

TQM IN A MANDATORY CONSTRUCTION COMPANY: AN EXPERIMENTAL CASE STUDY AND METHODOLOGY

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Abstract- The construction industry is often seen as less performance-oriented than others like manufacturing and services. Few construction firms around the world use TQM, while the top-down approach is commonplace. In order to implement TQM, upper management must support a bottom-up approach by establishing a "Quality Circle." This research suggests that top-level management buy-in is the first and most crucial step toward implementing TQM in the construction industry. However, there are many other challenges that businesses must surmount before they can fully realize the benefits of TQM, such as a lack of knowledge and information, self-doubt, a lack of common trust among employees, fierce market competition, inadequate strategies and requirements, poor behavior, a dearth of qualified field managers, and so on. Total Quality Management (TQM) is shown to be effectively implemented in one case study of an Iraq construction company by establishing a PMO and after a bottom-up strategy. Experience is applied in the provided case study construction firm after some analysis of the Pareto chart and root cause identification using Root Cause analysis. A method for implementing TQM in either a building company is then put forth after that.

Keywords: Quality Circles, TQM Tools, Pareto Analysis, TQM Gurus, TQM Implementation.

1. INTRODUCTION

The concept of Total Quality Management (TQM), which places an emphasis on both the customer and the product's quality [1], includes continuous improvement as an essential component. It is the product of efforts to improve the quality. It was founded by Walter Shewhart in the early 1920s, at a time when numerical principle was utilized as a method for controlling product quality. The idea was later advanced in Japan during the 1940s with the assistance of American thinkers such as Deming, Juran, Feigenbaum, and Crosby [2]. Concerns regarding the construction industry's inability to maintain adequate quality standards date back quite some time. Every year, businesses lose a great deal of time, money, and resources (both human and material) because of insufficient or completely useless quality control procedures. These losses occur across all industries.

The implementation of Total Quality Management (TQM) principles, which were originally utilized in Japan but have only recently been accepted in the United States, has been beneficial to the manufacturing industry. TQM precepts were initially used in Japan. The application of these principles has resulted in increases in production, reductions in the cost of production, and improvements in production efficiency. In addition, those working in the construction industry must comply with these guidelines [3].

It has been said that the 21st century has particularly stringent requirements. If a company wished to enhance its market share, it would become necessary for the company to incorporate quality into each and every aspect of its business operations. The term "Quality" can refer to a resource or an element. The final product that customers buy is frequently characterized by the term "quality," which is used by consumers quite frequently. The capacity of a product to fulfill the requirements of its purchasers is the criterion that determines its quality.

To look at it another way, the consistency of a product is a good indicator of how well it will satisfy both your needs and the needs of the customer. In most cases, the capacity of a product or service to persistently improve the experience of the customer is used to characterize the product's or service's quality. The cycle of life of a product or service uses characteristics at every stage, from the handling of information to satisfying the requirements of consumers. As a direct consequence of this, each department within an organization plays a part in determining the level of quality possessed by a product or service.

The definition of consistency that can be found in Crosby [4] is "conformance to standards or requirements." In his definition of quality, Juran used the phrase "suitability for use". In most cases, this is a reference to the product's reliability, compliance, safety, and reliability. As a result of the Japanese decision to compete both on the price and quality fronts after World War II, quality began to play a more significant role in the performance of businesses after that war. It appeared that performance was considered less important than this in the minds of corporate organizations in the US.

The growth of a Japanese economy does have an impact on the competitive landscape of markets around the world. The concept that higher quality corresponds to cheaper price, which was popularized by the Japanese and is still widely held today, was an early innovator. In most cases, a provider's cost as well as value are both reduced, and it is precisely this reduction in cost and value that constitutes "quality".

