

## A study of total quality management in construction industry

Chaitresh Sandeep Umrani \*

*Department of Civil Engineering, Walchand College of Engineering, Vishrambag, Sangli, Maharashtra, India.*

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### Abstract

Total Quality Management (TQM) is one of the globally popular and accepted philosophies to ensure the standardization and quality control and management in industries. TQM is also applicable in construction industry, but the implementation of TQM is less in construction industry as compared to that in other industry. For this review paper 20 published papers presented by distinguished scholars are taken in to consideration and attempt is made to understand and document the concept of TQM in construction industry with number of point of views. Theory of TQM, different concepts and steps related to TQM, problems related to implementation of TQM, different approaches to implement TQM, structures guiding implementation of TQM and also case studies considered by different authors concern with the construction industry is covered briefly to understand the overall concept.

**Keywords:** TQM; Construction Industry; Reviews; Understanding TQM; different point of views

## 1 Introduction

### 1.1. Background Information

- The civil engineering or construction assiduity has its origin, roots up to long back, ancient times. As the sanctum is one of the most introductory requirements of mortal beings, sanctum is necessary in all times, for every period, for the donors. And the construction assiduity satisfies this need of the mortal it has a vital significance in every period.
- As in all the diligence quality is the most important parameter to be considered and to be taken in to regard. From indeed ancient time quality is similar parameter which always checked, stressed and pointed for success of the final product. The magnificent civil engineering structures that we can see moment indeed after hundreds of, thousands of times, the quality that's checked and espoused at the time of construction, is one of the most important parameter that was considered at that time. As we all know history is the companion for future, we should take guidance of these. Not only in India, but in whole world also, at the time of construction of magnificent structures quality is the main parameter that was checked and precisely espoused.
- In ultramodern times also quality is the main, stressed part of every assiduity. Construction assiduity is also part of this quality assuring diligence. Along with way in civil engineering like planning, designing, check, accoutrements, Quality is the veritably important parameter that's to be considered. For this quality assurance, different ways, different styles are espoused as per convenience and the requirements of association.
- Quality is defined as 'fitness to purpose', i.e. in terms of construction; it's an installation which provides an applicable quality for the purpose for which it's intended. Quality controls measures and mindfulness towards quality has increased in ultramodern period in the construction assiduity.
- Total Quality Management(T.Q.M.), is a gospel or the way of planning, organizing and understanding each and every exertion that takes place at each and every position of work. The gospel of TQM is one of the way of forestallment and not the way of the disfigurement discovery.

