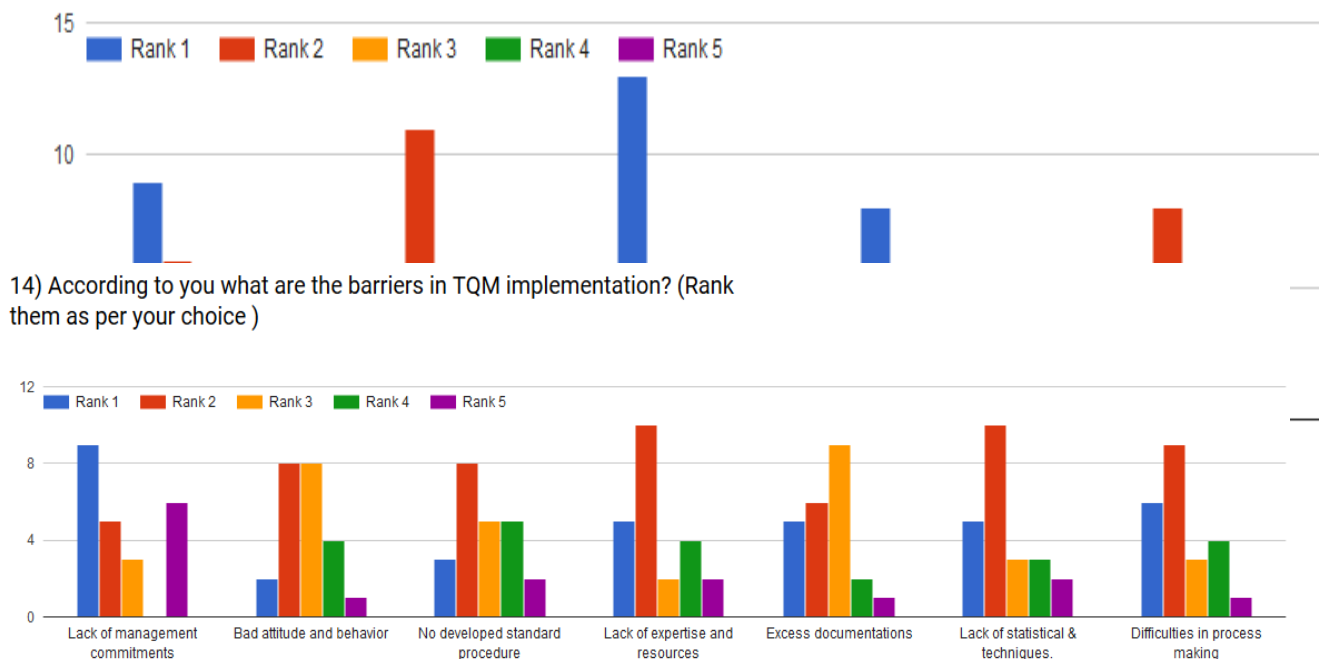
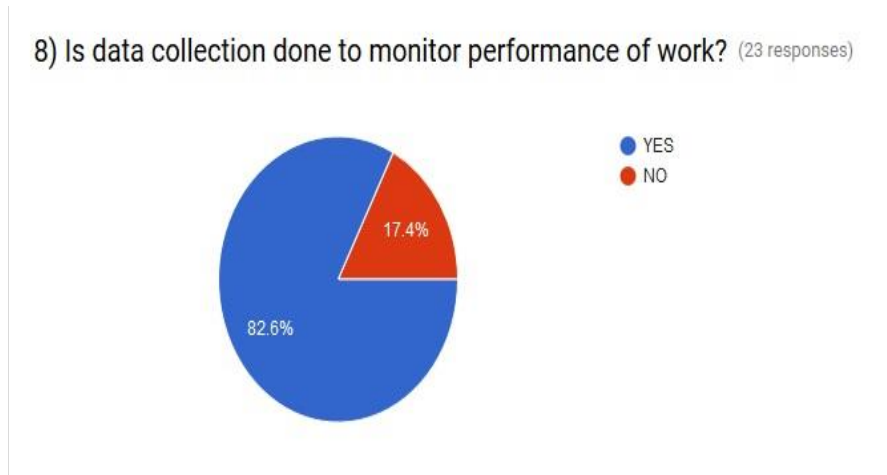