2. REVIEW OF LITERATURE

2.1. Quality Evolution

An emerging trend is quality management. Customers may select goods made in advanced cultures using advanced crafts. Professional artisans or craftsmen in those communities manage their own workshops, train others, and keep tabs on them. Artisan skills became unnecessary due to mass production and regularly scheduled processes. The goal was mass production. Eli Whitney is credited with being the first American innovator to initiate the process of making bolt action parts, which ultimately resulted in the creation of a musket manufacture line. Many people, which would include Frederick W. Taylor [5] argued that the next logical step should be taken. The phrase "father of research management" is often used to refer to him. Communication between processes, as well as the incorporation of improved procedures, were included as aspects of management that were addressed by his strategy as well. The management as well as procedures for quality assurance on the assembly line have been significantly improved thanks to Henry Ford's efforts. Even though Friedrich Benz is celebrated as Germany's "father of the automobile," mass production of cars did not begin until Volkswagen's efforts after World War II. The modern North American industrial sector places a premium on increasing productivity while decreasing production costs.

Japan sought to integrate quality management into everyday life as part of its post-second world war economic restructuring. The Japanese have developed a number of active-quality programs. Japan attained very high-quality standards as a result of quality systems in products from of the 1950s to the 1970s. The practice of management system is becoming increasingly all-encompassing, taking into account factors such as people, processes, and products. Numerous approaches include culture of excellence (i.e., civilian aspects) in addition to strategies [5].

2.2. TQM in the Construction Sector

The establishment of a building projects team consisting of a main contractor as well as other private contractors who are dedicated to the continual improvement and who can foster a real quality mindset is crucial to the development of a comprehensive quality management system [6].

There are three stages in which TQM can be implemented in a company: discovery and education, preparation and coordination, and actual work. Most construction companies were hesitant to implement TQM

because they either relied on the ISO 9000 series or didn't want to subject their employees to additional "acculturative stress". In addition, businesses think that there may be other critical issues, like security, to consider. Construction companies, for example, have been slow to adopt TQM practices because they don't see any immediate benefits from doing so. Because of the dynamic nature of construction sites and the inherent complexity of the work involved.

The management system needs to be flexible, focused on clear communication, and constantly evolving. Instead of relying on a predetermined formula that awards contracts to the lowest bidder, clients would instead seek to financially reward the most competent developers and vendors who can deliver the best service. The widely acknowledged connection between TQM practices and a wide range of market circumstances. Indicating that competitive pressures will be the driving force behind TQM adoption. When forming partnerships with customers, companies should prioritize vendor quality over cost.

2.3. A Rotary District of Quality

The continuous improvement concept has been adopted by an increasing number of Iraqi companies over the last two decades. Quality circles must be implemented in factories and other businesses so that society can reap the largest economic benefits and profits. The performance assessment is a loosely connected collaboration between the private and the public sectors that appears to work to achieve common goals. On the advisory committee for continuous improvement, operations, strategic orientation, innovation, and measurement and reporting are all well-represented. The commission's role is to advise the quality circles. Quality management systems in business owners and other institutions are tracked and monitored by the advisory board [7].

2.4. Results From Quality Gurus

Recently, it was found that different "quality gurus" have different ideas about how to manage quality as a whole. Still, the techniques and rules that these subject matter experts suggest help the researcher understand TQM better. It is a good idea to include their opinions in this investigation. Although they approach TQM in different ways, they do share some characteristics.

1. The responsibility for supporting both human and technological processes rests with organizational leadership. A company's leadership oversees establishing the tone and planning daily operations. Everyone benefits when quality is improved, so management must encourage employee enthusiasm for it and create a quality culture by changing employees' perspectives.
2. Strategic planning, government oversight, and comprehensive evaluation of the business are highlighted.
3. Employee learning and preparedness is emphasized for its ability to alter employees' attitudes, perspectives, and actions, as well as to enhance their proficiency in carrying out their responsibilities.

4. Process monitoring and the ongoing refinement of the quality framework and product design are of paramount importance. Preventative testing is preferred over post-mortem analysis.

5. Quality control is a continuing activity that impacts the entire production process, from raw materials to finished products for a successful business. Plans for quality management should include practical practices in market research, planning, technology, supplying, assembly, running tests, shipments, billing, implementation, and operation, to name just a few.