\* Corresponding author: Chaitresh Sandeep Umrani

- As far as the total world script is concerned, India is one of the fastest growing countries (to be precise alternate fastest growing country) in the field of construction assiduity and the construction assiduity is an important part of the Indian frugality.
- Industrialization, urbanization, profitable development and people's rising prospects are like some of the reasons which have touched off the development and growth of the construction assiduity investments in our country India. So, as it was formerly important from the beginning itself, as per moment's script the significance of quality and quality operation has been increased.
- The main problem of TQM is that, it is n't applied to that important effective scale in construction diligence in India. Though it's true that, the conception of TQM is accepted and being rehearsed in the work by a considerable number of Large- scale diligence, it is n't being accepted and rehearsed and is neglected by small- scale or medium- scale diligence in India.
- For development of construction assiduity in any country, to be precisely in developing countries like India, small and medium scale construction diligence play an important part in overall profitable growth of country. nonstop quality enhancement also may be called as Total Quality Management that substantially focuses on making good thing more and more thing stylish.
- "Quality operation" is generally substituted, "Total Quality Management". Before the conception of TQM is defines, it's necessary to define the conception of quality operation. According to ISO 8402, Quality operation can be defined as follows "All conditioning of the overall operation function that determine the quality policy, objects and liabilities, and apply them by means similar as quality planning, quality control, quality assurance and quality enhancement within the quality system" Total Quality Management is a gospel gradationally evolved from the operation propositions similar as operation by objects, quality circles, strategic planning etc. To understand the conception, it's better first to understand the three words constituting the conception, i.e., Total, Quality and operation.
- Total Everyone in the association is involved in creating and maintaining the quality of the services and products offered by the association. It's a comprehensive way of dealing with complex sets of interacting issues involving everyone at all situations and addressing all major issues.
- Quality The association through individual and collaborative conduct focuses on meeting client's requirements, at smallest cost, first time and every time and hence feting that it's the client's perception that identifies quality. Total quality thus refers to the fact involved in achieving quality according to some conditions or laid down.
- operation While managing the system, the emphasis should be towards nonstop enhancement and not on quick fixes. also only Quality can be achieved. This requires everyone in the association to be responsible for managing their own job. TQM portrays a whole systems view for quality operation. TQM builds on the idea that an association is an interactive network of communication and control.
- Total Quality Management is an operation system for a client concentrated association that involves all workers in a continual enhancement of all aspects of the association.
- TQM is a comprehensive operation system which
- Focuses on meeting possessors' guests' needs by furnishing quality services at a cost that provides value to the possessor's guests
- Is driven by the hunt for nonstop enhancement in all operations
- Recognizes that everyone in the association has possessors/ guests who are either internal or external
- Views an association as an internal system with a common end rather than as individual departments acting to maximize their own performances
- Focuses on the way tasks are fulfilled rather than simply what tasks are fulfilled
- Emphasizes cooperation and a high position of participation by all workers.

Indian construction companies are facing tremendous quantum of competition from their counterparts across the globe. So in order to finish the bidding process of different systems on advanced side, Indian companies need to show huge competitiveness in every aspect of construction design right from generality to completion like high quality work completed by company within budget and quested time span. In this hunt of achieving design competitiveness companies need to borrow largely proven effective quality policy like total quality management (TQM).

For an Indian construction sector willing to capture sizeable request across globe, it's necessary that completed systems surpass the quality norms of the challengers with the help of TQM gospel which has implicit to bring evolutionary changes in associations.

Indian construction sector is facing large problem of non-attainment of respectable quality position due to hamstrung quality operation systems espoused. Since construction systems are big budget trials, large quantum of stakes are involved in them. It has set up that large quantum of investment in plutocrat, time and pool is getting wasted due to lack of the effective and effective quality operation system. Hence construction sector needs the use of Total quality

operation system as an effective result for the current problems of Indian construction sector like time and cost overruns, nonconformance to the standard quality parameters as well as unsatisfied guests.

Companies moment are aiming to ameliorate affair and reduce costs by reducing Work in progress, force situations, super eminent times, stock and increase affair with the use of new and sophisticated manufacturing and product ways.

Still, despite all the developments in perfecting productivity this has not, in the history, been matched by analogous developments in the technology to cover and automatically control the product processes. thus, the quality of the factors and products has not been harmonious and, as a consequence, high costs have been incurred due to the scrapping or the revamping of the factors. still this can also produce inferior or scrap products at the same rate.

Total quality operation is a gospel, a guiding structure that can be designed, constructed and precisely worked out as per the points and way mentioned in the total quality operation for a system. This will lead the association to the guests' satisfaction, success of the association, improvement in the request prestige, achieving frugality, precise and quality product at the end of construction.

### 1.2. Paper points and objects

- To study and understand conception of total quality operation.
- To carry out rigorous study of named published exploration papers on this particular subject.
- To understand formerly done and current script of total quality operation conception in construction assiduity.
- To have guidance for unborn work of operation of TQM in construction assiduity.

