Quality Control and Monitoring by it Solution for Better Application of TQM: A Review

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Abstract:
Quality control assures the consistency of an entity, product, or service. Quality control is concerned not only with the quality of the product and service, but also with the procedures used to accomplish it. One of the foundations of project management and project execution is construction quality management. The number of mistakes and rework in a project can be minimized with good construction quality control. This will help contractors maintain a productive relationship and reputation by allowing projects to be completed on schedule and on budget. As a consequence, quality is the most critical parameter from the project's triple constraints in any construction project. Traditional methods of construction quality control, such as manual inspection or sampling, are labor-intensive and may easily result in undetectable and permanent defects. Quality management IT software is a collaborative platform that centralizes, standardizes, and streamlines data from around the value chain. The quality control software is a web- and mobile-based platform that allows quality control teams to streamline quality control inspection processes and, as a result, ensure high quality standards across all goods and services. The platform transforms safety audits and construction site inspections by allowing users to create checklists, inspect sites, and produce audit reports all from the comfort of their mobile device. Smart quality control can help companies in a number of ways, including enhancing cross-functional coordination and saving time and effort. This paper focuses on quality control and monitoring by it solution for better application of total quality management in construction.

Keywords: Construction, Management, Quality Control, Software, Total Quality Management

I. Introduction

Quality is characterised as something's non-inferiority or superiority in industry, engineering, and manufacturing; it's also defined as being appropriate for its intended role (fitness for purpose) while meeting customer standards. Quality is a subjective, conditional, and perceptual characteristic that can be interpreted differently by different people. Consumers may be concerned with a product's or service's specification quality or how it compares to rivals in the marketplace. The conformance rate, or the degree to which the product/service was manufactured correctly, could be measured by producers. Support staff can assess quality based on a product's dependability, maintainability, or long-term viability.

Total quality management (TQM) is a process for detecting and eliminating manufacturing errors, streamlining supply chain management, improving customer service, and ensuring that employees are adequately qualified. Total quality control seeks to keep all parties involved in the manufacturing process responsible for the finished products or service's overall quality. Total quality management (TQM) is a means of controlling an organization's overall quality. The aim of the process is to improve the quality of an organization's outputs, such as goods and services, by improving internal processes on a continuous basis. Internal objectives as well as any existing industry standards can be expressed in the standards developed as part of the TQM approach. Industry standards may be specified on a number of levels, and they may include adherence to various laws and regulations that regulate the activity of a specific company. Even if the norm is not backed by official legislation, industry standards will require the manufacture of products to an agreed-upon standard. Figure I show the overviews of concept in quality management.

Figure I: Overview of Concepts in Quality Management

Total quality management (TQM) is a means of controlling an organization's overall quality. The process’ goal is to increase the efficiency of a company's outputs, such as goods and services, by improving internal processes on a continuous basis. Internal objectives as well as any existing industry standards can be expressed in the standards developed as part of the TQM approach.

II. Literature Review

Following are the literature reviews based on total quality management.

Mireille G. Battikha et al. (2002) described the first phase of the implementation of a computer-based framework for construction quality control. Data from various construction domains was used to assess and verify the system's functionality and versatility. The system can manage a wide range of data, including requirements/criteria, inspections/tests,
actual outcomes, and inspection and test plans, and integrate them with the physical aspect of the project. The inspection and test plan serves as a centralised representation of construction components and procedures, as well as related inspections/tests, requirements/criteria, actual performance, and non-conformance analyses. [6]

Frank Boukamp et al. (2007) addressed the method for automating the processing of construction requirements to aid inspection and quality control activities in construction projects. The automated identification of relevant specifications and the automated extraction of requirements imposed by these specifications will help and allow the automation of tasks that rely on information from construction specifications, such as inspection and defect detection. As a consequence, the specification reasoning approach presented here can be viewed as a first step toward automated defect detection on construction sites. Essential deviations can be detected and highlighted by comparing deviations to identified criteria and linking to an integrated project model, raising awareness of such deviations. This will aid in preventing deviation propagation and the incidence of defects as a result of such propagation. [3]

Yuping Cheng et al. (2015) gave an overview of the Construction Quality Supervision Collaboration System, which is a SaaS private cloud-based system (CQSCS). The current state and shortcomings of construction quality supervision are identified, and methods are proposed for strengthening construction quality supervision and management by incorporating the novel software architecture and application models of the SaaS private cloud. The system may be used to handle construction quality control in other countries or areas using the SaaS private cloud platform and modifying relative business feature modules. [9]

T. Sri Kalyan et al. (2016) investigated the feasibility of creating 3D as-built models using a new, inexpensive, easy-to-use, and technology that allows for faster modeling (Project Tango) to help the construction quality control process. The depth sensor helps in the recording of the spatial environment and directly produces 3D as-built models. As a case study, a construction project was chosen, and Project Tango was used to simulate three different scenarios (with both interior and exterior layouts). A post-processing method was developed to plan the scanned as-built designs for comparing with the concept BIM. Dimension accuracy analysis was also used to determine the accuracy of these as-built models. The developed as-built models and model BIM were then incorporated and updated in the Autodesk Navisworks environment to conduct the quality control analysis. Object completeness checking and spatial variance measurements were part of the evaluation process. [8]