2.5. Quality Tools

Scholars have uncovered a plethora of tools and methods for quality assurance. Tools are devices that are used singularly to achieve a specific goal, while methods are more general and are often thought of as a group of tools used together. Tools and techniques are a set of useful methods, characteristics, processes, and approaches that can be used to complete a variety of tasks. Good transformation and progress rely on them, among other things [10]. You have access to a variety of excellent resources created to address problems. The seven most crucial quality methods and tools that are stressed in six sigma education and training were chosen as a result. Because they are the most well-liked, widely disseminated, and frequently employed tools, it was decided to use them [11].

Different Quality Tools (QTs) are used to great effect by comparable businesses. The performance improvement framework has led to the widespread use of QTs in modern businesses. Yet not every organization will reap the same rewards from adopting every QT, as well as no agreement on how companies should decide which QTs to adopt [12]. Checklist, Histogram, Pareto analysis, Process flow chart, Cause and Effect diagram, Scatter diagram, and Control chart are the seven fundamental tools [13]. This research only makes use of two of the seven primary methods. The two primary approaches are the Check sheet and the Pareto analysis.

3. CONCEPTS AND PRACTICES FOR ABLE TO CONDUCT STUDIES

The initial focus of the study was a construction firm in Hyderabad, Iraq. Both data gathering and analysis were done in this business. The company's primary areas of focus are apartment sales and real estate development. Those who build and sell everything from single-family houses to large-scale storage facilities. The study's author is a full-time employee of the firm, which has ample opportunity to deploy cutting-edge tools across a broad spectrum of market segments. This company's management made an effort to increase productivity as well, but their efforts ultimately failed.

A data collection instrument is used to get information from both staff members and a flat customer from the outside. After an analysis of the data using Pareto's 80/20 rule, the most urgent problems are determined along with their potential rewards. tracing a problem's roots in a work process. Finding fundamental causes necessitates some sort of investigation. Then, various general change-inducing elements are described.

4. COLLECTING INFORMATION

To get a sense of the company's overall workflow, information was gathered about construction companies, building sites, fully prepared concrete plants, the architectural style department, the interior designer section, quality management, real estate, human resources, and marketing, to name just a few. It also aids in identifying potential trouble spots during the execution stage.

Surveys of 100 external consumers (buyers of apartments) were conducted to gather data on management and quality issues. The form contains a summary of the data gathered. Information about how employees perceive and comprehend quality issues is gathered from across the business to develop another client (member of staff) check sheet. The Pareto principle can then be used to analyze the data from the checklist. Calculating% ages is the next step after the ordering of the data from most frequent to least frequent occurrences. Vilfredo Pareto is generally credited with popularizing the 80-20 rule in the field of economics. After issues have indeed been evaluated and identified by various teams as well as segments of a contracting company, the detailed results, which include identified main issues, identified minor problems, and suppliers that they should be aware to solve for effective Performance measurement, are listed. These results include things like identified major problems, recognized small problems, and providers should be aware to fix for efficient TQM implementation. The concluding section discusses a few of the more important points.

4.1. Review Sheet

The "Deficiency Concentration Diagram" (or "worksheet") is a form used to keep track of relevant data. It's a simple method of archiving information for later use. Pre-printed, organized, and methodical data collection forms will make tracing the problem's roots much simpler. This is a versatile technique with many applications; however, it is most frequently used to analyze the frequency with which certain problems arise and the factors that contribute to their emergence. For the sake of statistical quality control, this technique for examining effective processes is widely employed [10].

4.2. The Pareto Concept

With the help of statistics, the "20%" of activities that have the greatest impact on the whole can be isolated using a technique called Pareto analysis. The method is simple to implement and enjoys widespread popularity. Pareto analysis is a simple method for identifying the 20% of actions or circumstances within an organization that can produce a significant impact [14]. It sorts the information or variables in descending frequency of occurrence. One hundred is added to the total frequency to get the total frequency. The 80-20 law, named after Italian economist Vilfredo Pareto, states that 20% of events are dominated by the "useful many", while the "vital few" account for 80% of occurrences.

A Pareto cart is commonly used to depict the outcomes of a Pareto analysis. On the map, the considerations are displayed in descending order. Critical factors can be identified with the aid of this diagram, which shows a simple graph in descending order with a linear trend overlaid that cuts an approximate amount of 80%. Joseph Juran developed this idea further and found that it has broad applicability [16]. It can be applied to a wide range of situations, such as locating a specific book in an online library's resources database, selecting the most impactful steps to take in a project, understanding where customers' frustrations with a product or service stem from, or pinpointing the top 20% of offerings that bring in 80% of revenue [17], [18].