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## 2 Reviews of Research Papers

- The research paper published by, James L. Burati Jr., Michael F. Matthews and Satyanarayana N. Kalidindi, named as "Quality Management in Construction Industry" [1], aims to have some findings in conclusion after study of a project for different attributes for effective quality management a system for the same in construction industry. For fulfilling the purpose at around 143 interviews were taken by the author in 19 different construction and contracting firms involved in heavy, industrial and commercial construction. From this survey the authors observed that the emergence of total quality management in construction industry was a significant finding. It was observed and concluded that applying concepts of TQM is one of the significant way of achieving quality in construction industry. The number of attributes were considered and studied for their effectiveness in achieving quality standards.
- The paper gives number of attributes and their significance level in achieving quality mainly by applying total quality management in construction industry. The broad attributes taken under consideration are TQM training, Quality management applications and cost benefits, Sources of quality problems, Quality management approach. In these attributes numbers of sub points were considered by authors and remarks by the different individual professionals were marked and given weightage based on remarks. The paper gives clear idea about TQM and its applications in construction industry and which are the points that should be taken for consideration and emphasized.
- In the paper by, Gerald W. Chase and Mark O. Federle, entitled as "Implementation of TQM in Building Design and Construction" [2], the authors had focused on two workshops held by Iowa State University's Construction Engineering faculty and the Quality Management Division of the American Society for Quality Control. The aim of workshops was mainly related to the Total Quality Management implementation and applications in the construction industry. The authors further had given focus on a session where in a group discussion was conducted amongst the overall 50 construction practitioners. This discussion resulted in some breakthroughs in the broadly three categories for TQM viz. 1) Organization, management involvement and training, 2) Feedbacks from employees and customers, 3) Team work, whole and soul involvement by employees and recognition. This lead to generation of TQM implementation plan and the related information for the implementation of the same for the class of contracting, designing and construction organizations.
- The paper contributes a lot by designing and documentation of a proper plan for guiding various parts of construction industry for proper execution and implementation of TQM in the field of construction industry by considering various steps, facts and also number of problems that are susceptible to arise in execution of the same.
- The paper published by, Peter S. Strange and Gareth D. Vaughan, entitled as "TQM: A View from The Playing Field"[3], mainly aims to discover challenges and problems that arises during execution of TQM particularly in construction industry. For this particular research authors considered medium size general contracting construction management organization. Different elements included in implementation of TQM in construction

industry and suggest some remedial measures to overcome the problems that may be generated in considered facts.