Figure 4.20: Quality Program Objectives (through google form)



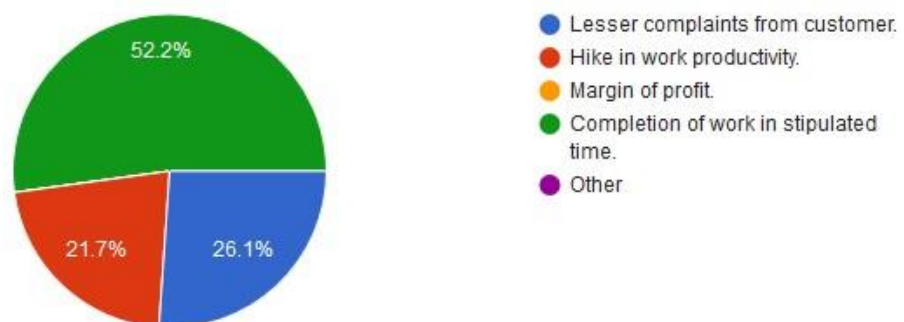
As can be seen from fig 4.20, almost 50% of the stakeholders thought that customer satisfaction is the main objective of the quality program, whereas there were very few takers for productivity hike, reduction in cost, involvement of employees and compliance with environment, health and safety as their quality program objectives.



**Figure 4.21: Data collection for performance monitoring (through google form)**

As can be seen from fig 4.21, almost all companies were some kind of data for monitoring the performance of various activities and processes on site.

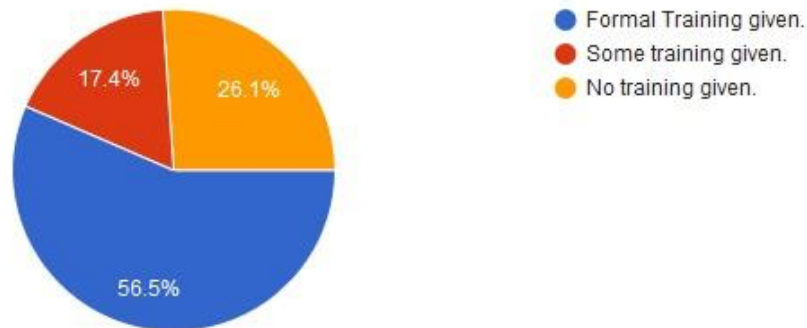
9) What are the parameters used to ascertain performance measurement?  
(Tick any one)  
(23 responses)



**Fig 4.22: Parameters to ascertain performance measurement (through google form)**

As can be seen from fig 4.22, maximum project stakeholders consider the completion of work in stipulated time as the most important parameter to ascertain performance measurement.

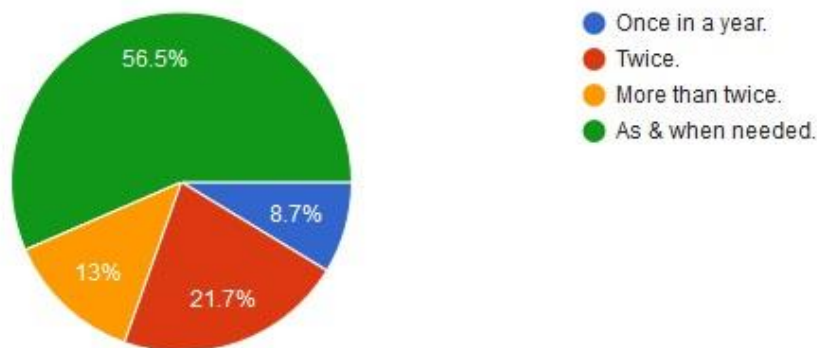
10) Is any kind of training related to TQM given? (Tick any one) (23 responses)