4.3. Review Sheet Information PARETO Explanation

Here are eight steps for using Pareto Analysis to zero in on the most important factors [19][20].

1. Make a bar graph that shows the frequency with which each cause occurs on the y axis and the x axis.
2. Put the chart's bars in descending order of significance, with the most important factor at the top.
3. Find the sum total for each contributing factor and list them in descending order.

4. Determine the percentage of total counts that can be attributed to each root cause, and list them in descending order. A percentage is found by multiplying the number of unique causes by 100: (Individual Cause Count) / (Total Cause Count).
5. It would be helpful to have a second y-axis that goes from 100% down to 0% in ten% increments.
6. Using the x-axis as the percentage of total causes, draw a bar chart.
7. Create a curve by connecting the points.
8. Create a line that is 80% of the way along y and runs perpendicular to x. Then cut the line where it crosses the curve on the x-axis. At this juncture on the x-axis, the vital few, on the left, are distinguished from the many, less consequential causes, on the right (trivial many).

This Pareto chart illustrates the most common factors in website malfunctions with the help of illustrative data. In this way, you can zero in on the 20% of cases responsible for 80% of the issues and make the most significant progress. Issues like dead links, misspelled words, and missing title tags are clearly the ones that need fixing here, this shown in Figures 1, 2 and Tables 1, 2.

