

Assessment of Maturity Level of Total Quality Management in Construction Industry

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Abstract: The purpose of this paper is to study the implementation of Total Quality Management (TQM), its and degree of awareness of TQM in Indian construction industry. This paper fills the gap in the literature by studying the implementation of TQM in construction industry. The implementation of TQM in construction industry is complex as it is different from other sectors. The implementation is at development level and mostly restricted to corporate firms. TQM is generally believed of some significance rather than great importance to the construction organizations. Hence to establish that there is need to change this understanding of Proprietors (clients), Project Managers, Engineers, Government bodies, this topic is chosen. An attempt is made to study the adoption of quality management practices in Indian construction industries and the maturity level of TQM in construction projects. To know the desired information a standard questionnaire is prepared after consulting experts and reviewing literatures. A survey has been conducted amongst all class of contractors and government bodies in different capacities and about 75 samples are collected. The analysis made gave clear picture of status of implementation of TQM in construction industry and the level of TQM literacy. More than 48% responses indicated that their companies have implemented a formal quality management system, and about 51% of engineer's indication of not knowing TQM principles needs to be addressed through structured awareness programs covering state agencies. It is observed that, the training covered for laborers is below average and needs to be increased as this component is most crucial in producing quality product. About 50% of the engineers suggested that construction industry is a rather unorganized sector in India and by implementing TQM the industry will become better organized.

Keywords: TQM, QMS, customer satisfaction, continuous improvement, training, construction firms/companies, engineers, contractors.

1. INTRODUCTION

The Total Quality Management (TQM) concept was introduced in 1940 and has witnessed changes and advancements over the years, Salter, (1993)¹. James Harrington et.al (2012)², the development of the TQM concept initially took place in the manufacturing industry, subsequently was adopted in other sectors including construction industry. The basic principles of TQM are customer satisfaction, continuous improvement, employee empowerment, training, supplier involvement, leadership and management commitment. Among these, customer satisfaction and continuous improvement are more important for any organization including construction industry, for sustainable operations. Sharma Pankaj et.al (2013)³, the implementation of TQM in construction industry is complex when compared to other sectors. Construction industry is distinct in induction and mobility of resources, changes in resource requirements, temporary site structures, and changes in scope of work during execution, uncertain weather and climatic conditions, unskilled, less experienced manpower and less organized structure. These distinct characteristics make implementation of TQM different as compared to other sectors. The research objective of this article is to study the existing quality management practices being followed in construction industry and the maturity level of TQM in this sector. Generally the construction firms in India are of the opinion that implementing TQM is just compliance to quality assurance and the scope and reach of TQM is not appreciated. The implementation of TQM in construction industry is at development level and is mostly limited to corporate construction firms. The medium level and small firms have initiated the implementation of TQM principles. Hence an attempt is made to assess opinion of engineers on TQM and its maturity level in construction industry through an online/ offline questionnaire survey.

2. LITERATURE REVIEW

Sharma Pankaj et.al (2013)³ point outs that, though the concept of TQM originated few decades ago but it has not been implemented in every industrial sector. Most of the small scale industries especially in developing countries consider investments required in TQM implementation as a burden and thus try to avoid it.

They instead go for ISO certifications which generally look effective on paper. Until and unless organizations don't focus on basic principles given by the concept of TQM like involvement of top level management, creation of suitable working culture, proper training and empowerment of employee etc. no new concept/technique can do wonders for quality improvement. The implementation of TQM in construction industry is complex as the construction industry is different from other sectors. Construction industry is distinctive in its operations like

- Mobility of staff.
- Diversity in the types, forms, and shapes of construction projects.
- Geographical location.
- Contractual relationships.
- Change in work force.
- Variation in materials properties and standards.
- Change in machineries.
- Plants and equipment's for different projects (K KChitkara)⁴.

James Harrington et.al (2012)² focused on quality assurance and quality control and its application during project implementation, while TQM is a strategic philosophy adopted by an organization and implemented on a continuous basis, even if the organization is waiting to carry out a new project. Many models developed for the implementation of TQM in construction industry were reviewed and opined that these models are only guidelines as it is difficult to devise a universal "cookbook" for TQM implementation. It is also pointed out that TQM gives a great amount of flexibility for developing solutions and each organization must develop its own structure and each manager should develop his mind set of quality management system and the solutions which are not directly transferable from one organization to another. It is concluded that implementing TQM is one of the most challenging tasks for any organization and successful TQM implementation requires a systematic, pragmatic, and well-structured approach.

Ahmed S. Agha (2012)⁵ states that, the construction industry has arrived late to TQM is that the construction professionals unaware of the TQM principles and techniques. To bring these benefits to the construction industry, more efforts must be made to spread the culture of TQM among the construction professionals and TQM courses must be in the engineering under graduated programs.

Abu Hassan Bin Abu Bakar et.al (2011)⁶ aimed to identify aimed to identify the level of effectiveness of the implementation of TQM principles by the construction contractors in the Sultanate of Oman in the top grade construction company as per classified by the Chamber of Commerce and Industry of Oman. Important factors were taken into account relating to the internal customers (the staff) of these companies. A quantitative research approach was adopted in this study, where the questionnaires were distributed to 114 top staff of excellent and one grade contractors to identify the level of quality practices in their organizations and ascertain that they follow the rules of total quality management or not. For analyzing purpose, chi square test, frequencies and response rate are used in this paper. They found that these companies generally take into account the principles of total quality management.

