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Introduction

Definition of Total Quality Management

Total quality management is the management approach of an organization, which concentrates on quality based on the participation of its members and aims at long-term success through satisfaction and benefits to all members of the organization and society *(Ahmed).*

Application of TQM on construction projects has two distinct purposes: (i) to satisfy the customer's requirements through a quality assurance (QA) system; and (ii) to achieve continuous improvements (CI). It must be noted that satisfying the customer's requirements does not necessarily involve achievement of the CI process, as it is perfectly feasible to have a QA system which can meet the QA obligations (e.g., through quality control processes) without delivering any benefit to the contractor through the CI process. While the customer's requirements are a contractual obligation and must be attended to, the CI aspect is the domain of the contractor *(Jaafari, 1996).*

Total quality management has been recognized as an enabler for performance improvement in the construction industry. Many construction organizations have embraced the philosophy and techniques of the TQM with enthusiasm, while others have been reluctant because of the perceived increases in costs and disruption it may cause. The empirical findings from contracting organizations that have adopted TQM practices in response to competitive and environment pressures. It was revealed that when implementing TQM contractors need to align their culture with the objectives of their TQM program if it is to form part of an effective and successful strategy for performance improvement *(Love and Treloar).* The contractors should undertake cultural audits before implementing TQM so that corporate objectives and behaviors can be aligned to the goals of the TQM program.

Background Information

Application of the Quality Assurance Standards to construction projects is relatively new, having started on a serious basis in the early 1990s *(Jaafari, 1996)*. It all began as a government requirement on public projects, particularly those which received Federal funding. Prior to the move to QA clients or their representatives tended to oversee the quality of the works directly using a quality control process. When the change was introduced it was required that contractors accept responsibility for quality assurance of their operations through a QA system and associated quality control procedures. The result was that contractors began to employ additional engineers and inspectors, and introduce appropriate control processes to ensure that the works would be constructed to the required design and specifications (even if these specifications would not result in a quality end product) *(Jaafari, 1996)*.

Critical Success Factors In TQM

TQM has gained widespread global acceptance. However, some have achieved remarkable success while others have suffered dismal failures. Many of the failures can be attributed to a misunderstanding of TQM or the way the organization had implemented TQM *(Ahmed)*.

Customer Focus

In the TQM philosophy, total customer satisfaction is the goal of entire system, and a pervasive customer focus is what gets us there. The function of the construction industry is to provide customers with facilities that meet their needs. For a company to remain in business this service must be provided at a competitive cost. TQM is a management philosophy that effectively determines the needs of the customer and provides the framework, environment, and culture for meeting those needs at the lowest possible cost. By ensuring quality at each stage in the construction process, and thereby minimizing costly rework, as well as other costs, the quality of the final products should satisfy the final customer. By definition, customers may be either internal or external. The external customer is the consumer or client, in other words the end user of the products or services being offered. An internal customer is

a second process or department within the organization, which depends on the product of the first. For example, for designers the products are plans and specifications, and the customers are the owner and the contractor responsible for the construction. For the contractor, the product is the completed facility, and the customer is the final user of the facility. There are also customers within the construction organization. These internal customers receive products and information from other groups of individuals within their organization. Thus, satisfying the needs of these internal customers is an essential part of the process of supplying the final external customer with a quality product. Every party in a process has three roles: supplier, processor, and customer.

Customer satisfaction is one of the key elements in TQM, an approach that emphasizes overall satisfaction through the continuous improvement of products. Construction companies are adopting TQM to improve their performance of products. However, construction has lagged behind other industries in implementing TQM because of its inability to accurately determine customer requirements and successfully transform these requirements into the complete facility *(Ahmed and Kangari, 1995).* In addition, there is much dissimilarity between manufacturing and construction, so TQM techniques must be adapted for the construction industry. Understanding the customer's requirements is essential in ensuring customer satisfaction, and the demand for the construction product must be viewed in relation to the intended use of the facility. Ahmed and Kangari (1995) suggest that customer orientation, communication skills and response to complaints all play an important role in the overall satisfaction of the customer in the construction industry.

Juran defined this as the triple role concept *(Ahmed).* These three roles are carried out at every level of the construction process. The designer is a customer of owner. The designer produces the design and supplies plans and specifications to the contractor. Thus, the contractor is the designer's customer, who uses the designer's plan and specifications to carry out the construction process and supplies the completed facility to the owner. The owner supplies the requirements to the designer, receives the facility from the contractor, and is responsible for the facilities operation *(Burati 1992).* This clearly illustrates that construction

is a process, and that TQM principles that have been applied to other processes are potentially adaptable to the construction industry.