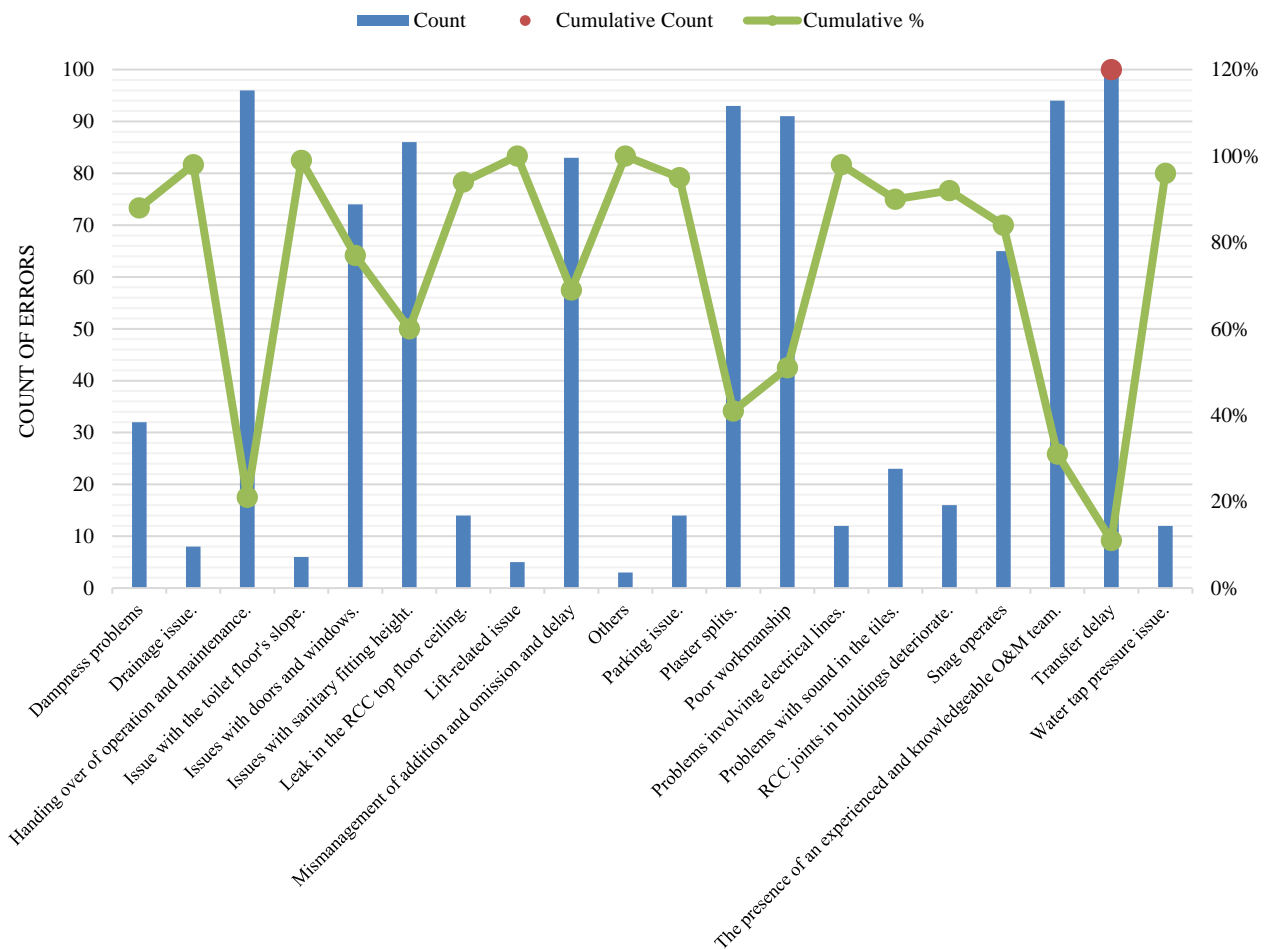


Figure 1. Using a Pareto Chart, we can see how external stakeholders (flat buyers) are connected to service and quality problems