Kazemi (2011)⁷ investigated the implementation of TQM within small and medium size construction enterprises (SMEs). It presented an information about the current practice in the construction industry, critical success factors for implementing TQM, primary barriers to the implementation process, and a general proposed framework for TQM implementation in construction related organizations. He indicated that TQM is generally believed to be of certain significance rather than great importance to the construction organizations and there is need to change view point of owners, project managers, engineers and government bodies in implementing TQM.

SinaAvsar et.al (2006)⁸ pointed out how construction professionals implement TQM and its tools in their projects in the different stages (design and construction) from the results and conclusions from case study of 'the construction of a 22-km² reclamation area in New Doha international airport (NDIA) it's clear that TQM is not a fad and how much benefits that TQM can bring to your construction business (improve business quality, increase customer satisfaction, reduce cost, save time and much more).

Enno Ed et.al (2003)⁹ stressed about QES (Quality Environment and Safety) management systems concerned with actions that can create an organizational setting in which workers can be trained and motivated to perform safe, healthy, and productive construction work which satisfies customer needs. They indicated that the process is a plan-do-check-action (PDCA) process which is nothing but a part of TQM.

Pheng et.al (2004)¹⁰ indicated that the problems that construction firms may face during the implementation phase of TQM include managers failing to understand the TQM concept and philosophy, contractors being more inclined towards profit, initial costs of implementing TQM being perceived to be high though these are offset in the long run. Also TQM may not be so feasible for small firms, employees within the

organization may be resistant to change, which will render TQM education and awareness more difficult. He opined that, in spite of these problems, TQM embraces the philosophy, principles, procedures, and practices necessary for providing customer satisfaction as well as achieving productivity and business performance in the construction industry.

Ngowi (1997)¹¹ conducted a survey that targeted both management and an artisan category to know the impact of TQM application. It covered 100 construction companies in Botswana. Two sets of interviews, one for managerial staff and the other for artisans were conducted. The questions were based on the key features of TQM. The survey results indicated that, in general the adopting the key features of TQM often are at variance with the national culture. It does not mean that, the latter should change in order to be consistent with the former. The essential thing is to create the awareness of this inconsistency and to develop a tool that can find out the items that should be addressed so that conflicts can be minimized.

Deffenbaugh (1993)¹² opined that major challenge in implementing TQM in the construction industry is applying its principles on the jobsite.

3. PRESENT STUDY

An online and offline survey has been carried out with standard questionnaires for engineers of construction companies and client organizations to assess the present status of TQM in India, and the survey covered the corporate companies as well as small firms including both state and private organizations.

3.1 Data collection

The survey questionnaire consisted of 16 questions covering the key areas of TQM like, knowledge, application, practices, perception of quality, nature of works handled etc. The survey has been carried out in different capacities like some were personally interviewed, some on-site data collection, and some online surveys. Total of 75 samples have been collected.

The engineers of corporate firms having projects across India covered in the survey, have varied experience ranging from 5 years to 30 years. About 75 interviews were carried out covering both corporate and small firms and most of the professionals interviewed are located in the state of Karnataka, India.

The questions were related to type of projects handled by company, knowledge on TQM and opinion on implementation of TQM in the construction industry. The motive behind asking these questions is to know the awareness of TQM and the responses of the professionals towards implementation of TQM. Next set of questions were asked to know about the existing status of TQM implementation, principles being followed, methods of gathering customer suggestions and potential for continuous improvement. These questions were included to seek the attitude of the companies towards customer and employees satisfaction. Another set of questions were related to method of solving problems during execution, employee suggestions and facilities provided to employees. Questions also covered aspects related to training activities, communication of quality policies, quality audit and various departments at site.

3.2 Analysis

The data sorting is carried out as a first step of analysis. Frequencies are calculated for each question and the corresponding percentages are determined. The results are presented in a graphical format.

The responses analyzed are presented in Figure 1 to Figure 10.

3.3 Salient Observations

First three questions enquired about type of Construction Company, the knowledge level of TQM and opinion about implementation of TQM in the construction industry. From the survey, the samples are collected from different sectors in construction. The graph (Figure1) shows the classification on percentage scale. Out of 75 samples collected, 28% are Infrastructure sector, 13% are Hospitality sector, 43% are Residential sector and about 17% are Industrial sector (Refer Figure 1). Among the construction professionals working in different sectors including government organizations; about 49% of them said that they know about TQM, about 31% said that they heard of the TQM but do not know about it, about 16% of them are well versed with TQM and about 4% told that they do not know TQM (Figure 2). The opinion about implementation of TQM asked to the construction personnel's and their responses are; around 39% told that TQM implementation does not make complexity in the construction operations in terms of money and time, and on the contrary around 33% said it makes complexities and rest 28% were not sure and they told, it may cause complications (Figure 3).