- This paper serves like a reagent to understand and overcome the real world problems occurring in applying TQM in construction firms. The seven primary principles associated with TQM are analyzed by considering practices and opportunities created after redefining the product and success in practical current point of view at that time. This paper in conclusion suggests some basic and easy steps the company can accommodate for effective and long term application of TQM in construction field.
- In the paper by, James L. Burati and Thomas H. Oswald, named as "Implementing TQM in Engineering and Construction"[4], the main focus by authors is on collecting and describing proven practices in TQM application in construction industry with the help of interviews taken by different construction practitioners. The fact that there is no any hard and fast guidance available for implementation of TQM in construction industry, after understanding the data collected from the survey, the whole process was divided in to four phases by the authors and recommendations were made.
- The phases as specified by the authors are as follows: 1) exploration and commitment, 2) planning and preparation, 3) implementation and 4) sustaining. In phase (1) the upper management gets aware about the changes regarding quality policies and takes TQM as mode of change. In phase (2) proper approach for quality and quality management is prepared as a plan for the execution and top-down quality training is initiated. In phase (3) training initiated earlier is expanded and teams are formed in different categories for quality improvement program. In phase (4) the actual, uninterrupted, as planned implementation of TQM.
- The research paper by G. W. Chase, entitled as, "Effective Total Quality Management Process for Construction"[5], mainly aims to find out elements of process of TQM. The source used for this purpose was workshops conducted by the state universities and study with the help of construction practitioners. The elements found are: (1) Upper-management involvement, commitment, and leadership; (2) vision, mission, and guiding principles, developed in concert with the employees of an organization; (3) a significant amount of training in quality awareness, communication, leadership, teamwork, process improvement, and job-related skills; (4) improved communications; (5) teamwork; (6) a focus on satisfying the customer; (7) a focus on improving the work environment, helping employees improve, and involving them in the improvement efforts of the organization; (8) the use of formalized process improvement techniques; (9) helping suppliers and subcontractors improve; and (10) striving for continuous improvement. This is like general outline of TQM in both Design and Construction involved firms.
- In the exploration paper published by, Christopher H. Kiwu and Trefor P. Williams, named as "operation of TQM to Environmental Construction"[6], the authors have actually visited and studied different 40 systems involved in Environmental Construction under U.S.Navy. Out of these systems considered for study, 21 were set up to be applying TQM in construction process. The paper principally aims to conclude with a comparing statement in between TQM applying and TQM non applying construction enterprises. The paper concludes with statement that for these Navy systems, the operation of TQM ways does n't significantly lower design costs. The results suggest that operation of TQM ways in these environmental systems may be salutary in controlling design duration, but other external factors can intermediate and come the controlling influence on design cost. The design uses a unique and significant Stem & Leaf plots for different rudiments and factors considered for making, concluding and presenting for both considered cases types.
- In the exploration paper by, Mireille G. Battikha, entitled as, "QUALICON Computer- Based System for Construction Quality Management" [7], the focus is on study of a computer- grounded construction quality operation system for design, adaption and prosecution for effective quality operation in construction business. The system is working by taking rudiments of ISO 9001 standard and integrating them with other computer- backed design operation function. They can help operation in 1) the description of conditions criteria for design, construction, and quality operation; 2) the development of examination and test plans; 3) the shadowing of factual examination/ test results; 4) the verification of their conformance to defined criteria; 5) the attestation of once experience in the form of standard templates for aiding the tasks involved; and 6) the generation of reports. The paper is n't specifically describes about TQM in construction assiduity prima facie, but the detail study will show that use of ISO 9001 as a standard for quality operation specifies use and operation of TQM.
- The exploration paper published by, Dr. Mrs. Sushma Kulkarni and entitled as, "Total Quality Management A need of Construction Industry" [8], substantially focuses on understanding TQM gospel and the crucial rudiments for perpetration of TQM process is bandied with reference to construction assiduity. In broad sense, paper concludes as, In TQM the word aggregate is veritably important in this expression because it states that we seek comprehensive ways of dealing with complex sets of interacting issue- involving everyone at all situations, addressing all major issues. Construction assiduity must realize that the organizational objects of client delight, hand involvement, productivity and profitability are nearly inter-linked with the perpetration of TQM. Acceptance and use of TQM is the only tool to insure competitiveness in domestic and global requests. The perpetration of

TQM is the need of the construction assiduity to insure the quality of the ultimate product i.e. construction and also enforcing TQM will give a fresh value in the request.