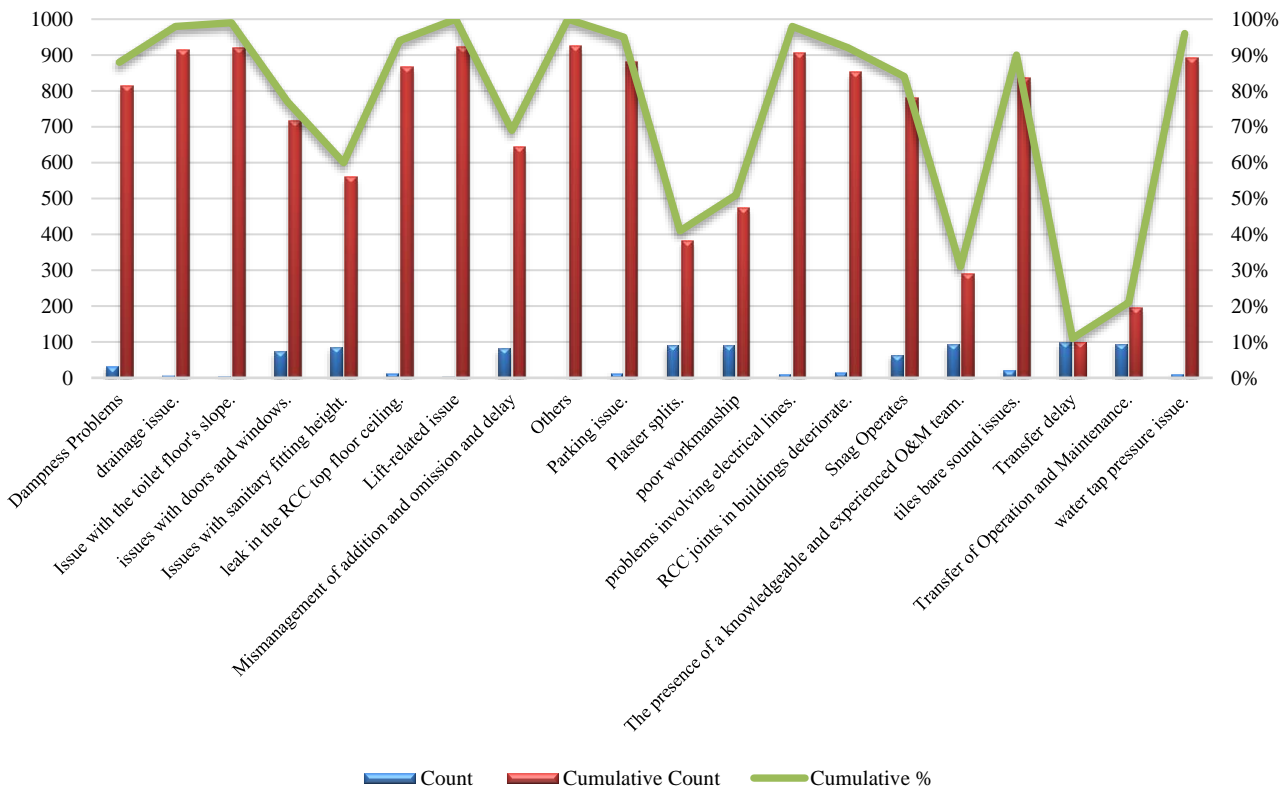


Figure 2. Quality issue employee survey 100 cases are surveyed (on Location and in the Corporate Office)

Table 1. The Pareto Chart demonstrates how issues with quality and service impact flat sales to various stakeholders (buyers)

Name of Complaints	Count	Cumulative Count	Cumulative %
Dampness problems	32	814	88%
Drainage issue	8	913	98%
Handing over of operation and maintenance	96	196	21%
Issue with the toilet floor's slope.	6	919	99%
Issues with doors and windows	74	717	77%
Issues with sanitary fitting height	86	560	60%
Leak in the RCC top floor ceiling	14	867	94%
Lift-related issue	5	924	100%
Mismanagement of addition and omission and delay	83	643	69%
Others	3	927	100%
Parking issue	14	881	95%
Plaster splits	93	383	41%
Poor workmanship	91	474	51%
Problems involving electrical lines	12	905	98%
Problems with sound in the tiles	23	837	90%
RCC joints in buildings deteriorate	16	853	92%
Snag operates	65	782	84%
The presence of a knowledgeable and knowledgeable O&M team	94	290	31%
Transfer delay	100	100	11%
Water taps pressure issue	12	893	96%

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5. EXAMINATION OF THE RESULTS AND DISCUSSION

A Pareto analysis shows that the most important things are a delay in transfer of power, difficulty in transitioning O&M (methodology and repairs) [21], lack of skilled and experienced O&M workers, and high costs. Factors include plaster cracks, a lack of quality control, problems with the ideal height of sanitary fittings, an insufficient financial incentive, motivational problems, an incorrect budgetary control, an incompetent manager, scope creep, a rule meant to cut down on administrative fees, an incompetent site supervisor, discriminatory hiring practices, and an ineffective department of human resources [22].

The primary causes often lead to the subsequent effects. When deadlines aren't met, customers aren't happy.

Table 2. Performance appraisal on the quality issue 100 cases is being investigated (at the Head Office and strategic planning at the Site)

Name of Complaints	Count	Cumulative Count	Cumulative %
Dampness Problems	32	814	88%
drainage issue	8	913	98%
Issue with the toilet floor's slope.	6	919	99%
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Issues with sanitary fitting height	86	560	60%

The price of rework, materials, and labor all went up. A further loss and expenditure, Compatibility issues between locations, which adds time to the project, Problems with the neighbors [23]. decreased production (low productivity), unfavorable effects on image, poorly constructed roof; potential death trap for the sake of further rectification, be resolute in your disappointment.

5.1. Disputes in Managing

5.1.1. Insufficient Performance Reviews and Employee Engagement

Quality management can also be assessed by looking at how happy the staff is with their jobs. This tool has the potential to greatly improve output quality. If employees are regularly praised for their efforts and evaluated fairly, they will be strongly motivated to continue doing their best. Despite having a human resource, the company is failing to carry out its primary responsibilities. They are primarily the responsibility of upper management. Some prospective employees consequently become demotivated and perform less effectively.

5.1.2. Lack of Competent Personnel

The approach contends that a lack of education is the main barrier to the efficiency of the construction industry. Most subcontractor workers lack adequate training. They frequently come from country areas, as well as a seasoned mason instructs them in the art of masonry. They lack theoretical knowledge and formal education. As a result, it is found upon inspection that they are acting in violation of accepted laws and customs. Because of this, it is difficult to produce quality work to the required standard, and occasionally it is necessary to rework something, incurring higher material and labor costs.