The next two questions queried about implementation of quality management system in the construction companies and about the basic principles of TQM that are being followed in their company. More than 48 % of the companies replied that they have implemented a formal quality management system. Also some of the major companies are following EHS policy, OSHAS 18001-2007 certified (occupational health and

safety management systems), ISO 14001-2004 which deals with environmental management. About 19 % of the companies replied that they have planned to implement and another 13% in preparation and about 16% of the companies replied that they have not installed any quality management system (Figure 4). Regarding following principles of TQM, almost 86% of the companies answered that they are following the 'customer satisfaction', about 80% are following continuous improvement and about 41% answered that they are following 'training' and about 40% are following 'leadership and management commitment' principles. The response for involvement of supplier is very low, only about 13% replied that they involve suppliers in their QMS (Table I).

Among TQM's main principles Customer satisfaction and continuous improvement are very important. Customer satisfaction is sought by twelfth question which asks the methods companies are following to get customer suggestions. From the survey it is observed that about 70% of the companies seek for customer suggestions in a well-organized manner through written slips and electronic media and are serious about it. About 30% not following the structured manner which indicates that they might not take the principle earnestly. Questions six and seven sought about the definition and perception of quality. Out of all responses about 59% of them said that the terms that best define quality are 'customer satisfaction' and around 76% told it's 'durability & performance'. About 36% said it's a 'value for money' and around 28% said it is tests and acceptance. Regarding perception of quality about 56% say that quality is 'elimination of defects' and 22% think that it's a competitive advantage and about 13% think that it's a tool to increase profits. (Refer Figure 5 and Figure 6)

Question eight sought the method that is used to communicate the company's quality policies to the work force. About 56% indicated their mode of communication as quality manual, about 18% through telephonic/electronic media and around 44% is through verbal (Table II). The level at which the training activities are conducted is covered by ninth question. About 28% said that they conduct training activities monthly and about 30% conduct quarterly. Around 30% said that they conduct training activities once or twice a year. The level of training is covered in question 11 and it was observed that training given is more for engineers (74%) than other class, followed by supervisors 43%, Managers 27% and labors 21%. As labors are directly involved in construction followed by supervisors, more attention is required for them in terms of training (Figure 9).

The tenth question explains about the total duration the company has allotted for the training activities per year. It was observed that around 37% percent of the companies have a dedicated time of training period to be less than a week, 22% of them for a week, 18% for two weeks and around 21% for more than two weeks (Figure 8). It can be observed that majorly organizations do not have a longer period for training and it is required to have a dedicated time slot for training of employees at different levels and at different durations during a process.

Quality review/audit system during the process and information about various departments in the construction site are enquired by thirteenth and fourteenth question respectively. About 75% of the companies are following the quality review/audit systems in different periodicities (monthly, quarterly, twice in a year, once in a year etc.) and about 25% are not following this process (Figure 10). Construction companies are supposed to have certain departments in their site for the proper operation of the activities. From the data collected it can be said that about 76% of them have quality control, planning, materials, and safety departments. About 61% have human resource and about 57% have plants and equipment department and around 82% of them have accounts department at the site. These statistics shows the positive signs of development in the construction industry.

TQM also speaks of employee empowerment and their welfare. These areas are sought by fifteenth, sixteenth and seventeenth question respectively. The survey revealed that when there is a problem during construction; about 32% of the companies assign individual to solve the problem and 29% companies replied that they will set up a multidisciplinary team for specific problems and around 27% said that they have a permanent team available for solving problems (Table III).

The employee suggestions are also important for any organization, about 66% of the companies gather the employee suggestions through progress review meetings, followed by 18% gather through electronic media (e-mails, blogs etc.), 5% replied that they have drop box system for gathering employee suggestions and around 10% indirectly expressed that they do not gather their employee suggestions (Table IV). The various facilities provided for the employees in the company are represented. Around 53% of the responses indicated that logistics and ESI facilities are provided in their company; around 70% told that they are provided/providing health support; around 75% replied that PF facility is provided and around 35% were provided with gratuity facility.

3.4 Sample wise analysis

Each and every sample was analyzed separately. The scoring system was adopted. Quantification is done by assigning scores to the questions such that desirable situation had a higher score compared to less

desirable situation. The maximum total score was 100 for a sample. The scores are calculated for samples and the average, standard deviation, median mode are calculated. (Refer Figure 11).

From scoring type analysis it is found that most of the companies (36%) surveyed has scores ranging 71-80. Only 4% of the companies got scores more than 90. Average of scores companies got is 73, and mode value is 70, which indicates that most of the companies have got scores around 70. It is a good sign of development in the industry.

3.5 Changes observed in firms implementing QMS

About 43% engineers indicated that they have very much benefitted by producing better quality products after implementing QMS. About 30% of the responses indicated that considerable focus is made towards customer satisfaction, and are receiving good feedback from customers. About 40% of responses indicated reduction in accidents, wastage of resources and project delays.

3.6 Suggestions received for implementing TQM

About 50 % of engineers suggested that construction industry is a most unorganized sector in India and through TQM industry will become organized. About 70% said that TQM is an essential part of the construction industry and awareness needs to be created for its implementation. Around 30% opined that, construction companies should not consider TQM as an extra burden as TQM forms a vital part of construction industry as it involves various quality improvement techniques and programs.