Junying Lou et al. (2017) mentioned that urban development should be quality-oriented, and that BIM knowledge exchange, features, and functions for project construction will help to ensure that quality requirements are met. This paper examined the design characteristics and quality management challenges of an urban complex project based on the construction of an urban complex. The project construction quality is then improved by prior control, process control, and post control by integrating BIM and AR technology in the concrete application of the construction stage. AR offers an efficient method of construction quality control, and it is hoped that it will serve as a model for large-scale project construction as well as BIM application and growth. [4]

Denghua Zhong et al. (2018) developed a theory and mathematical model for real-time compaction quality monitoring in deep, narrow valleys, as well as a new approach based on positioning compensation technology (PCT), which incorporates GNSS and Robotic Total Station (RTS). This new approach allows for all-terrain and whole-process compaction quality monitoring of earth-rockfill dam construction, which compensates for the shortcomings of GNSS-only compaction process monitoring. By integrating GNSS and RTS operations, this paper proposed the PCT and positioning approach for compaction machines. Its use significantly increases the consistency and accuracy of real-time compaction quality monitoring. For a concrete face rock fill dam, a real-time compaction quality monitoring system is built. The results show that the system is efficient for monitoring the quality of dam compaction units during construction, ensuring that compaction quality and efficiency are both high. [1]

Zhiliang Ma et al. (2018) proposed an efficient and collaborative methodology for construction quality control by creating a BIM and indoor positioning-based method. The system automates the process of producing inspection tasks, gathering inspection data, and summarising inspection results, which are all important aspects of construction quality management. To generate the inspection lot, check items, and target objects in accordance with international specifications, an algorithm based on BIM technology was designed. The device was put to the test in a real construction project, demonstrating its reliability and effectiveness as well as its usability on real construction sites. It will reduce the risk of missing check items and target objects during inspections and eliminate existing repetitive activities like inspection task preparation and inspection data re-entry, reducing inspector workload. [10]

III. Total Quality Management

Total Quality Management (TQM) is a modernization of the conventional business model. It's a tried-and-true strategy for succeeding in world-class competition. Only by modifying management's behaviours will an entire organization's culture and actions be changed. For the most part, TQM is common sense. We can deduce the following from the three words:

Total refers to the aggregate of all parameters. Quality refers to a product's or service's level of excellence. Management is described as the act, art, or practise of managing, controlling, directing, and so on. TQM is therefore the art of handling the whole in order to achieve excellence. Do unto others as you would like to be handled, is an easy but powerful way to describe it.

TQM is described as a philosophy as well as a collection of guiding principles that serve as the cornerstone of an organisation that is constantly improving. It is the use of quantitative approaches and human resources to enhance all facets of an organization's operations in order to meet and satisfy consumer expectations now and in the future. TQM is a disciplined methodology that combines fundamental management strategies, current improvement efforts, and technological methods.

TQM's aim is to deliver a high-quality product or service to consumers, resulting in improved efficiency and reduced costs. The competitive advantage in the industry would be improved with a higher quality product at a lower price. This sequence of events would make it easier for the company to meet its profit
and growth goals. Furthermore, the labour force would have job protection, resulting in a satisfying work environment. Figure II shows the total quality management pyramid.

The Quality Journey believes that obsolete management pyramids should be demolished, and that a new management pyramid should be built instead, one that can live up to the vision and challenges inherent in the concept of TQM. The TQM pyramid (which is based on the Kanji and Asher prototype) is a four-sided pyramid with a base, as shown in Figure II.

**Figure II: The TQM Pyramid**

### Implementation Process

We agree that rivalry and the desire to keep customers happy are two of the most common driving factors behind TQM implementation within an enterprise. The four-stage method of introducing TQM in an organisation was used by Kanji and Asher (1993). The phases are as follows:

- Description and planning;
- Management awareness and commitment and implementation;
- An improvement plan;
- Conduct a critical review.

The performance of the critical analysis stage is Deming's loop, which is Plan-Do-Check-Act.

The above four stages of implementation, on the other hand, can be modelled using Deming's PDCA cycle as follows: (Figure III show the PDCA model for implementation in construction firm).

**Figure III: PDCA Model for Implementation**

ISO 9001 Requirements for QMS

Scope, Normative References, Concepts, Quality Management Systems, Management Accountability, Resource Management, Product and/or Service Realization, and Evaluation, Review, and Development are the eight clauses of the standard. The first three clauses are for information only, while the last five are conditions that must be fulfilled by an entity. This section uses the same numbering scheme as the standard.

The process approach refers to the implementation of a series of procedures within an entity, as well as their recognition and interactions, and the management of these processes. This method stresses the significance of:

- Identifying and meeting the specifications.
- The requirement to know of processes in terms of added value.
- Collecting details on the reliability and efficacy of the operation.
- Continuous process enhancement focused on quantitative measurements.

**Figure IV: Process Flow of Quality Management in Software**

**Figure V: Model of Process Based of QMS**

### Quality Management Process Flow in Software

Figure IV shows the process flow of smart quality management in IT software. The creation of checklist and planning the visits could be done by PC. Inspection and audits can be done through mobile devices.

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V. Conclusion

Following conclusion are made based on literature reviews.
1. Third-party monitoring units, design units, construction units, supervision units, and construction units may obtain timely quality information during the project's construction phase by using an integrated framework.
2. In order to create a more comprehensive inspection plan, the system automatically associates with construction schedules and assigns inspectors to the system.
3. Customization of the standard’s checks objects and specifications for various application scenarios.
4. Traditional construction quality control techniques, such as manual checks or sampling tests, are time-consuming and can easily result in undetectable and irreversible defects.

VI. References