5.1.3. Insufficient Education

Lack of knowledge is another issue with this organization. Most of this company's employees and subcontractors lack the necessary industry-specific training. Most of them learn their trade by doing it, without any theoretical foundation. Because of ineffective management and poor supervision, they frequently make mistakes at work. Furthermore, different subcontractors carried out the same work in a variety of ways due to their lack of theoretical understanding. This is a fairly common issue in Iraq.

5.1.4. Management Carries out Cost-Cutting Strategy

The business still has knowledge of this management technique. The higher quality is still a factor in their minds, even though they no longer have the option to pay the higher price. Other duties could be completed to a much greater extent for the same cost. The data here indicates that these firms are not spending noticeably more on construction-related or employee-related training. The senior management as a whole is responsible for finding ways to save money all through the development process. This makes it tough to stick to deadlines or complete shoddy work. As a result, productivity, profitability, and output are often negatively affected.

5.1.5. Slow and Unkind Behavior

There has been a growth in poorly motivated and uncomfortable behaviors as a result of the competitive industry, insufficient management techniques, and the complete absence of higher standards. Sayings like "If it ain't going to happen, don't fix it" and "It isn't my duty" frequently reflect the beliefs of the general public. Some of them have a certain resemblance. They all lead to problems. This strategy is frequently brought on by management tactics that appear to be hostile toward the workforce, lower motivation, increased pay, increased pressure, and higher pay.

5.2. Building Components Issues

5.2.1. The Design Methods of Different Designers are Fundamentally Different

Numerous designers are now methodically approaching structural design for nearly identical building types. Designers can maintain uniformity in the application of certain generic systems by conferring with one another during the design process. The protection and excavation of the shoreline's soil, shore pile preparing, the size and thickness of the columns, beams, and slabs, and other systems are some examples of these systems. From time to time, architects will seek the advice and counsel of a consultant as they work on a new design. However, a 100% visual match is not achieved. The problem is caused by people's reluctance to seek advice from professionals. Furthermore, there is no senior coordinator assigned to this sub-section.

5.2.2. An Absence of Coordination with the Relevant Architect

The term "construction" encompasses any endeavor that involves building, rebuilding, altering, or repairing a structure. As a result, construction firms frequently revise or alter original blueprints. An architect is the person responsible for conceptualizing the underlying theory of a building. An architect typically develops a strategy, a model, and a point of view. Reinforcement, concrete, cement, bricks, or blocks are just some of the materials that have been meticulously detailed by the designers. As an added service, he advises the architect on the optimal wall thickness and RCC member size. To make changes or updates to a design, a designer must therefore consult with the approved architect. Otherwise, originality in building design might be stifled.

5.3. Difficulties in the Field of Architecture

Flaws in design and apathy hinder progress: Plumbing fixture performance can be negatively impacted by architect error. As per the blueprints, they frequently fashioned the incorrect arrangement. Tenants often have complaints after handover when the developer is still paying for maintenance. We formed a committee to oversee the preliminary design and internal layout of the kitchen and bathrooms. Three separate times, we visited each location for an inspection. In just a year, this team has been able to overcome a lot of obstacles.

The practice of architecture design is another factor. Architects often make changes to their plans and suggestions after a project has been finished. Therefore, developers waste time, money, and materials and fail to meet their deadlines. In most cases, architects' knowledge isn't up to snuff. The only way out of this predicament is for architects to propose solutions that are fair and workable for everyone involved. This implies that experienced architects are required.

6. CONCLUSION

High-quality performance in the construction industry is difficult to achieve for many reasons. The construction industry is increasingly employing TQM to solve quality problems. Organizational culture and leadership must change to accommodate TQM implementation. Historically, construction firms were often undervalued and disorganized. The organization must accept a TQM culture in which performance comes first, as opposed to the current approach. A range of factors, including job involvement, training and education teamwork, management of human resources and empowering, supplier relations, continuous improvements, and strategic, process management, were discovered through an examination of the literature, analysis of such results, and evaluation of a study case carried out in various government agencies of a construction company. The TQM implementation of the construction organization should include these quality culture components in order to ensure the organization's ongoing success.

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