- The exploration paper published by, Low Sui Pheng and Jasmine Ann Teo entitled as, “enforcing Total Quality Management in Construction enterprises” [9], specifies report of a rigorous study done by the authors in two construction enterprises who were successfully enforcing TQM in construction process in the establishment. The benefits that were endured by the establishment include reduction in quality costs, better hand job satisfaction, reduction in customer complaints and customer satisfaction, ab initio right starting and proper prosecution of work, proper dealing with sub-contractors. TQM performance measures were also reflected through top operation commitment, client involvement and satisfaction, hand involvement and commission, client – supplier connections, and process enhancement and operation. After the study and understanding, a frame for perpetration of TQM in construction assiduity is recommended. The paper gives a proper breakdown structure and well defined structure for colorful way and stages involved in operation of TQM in construction assiduity which is helpful to understand and execute the conception.
- The exploration paper published by, D. Darshi De Saram, Syed M. Ahmed and Michael Anson entitled as, “felicity of the Critical Incident fashion to Measure Quality of Construction Collaboration” [10], focuses on trials on Critical Incident ways(CIT) in construction assiduity. For this authors carried out interview and questionnaire checks to assemble a collection of critical largely satisfying and largely dissatisfying incidents endured by a variety of guests and other parties concerned other stakeholders in the collaboration processes. Analysis of the 23 incidents demonstrated that the CIT could enable identification of guests’ implicit, unequivocal and idle prospects, evaluation of the quality of collaboration processes and affair and appreciation of that information that would be useful for quality enhancement. This paper concludes that the CIT is a practical system for measuring the quality of construction collaboration processes. There are no records to date of the operation of the CIT in the construction assiduity. It’s imaged that in- depth knowledge gathered through its harmonious operation could be used to develop a operation maturity grid that would, in incremental way, give guidance to unborn design directors on how to ameliorate the collaboration function. This is laterally related to the conception of TQM in construction assiduity.
- In the exploration paper published by, Tarek Elghamrawy and Tomoya Shibayama entitled as, “Total Quality operation perpetration in the Egyptian Construction Assiduity” [11], the focus is given to the studies related to construction diligence in Egypt. By examining the Japanese contractors working in Egypt and comparing their managing systems to the original bones, a relative analysis of the two contractors working in the Egyptian field is presented in this paper to illustrate how TQM can be enforced effectively in the Egyptian construction assiduity. Some constraining points while applying quality programs were concluded as the position bound nature of the product process, the competitive bidding, which emphasizes cost and the absence of the quality culture of the guests, subcontractor and point operatives. likewise, authors shown, some features of the Japanese construction assiduity that could be enforced in the Egyptian field in addition to a new model for TQM perpetration that appropriates the Egyptian construction assiduity. The paper concludes with findings and some recommendations related to the operation of TQM in construction assiduity particularly to the Egyptian script, which can be extended to the world perspective of applying TQM in construction assiduity.
- The exploration paper by, Wenzhe Tang, Maoshan Qiang, Colin F. Duffield, David M. Young and Youmei Lu entitled as, “Enhancing Total Quality Management by Partnering in Construction” [12] substantially focuses on the fact that partnering can grease TQM operation, yet the definitive nature on the relation between the two ways is still not clear due to a lack of rigorous empirical substantiation. For this authors conducted a deep check and also considered a case study of construction of Three Gorgeous Dam. This paper contributes by giving detailed knowledge about another vital factor of partnering which can have a significant impact on perpetration of TQM in construction assiduity.
- The exploration paper presented by, Tas Yong Koh and Sui Pheng Low entitled as, “Empiricist Framework for TQM perpetration in Construction Companies” [13], substantially focuses on exploration of the perpetration position and the types of TQM practices espoused in construction diligence. The different rudiments of perpetration of TQM were linked. With the help of check each step and stage was studied in detail. At the end the authors conclude by proposing a frame for perpetration of TQM in construction assiduity.
- In the exploration paper published by, Kenneth T. Sullivan and entitled as, “Quality Management Programs in the Construction Industry Best Value Compared with Other Methodologies” [14], the author has given focus on assaying and comparing different ways that are available for perpetration of quality norms which are TQM, spare product and six sigma with stylish value system. Paper contributes by saying; the need to increase effectiveness has no way been more present than in the current construction assiduity. With smaller coffers available at advanced prices, the construction assiduity, particularly possessors, will be forced to manage further completely their pitfalls with the proven practices of quality operation programs. Quality operation programs that have set up great success in the manufacturing request, similar as TQM, spare product and six sigma, have been unfit to secure a niche in the construction assiduity.