Process Improvements

A process is a way of getting things done. A process consists of the tasks, procedures and policies necessary to carry out an internal or external customer need *(Adrian 1995)*. According to the TQM philosophy if the process is correct, so will be the end result product). Thus the organization should work to improve the process so as to improve the end product or service. Three different approaches have emerged for improving the efficiency or effectiveness of a process. Continuous improvement is an approach used on an ongoing basis for incremental gains. Benchmarking should be used periodically, and reengineering can be launched occasionally to achieve dramatic breakthrough. By focusing on process by measurement and analysis, a process can possibly be improved by changing five M's of the process namely man, machine, material, method and measurement. A strong emphasis in process improvement centers on measurement of variation, the control of variation, and the knowledge of variation to seek improvement. This analysis is referred to as statistical process control or statistical analysis. This is at the center of process improvement. The objective of measuring the variation in a process is to learn how to control the variation and also how to improve the process by viewing variation as a tool for improvement. The analysis of the positive side (good performance or quality) of the variation of process is referred as a "breakthrough improvement" or "breakthrough management" which is another key component of TQM *(Arditi and Gunaydin, 1997).*

Continuous Improvements

The goal of continuous improvement is common to many managerial theories; however, what differentiates TQM is that it specifies a specific step-by-step process to achieve this. This process consists of nine steps as below: Identify the process, Organize a multi-disciplinary team to study the process and recommend improvements, Define areas where data is needed, Collect data on the process, Analyze the collected data and brainstorm for improvement, Determine recommendations and methods of implementation, Implement the recommendations outlined in step six, Collect new data on the process after the proposed

changes have been implemented to verify their effectiveness, and Circle back to step five and again analyze the data and brainstorm for further improvement *(Ahmed)*. The nine-step cycle emphasizes on: focusing the progress, measuring the process, brainstorming for improvement and verification and re-measurement.

Under TQM, management in the construction industry has two functions *(Ahmed)*: (1) To maintain and improve current methods and procedures through process control and (2) To direct efforts to achieve, through innovation, major technological advances in construction processes. The incremental improvement of the process is achieved through process improvement and control. In every construction organization there are major processes by which all the work is accomplished. However, there are innumerable parts in the construction process. Through the use of flow diagrams, every process can be broken down into stages. Within each stage, input changes to output, and the methods and procedures directing the change of state (i.e. the construction procedures) can be constantly improved to better satisfy the customer at the next stage. During each stage the employees should communicate closely with their supplier and customer to optimize the work process for that stage. This requires each employee to recognize their place in the process and their respective supplier and customer.

Quality Improvement Techniques

Total Quality Management mainly demands a process of continued improvement aimed at reducing variability. An organization wishing to support and develop such a process needs to use quality management tools and techniques. It is prudent to start with the more simple tools and techniques: Check-sheet, Check list, Histogram, Pareto Diagram, Cause-and-Effect Diagram (Fishbone Diagram), Scatter Chart and Flowchart *(Ahmed)*.

Methodology

The case studies for Total Quality Management in construction industry are being analyzed and lay emphasis on how a construction industry and projects should support/approach TQM

and the need for contractors to align their culture with the objectives to improve performance based on customer satisfaction.

Case Study 1

A field survey was carried out on three large 'live' projects. Individuals involved with these projects were interviewed to ascertain their perception of the quality assurance methods, their preparation for transition to quality assurance-based method of construction, on-going support provided to them and other significant factors which were perceived to stand in the way of achieving workers' empowerment in the construction industry. Although these works address the problems and challenges of applying QA and CI to large construction projects, the findings are not unique to the construction industry, as the principles are relevant to all branches of industry.

Three projects under construction were selected for the study, comprising a large civil project, a road project and a multi-storey office building. These projects were being constructed by the leading and large construction contractors. One of the main sources of data was the comments and views expressed by the respondents to the researchers, which assisted the researchers in better understanding the prevailing attitude of the workforce to the QA and CI questions from the questionnaire *(Jaafari, 1996).*

Project 1 was a 'design and construct' contract, but the owner maintained an active hands-on site monitoring throughout the project. This project used a tailor-made set of conditions of contract and was considered closest to QA-based contracting than the others. Project 2 was already designed and documented by the owner. Its construction contract was based on general conditions of contract typically used for public construction works with special conditions added to require the contractor to carry out construction quality control and also to develop and implement a quality assurance system to provide confidence that the management process were assured. Provision of inspection and hold points as well as surveillance and verification functions, carried out zealously by the owner or his

representatives on site, meant that the owner did not generally trust the contractor; that the work was considered large and complex (for which the owner was ultimately responsible). Project 3 was an office building and was being delivered under traditional contracting with QA provisions added. There were many similarities between this and the other projects. More problems were, however, being experienced on this project compared with project 2. This was due to the nature of the works which was predominantly trade and craft-based, and were resourced by small sub-contractors, who did not generally believe that the QA was any of their concern, thus requiring a greater amount of effort to control.