**Fig 4.23: Parameters to ascertain performance measurement (through google form)**

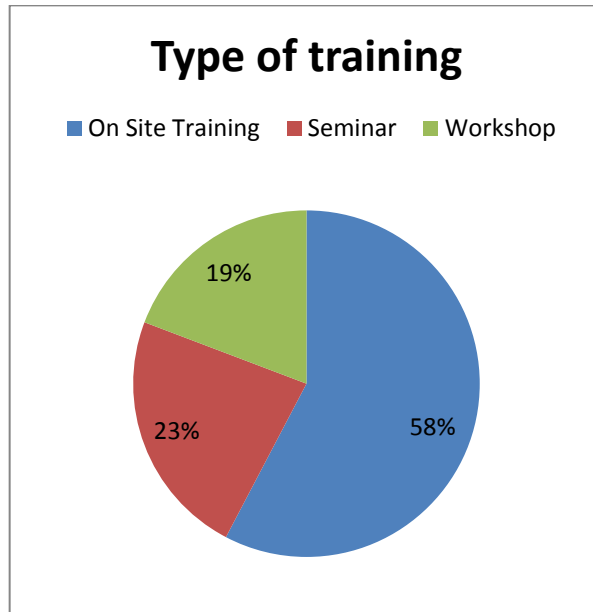
As can be seen from fig 4.23, almost all stakeholders are of the view that some training, either formal or informal is given for TQM.

11) Frequency of training Program? (Tick any one) (23 responses)



**Fig 4.24: Frequency of Training Program (through google form)**

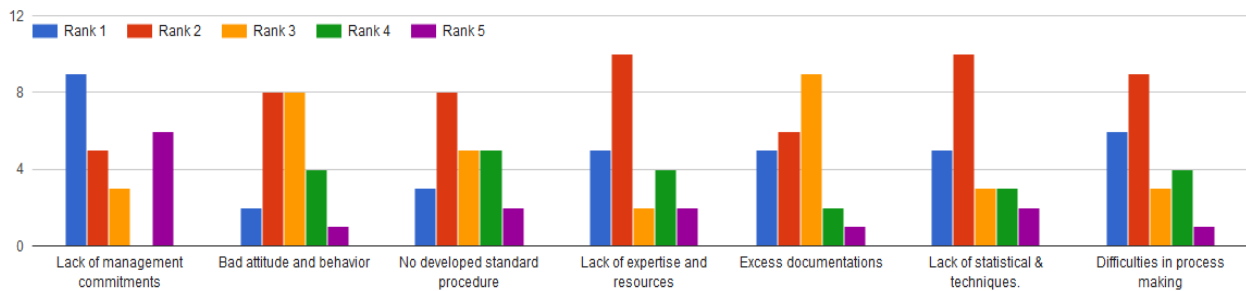
As can be seen from fig 4.24, almost all stakeholders say that the training program for TQM is conducted atleast once in a year or as and when desired.



**Fig 4.25: Type of training (through google form)**

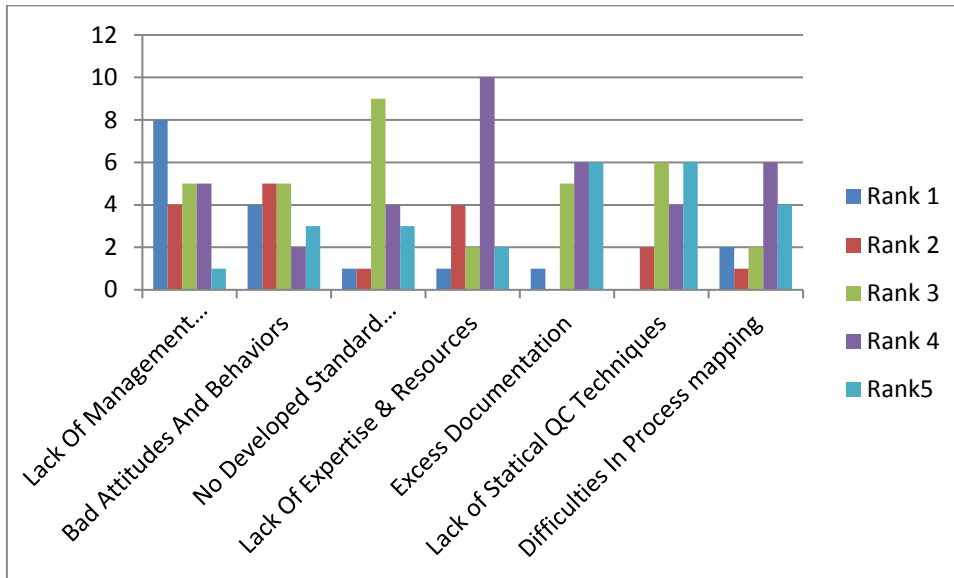
As can be seen from fig 4.25, it can be said that maximum sites have on-site training for TQM