- The paper published by, Davood Gharakhani, Hossein Rahmati, Mohammad Reza Farrokhi, Arshad Farahmandian and entitled as, "Total Quality Management and Organizational Performance" [15], focuses on study of TQM and organizational performance with the help of studies done so far by multitudinous exploration scholars. The study is epitomized by recapitulating the conception of TQM in construction assiduity and association. The paper gives in detail, the theoretical knowledge related to TQM.
- The exploration paper published by, Behnam Neyestani & Joseph Berlin P. Juanzon and entitled as, "Developing an Applicable Performance Dimension Framework for Total Quality Management(TQM) in Construction and Other diligence" [16], substantially focuses on development of a suitable frame to assess the goods of TQM perpetration on association's performance in construction assiduity. For this end, the study was conducted a comprehensive literature review to specify the being crucial performance pointers from 26 TQM fabrics that formulated by scholars. Eventually, a aggregate of ten KPIs were determined and presented within balanced score card system as an applicable performance measures frame, which enables assessing critical areas that veritably vital to the success of TQM perpetration in construction enterprises at design and enterprise situations. The study proposes a model to assess the performance of TQM perpetration in construction as well as other diligence which is composed of four main phases as follows Learning & growth, Internal business process, client and Financial.
- The exploration paper by, Benitto Thomas and Arunima Jayakumar entitled as, "Overseeing Quality Management in Construction diligence" [17], substantially focuses on furnishing perfection in consumer fidelity through ceaseless upgrades of particulars and procedures by the aggregate addition and devotion of each person who is in just about any capacity part of that process. Achieving client care is most significant ideal of the associations and quality operation(QM) is the topmost ways to manage make this be target. The paper speaks about total quality operation system with reference of ISO9000 & ISO9001 and also about the factual perpetration of the clauses. Also it contributes by giving a new updated system for perpetration of TQM in construction assiduity.
- In the exploration paper published by, Fatemeh Nouban, Mohammad Abazid and entitled as, "An Overview of the Total Quality Management in Construction Management" [18], the focus is to pinpoint the rearmost studies made on the rudiments that affect the perpetration of the principles of TQM in the ground field of construction operation. The paper focuses and concludes on the data that; labor workers should be included in the operation of the principles of TQM. They should also be given proper training in problem- working. Internal affairs of companies should be watched for with the same quantum of trouble they put into their guests' satisfaction. provocation is essential in order for the pool of companies to grow. collective pretensions are to be set by them to bring all parties to a contract to work together.
- The exploration paper published by, Mohd Zaid Malik., Rajiv Banerjee and Syed Aqeel Ahmad and entitled as, "A Review Paper On Perpetration of Total Quality Management (TQM) in Construction Industry" [19], substantially focuses on to review the rearmost studies which concentrated on perfecting quality through enforcing TQM in the construction assiduity and its applicable operations in the different phases of construction systems. The paper substantially focuses on how construction assiduity differs from other diligence and how relinquishment of TQM in this field will be applied. Unique problems being in construction assiduity that proves to be chain in perpetration of TQM in this sector are also addressed.
- In the exploration paper published by, Oluwaseyi AJAY and Temidayo OSUNSANMI and entitled as, "Constraints And Challenges in The perpetration of Total Quality Management(TQM) in Contracting Organization" [20], the focus is given on chancing the constraint and challenges in the perpetration of TQM of construction companies. The focus of the study is on Nigeria construction diligence. From the study it's shown that the factors affecting the perpetration of TQM are operation commitment factors, the part of quality department and training and education. The challenges of TQM are lack of available quality system attestation, lack of understanding of the process demand and high cost to apply TQM.

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### 3 Conclusion

- This review paper as aimed was intended to understand the current scenario of application of TQM in construction industry and overall step by step development of TQM in construction industry. This aim is tried to be fulfilled by this paper.
- TQM was widely used in manufacturing industries like mechanical, electronics, computer, etc. where the end product is specific and fixed. The application of TQM in construction industry was not seen on a broader scale. To understand this, the study was conducted and it resulted to the conclusion that due to uncertain nature of elements involved in construction industry is one of the main hurdles in implementation of TQM. But the fact is this problem can be overcome by keenly applying and modifying some elements of TQM.
- The theory of TQM, models for implementation of TQM, challenges associated with implementation of TQM, need of TQM in construction industry, guidelines and standards used for implementation of TQM, advancements like computerization of quality management process, all these factors are covered in collected papers presented by

distinguished scholars. With the help of this the development and current scenario of TQM in construction industry can be seen and this can be utilized for further work for advancement in TQM in Construction Industry

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