4. DISCUSSIONS AND CONCLUSIONS

Out of surveyed companies about 35% of the companies are following EHS policies. Few are ISO14001, OHSAS 18001 Certified and following National safety law BOCW. The various EHS activities are conducted by these companies like PPE system, medical camps, air/dust/noise monitoring, water testing, disposal of wastage, tool box meeting, spillage control, safety pep talks, 'Helmet Of Honor' –rating to each project site (Monthly) with due reward & recognition to the best site & Contractor, safety training programs, etc.

Construction companies should take seriously the quality management system (QMS) and adopt its principles onsite. Because it is not so difficult to document the quality standards on a sheet of paper and get certified, but the real challenge is applying those principles on-site. From the survey it is known that among the surveyed companies about 57% of the companies have already implemented quality management system and an average of 56% of companies are following the basic principles of TQM, rest 45-50% companies are still planning to implement a formal QMS. The literacy level of TQM from the survey samples is around 69%. This is a positive indication in the industry. Also it is reflected from the survey that the labors are given the least consideration (38%) in providing training. As they are directly involved in construction activities the training is very much important. It can be agreed that it is not possible to provide the training to labors like other higher levels (supervisors, engineers) as many of them are not literate to understand technical language, but they can be provided with a suitable type of training according to their capacity and understanding levels. This makes easy to convey the message to them and they also follow the instructions easily. TQM mainly speaks of continuous improvement; the survey gathered the information from construction professionals and companies. Around 30 samples revealed that they have potential for improvement in on-site- supervision and on-site-safety, they are improving their operations regularly (project-to-project). On an average around 21 companies/professionals responded that they have high potential in improving their construction activities and around 18 companies/professionals responded that they do not have high potential for improvement but they want to improve as per the necessity and requirements at a slower pace.

The curve from sample wise analysis indicates that maturity level is high in only 4% of the companies and medium level maturity among 62% of the companies and maturity level is low among rest 34% of the companies.

The professionals also expressed their opinion about getting quality products; they said it's not the sole responsibility of the contractor/engineer executing the work; rather it is also the responsibility of the owner and other stake holders to ensure the quality of the product. For instance in some small projects it is agreed that the materials will be supplied from the client/owner side and the role of the contractor is to just execute the work. In such situations contractor cannot control the quality only by execution methods rather it is equally dependent on quality of the materials being used. Some chartered engineers also mentioned that it also depends on the skill of the labors involved in work. So finally from the various responses got, it can be said that quality has got many predecessors like materials, skills, methods, money, time etc. TQM forms a vital part of construction industry as it involves various quality improvement techniques and programs, so all construction companies should consider TQM as an investment rather than expenditure. The initialization can be done by adopting simple TQM elements like Plan-Do-Check-Act cycle or Cause and effect diagram (Fishbond diagram). TQM is an essential

part of the construction industry; awareness needs to be created for its establishment. Many companies are following the basic principles of TQM, but they are not aware of TQM, so there is utmost need to conduct/organize workshops, seminars and training sessions for the construction professionals and encourage them to implement TQM in their companies.