14) According to you what are the barriers in TQM implementation? (Rank them as per your choice )



**Fig 4.26: Parameters to ascertain performance measurement (through google form)**

As can be seen from fig 4.26, there are diverse areas in which training is given on different sites.



**Fig 4.27: Barriers to TQM implementation (through google form)**

As can be seen from fig 4.27, maximum stakeholders believe that lack of expertise and resource is the major Barriers to TQM implementation

## CHAPTER 5: RESULTS AND DISCUSSION

The data analyzed through personal interview and through google forms showed remarkable similarities in many aspect, but also differed in a few. A comparative analysis is shown in Table 5.1

**Table 5.1: Results obtained for TQM questionnaire survey**

Sr no	Online	Offline	Combined
1	Value for money	External customer satisfaction	As per the survey carried out quality is defined by 'VFM' and 'ECS'.
2	Quality	Quality and cost	Factors important for success of project are cost and quality of work.
3	Quality assurance and quality control	Total Quality Management	Most of the respondents, said that programmer related to Quality Assurance, Quality Control and Total Quality Management as a whole were arranged.
4	Customer satisfaction	Customer satisfaction	Respondents feel that, customer satisfaction should be the objective of all quality programs
5	Data collection is done	Data collection is done	In most of Organizations, data collection is carried out.
6	Completion of work in stipulated time	Completion of work in stipulated time	In most cases, Completion of work in stipulated time is considered as the prime parameter to ascertain or measure performance.
7	Formal training	Formal and some training	In most of the organizations, some

			amount of formal training on Total Quality Management is provided.
8	As when needed	Once in a year	Respondents feel that frequency of training programs need to be improved.
9	Onsite training	Onsite training	In all cases, training of Total Quality Management is provided on site itself.
10	Team work	Customer satisfaction	Most of the training programs are team building oriented towards achieving customer satisfaction.
11	Difficulties in process mapping	Lack of management commitment	The respondents feel that the major hurdles in the way of Total Quality Management implementation are Lack of management commitment and Difficulties in process mapping.

## **CHAPTER 6: CONCLUSION & FUTURE SCOPE**

### **6.1 Conclusion:**

It is apparent that if TQM is to be implemented successfully on construction sites the Inhibitive issues that have been identified from the literature and the contractor survey need to be addressed on a comprehensive and integrative basis. The principles of TQM should be applied beyond management levels and include workers on construction sites. These workers must be empowered, involved and trained in problem solving.

Companies need to work on improving worker relationships in the same way that they do for their external customers. Through effective communication and improved project coordination workers must be motivated to improve their work. Contractors must move away from their obsession with the bottom line. They need to bind all parties together including subcontractors by mutually set and internalized goals. However, any attempt to bring about meaningful change with respect to implementing TQM on construction sites will only succeed if top or senior management commit and involve themselves in the TQM process.

### **6.2 Limitations of the Study**

Companies are not willing to disclose information regarding litigation claims against them, as these matters are usually based on sensitive information which is not readily revealed. The same applies to their existing QMS, of which they do not wish to reveal details, or possible shortcomings, as they do not wish this information to be in the public domain. This study is a historical overview of quality management. The ideal situation would have been to compare the improvement in quality from a historical period before the introduction of ISO, with a later period after the introduction thereof.

### **6.3 Future Scope:**

- More number of companies working in diverse sectors could be analysed
- Results of TQM application can be validated after a period of its implementation
- Indices could be used to benchmark the results
- A 360 degree analysis should be done to arrive at actual TQM on site
- More statistical tools could be used to find measures of dispersion



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