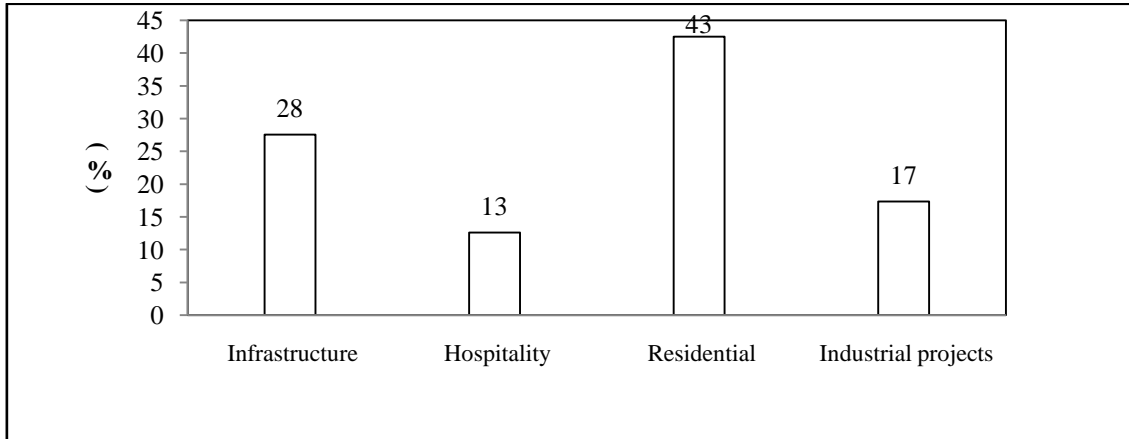


Figure 1 Type of projects handled

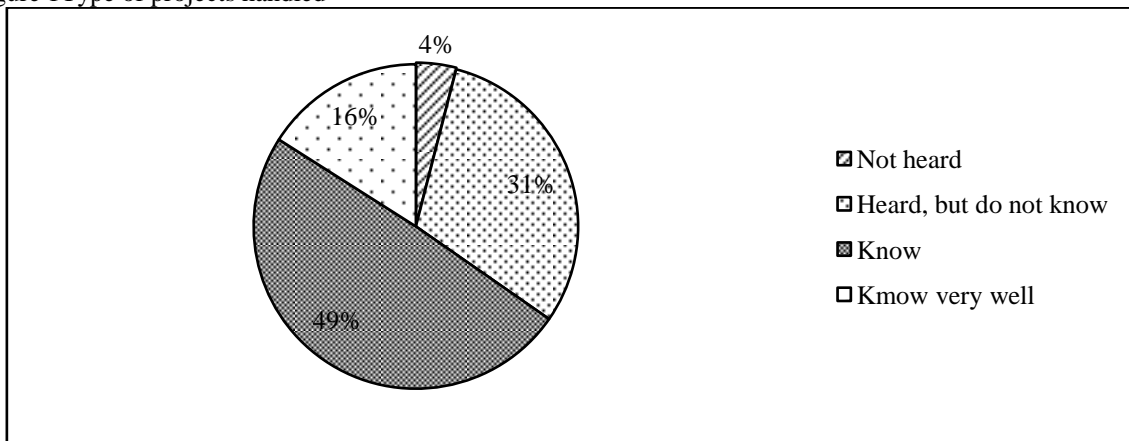


Figure 2 Knowledge of TQM

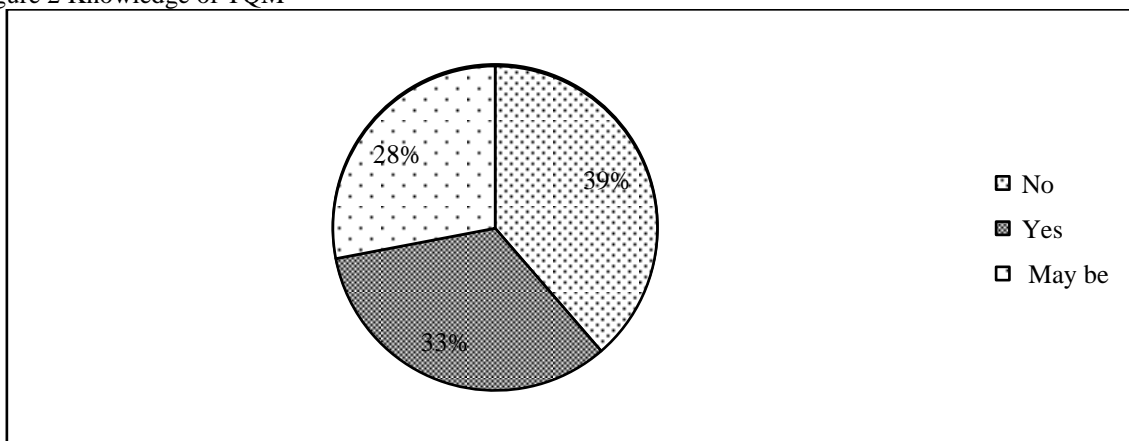


Figure 3 Opinion about complexity of TQM

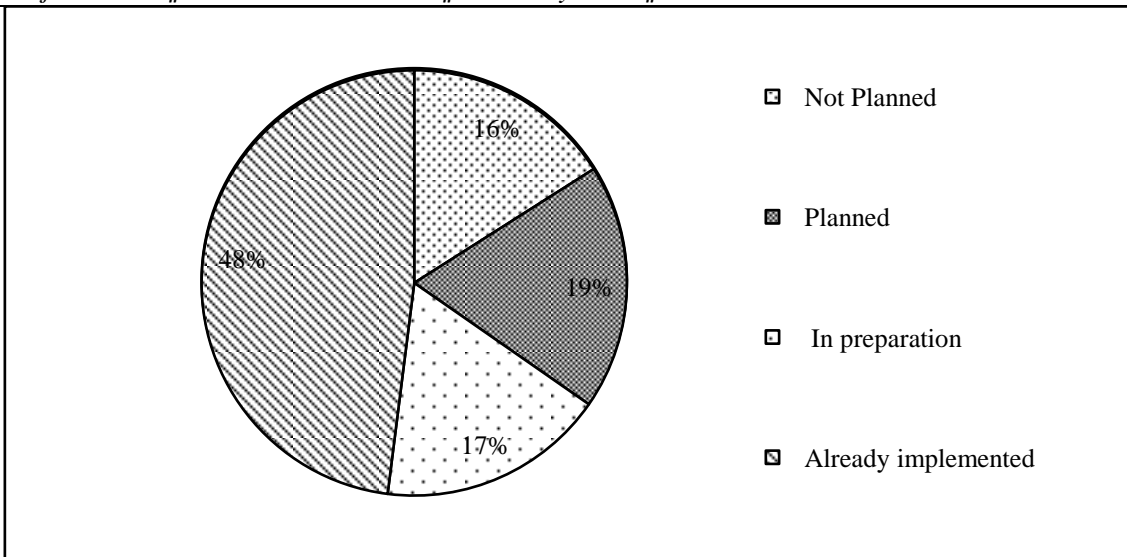


Figure 4 Installation of formal QMS

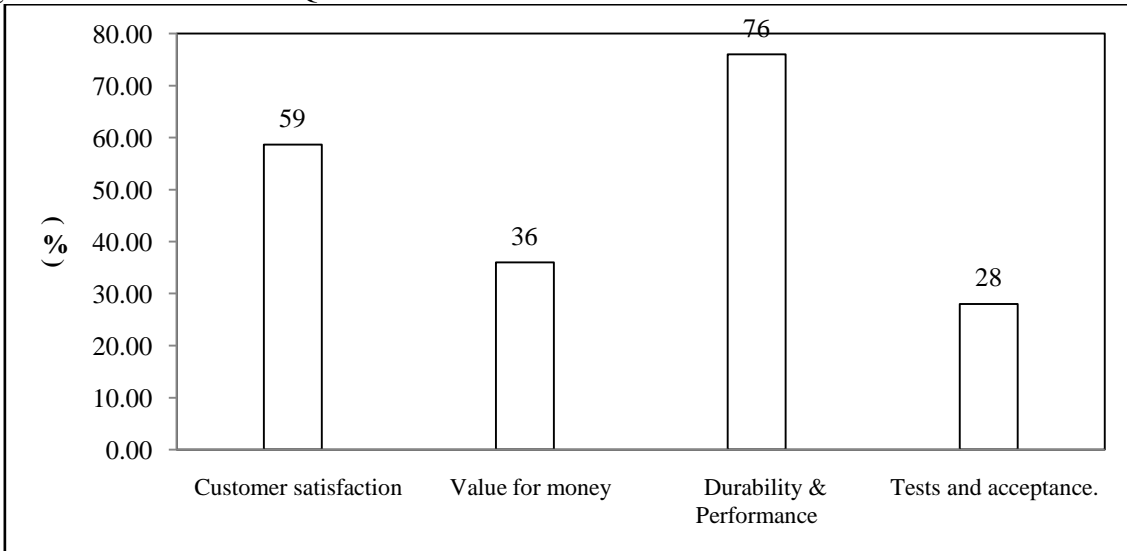


Figure 5 Terms that define quality

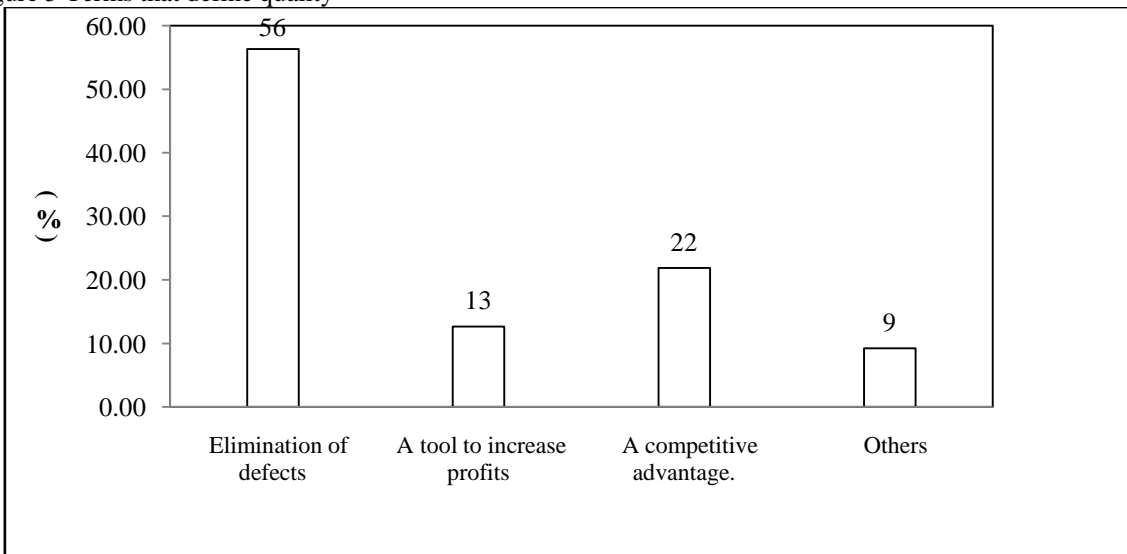


Figure 6 Need for quality

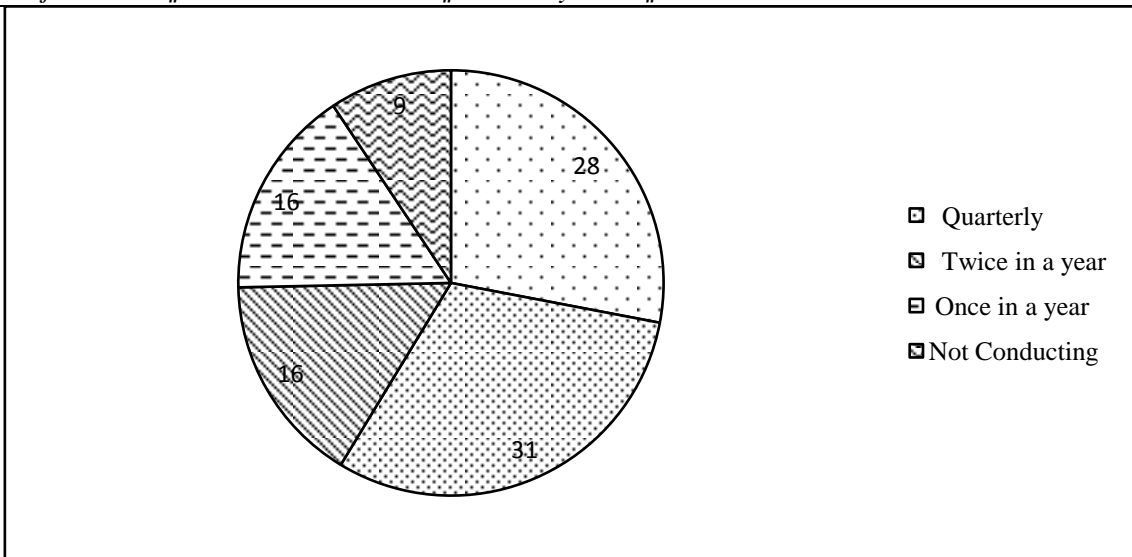


Figure 7 Frequency of conducting training activities

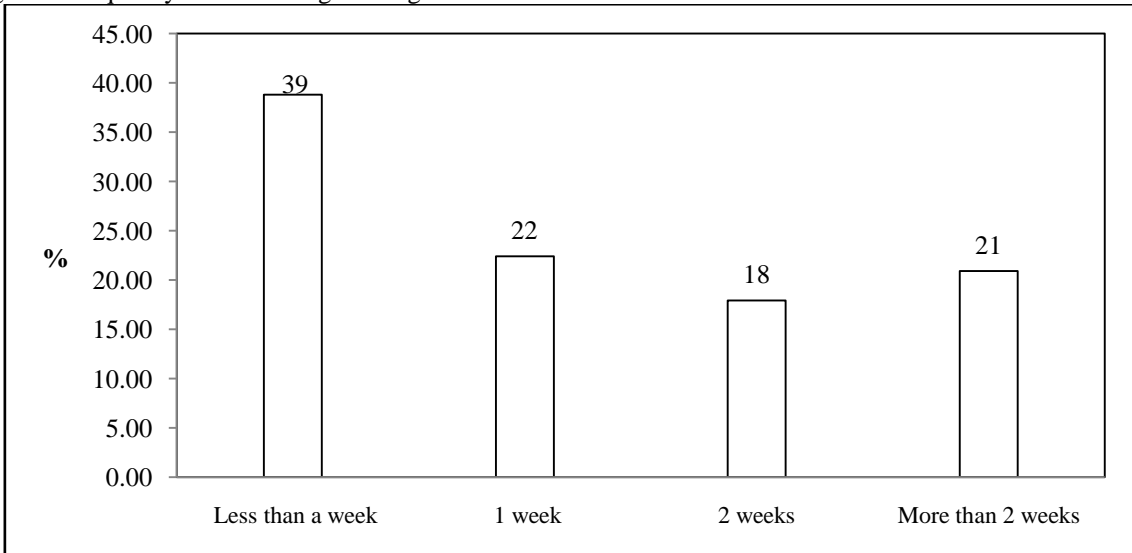


Figure 8 Time allotted for training activities per year

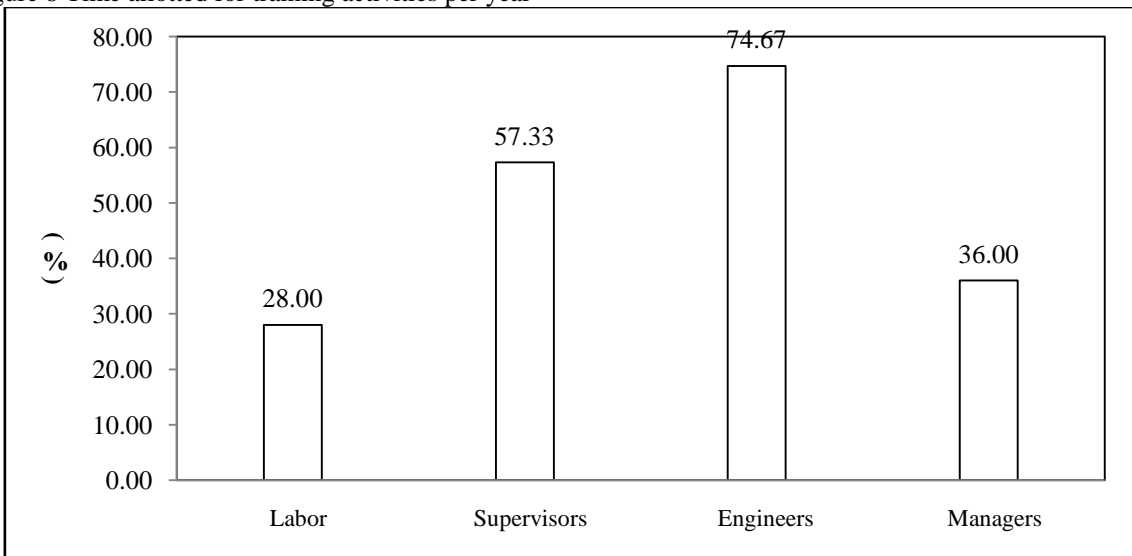


Figure 9 Level at which training activities are conducted

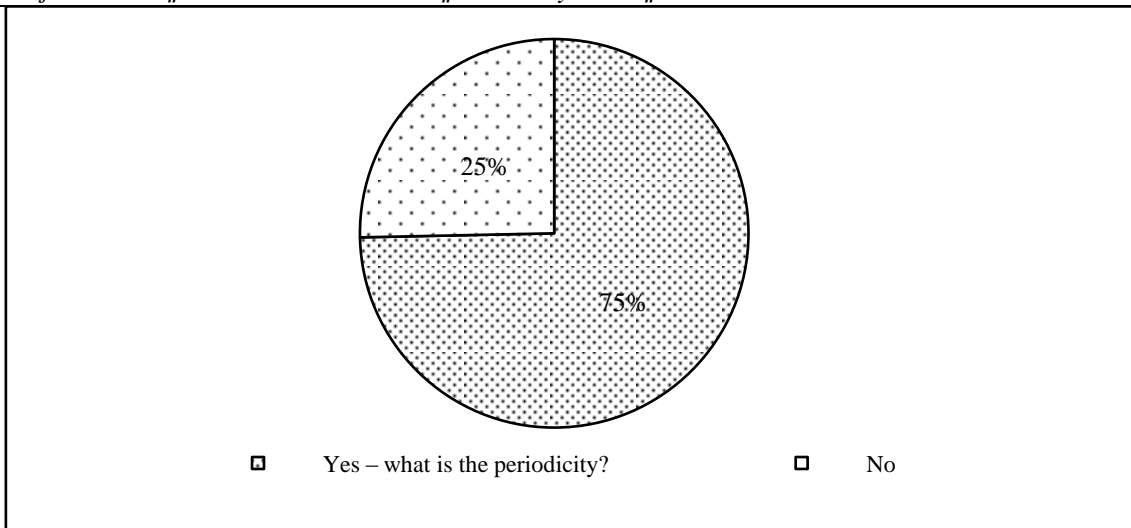


Figure 10 Quality review audit system

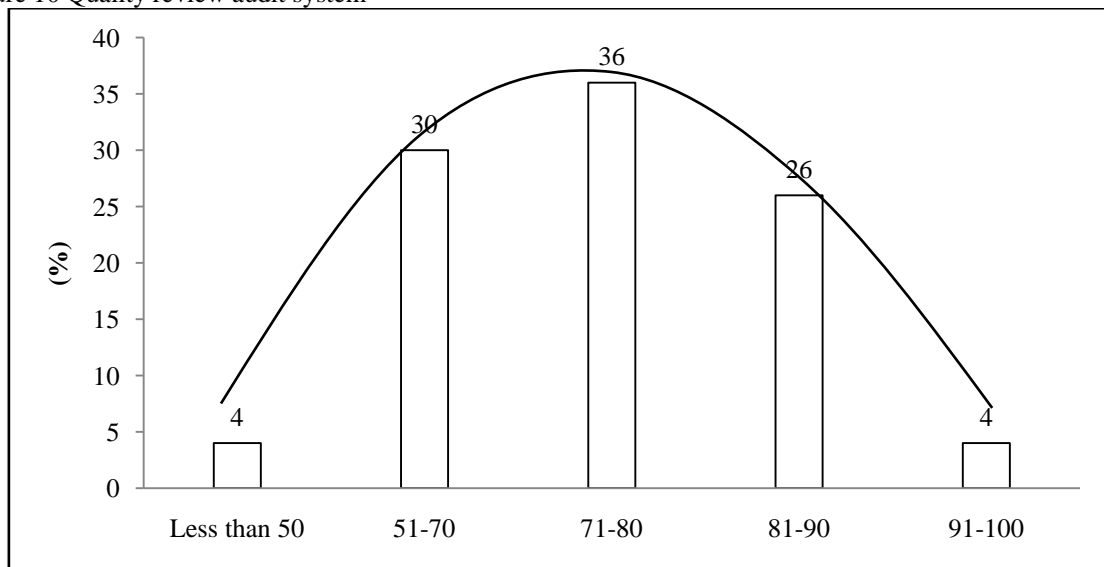


Figure 11 Statistics of scores got by various samples in the survey for TQM implementation

Table I The basic principles of TQM followed in company

SI No.	Parameters	Frequency	Percentage
1	Customer satisfaction	65	87
2	Continuous improvement	60	80
3	Focus on employees(Employee empowerment)	22	29
4	Training	41	55
5	Supplier involvement	13	17
6	Leadership and Management commitment	40	53

Table II Mode of communication of company's quality policies to employees and workers

SI No.	Mode	Frequency	Percentage
1	Verbal	33	44
2	Quality manual	42	56
3	Telephonic/electronic media	14	19
4	Other methods	7	9

Table III Method of solving problem in an organization

SI No.	Methods	Frequency	Percentage
1	Assign individual to solve	29	33
2	Set up a multi-disciplinary team for each problem	26	29
3	A permanent team is available	27	30
4	Other methods	7	8

Table IV Systems in the organizations to gather employee suggestions

SI No.	Methods	Frequency	Percentage
1	Progress review meetings	50	67
2	Drop box method	4	5
3	Electronic media (emails, blogs, comments. Etc.)	14	19
4	Other methods	7	9

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