The outcome of the questionnaire was that even though there was familiarity of QA in the project, the projects still required the commitment towards quality methods, overall usefulness of QA systems, lack of project specific training and poor workers' participation. The awareness of how construction industry supports TQM and developing means of implementing TQM at project level effectively was necessary, thereby achieving workers' empowerment.

TQM in Construction Industry

Strategies Needed at Industry Level

For getting industry to respond to the TQM innovation, a number of strategies may be contemplated, ranging from widespread general education and retraining of the workforce through to the adoption of specific procurement styles by the owner groups. These are not necessarily mutually exclusive but complement one another. One thing is certain; given the characteristics and behavior of the industry, successful demonstration projects are needed to convince the bulk of the industry of the value of the TQM approach that is, how to make the CI process work on projects and how to benefit from the cost saving potential of this process. The demonstration projects should be very carefully prepared beforehand and the workforce trained to operate effectively the CI process. Devices to estimate savings (whether direct or consequential), must be installed and a final cost-benefit analysis report prepared for general dissemination. Other spin offs from such demonstration projects could be a set of simple guidelines to: (i) clarify TQM; (ii) highlight how the requirements of the relevant Standards

(or QA obligations to clients) can be met, while substantial efficiencies are achieved in construction processes; (iii) show how workers' participation and empowerment can be practically achieved on construction projects; and (iv) show the processes of innovation and technology transfer, upon which much of the future competitiveness of industry reside. The relationship between technology transfer and the CI process is obvious - without continuous technology transfer there can be a limit to process improvement.

Communication for Promoting TQM at Industry Level

The communication process is perhaps the vital link between success and failure of any good idea or innovation in which the human factor plays a critical role. It is the most important element in the 'quality' revolution, as it addresses the very issue of changing people's mindsets. 'QA is an element of pride and workmanship'. Without exception, the observations on the three projects proved that the QA systems were generally seen by the workers as cumbersome; and some saw these as irrelevant to the quality of the works, or even stifling initiative and workers' participation (opposite to what one might expect from the TQM philosophy). There was also widespread disinterest in the QA and its importance at the level of tradesmen. These are clearly manifestations of the failure of the communication process at large.

The communication process at industry level must attempt to create a shared vision for the necessity to embrace TQM principles and improve the construction processes, that is, to prepare the rank and file for cultural changes. It must be honest and positive, convincing people that their future will be better served if they embrace the quality assurance and the CI innovation. It should be inspirational and targeted to the trades and technical cadre within the industry. The evidence on the case projects shows that the design professionals and consulting fraternity in industry are generally better informed and have embraced the quality innovation, perhaps due to the fact that their work was always in need of double checking due to the influence of statutory requirements. However, there is as yet no quantitative evidence linking any improvement in the quality of the finished facilities to the quality management practices of the respective design professionals. That is to say that while QA practices might reduce the incidences of errors or omissions, these will not necessarily

remedy poor design conceptualization or lack of cost competitiveness of the finished facilities.

Projects Approach to TQM

It must be emphasized that the focus is on the implementation of projects regardless of whether the detailed design and construction are carried out under a contract or separately. The assumption is that the project as a 'body corporate' can have an identity of its own, and can be improved through the application of TQM principles. Even though the project organization is made up of teams assembled from different organizations (some with own hereditary cultures), it can be constituted as a single organization and it can be capable of learning and improving during the currency of the project.

However, the extent of learning and adaptation varies considerably from project to project, and depends on whether or not a true project-specific culture can be nurtured so as to motivate the participants to function as if all are members of a single organization with clarity of vision, uniformity of objectives and cultural consistency.

TQM Strategies at Project Level

The construction manager must decide upon a series of strategies specific to the project under consideration in order to:

- create a clear and shared vision, unity of purpose and cultural consistency;
- set the scene for motivating the human factor, achieving job pride and satisfaction as well as working to the principles of total quality management on the project;
- create conditions for coalescing of the participants into an effective project organization and team capable of learning and improvement continuously during the currency of the project (i.e., development of an organizational 'conscious' and perhaps benchmarking to measure against contemporaries);
- address the means and methods of lifting the project's capabilities in terms of assurance of the quality of the works and improvement in the relevant processes (eg, through a series of targeted training workshops);

- get the project organization to allocate resources, and collectively develop, revise and implement specific TQM plans;
- develop and implement an effective and efficient communication system and procedures for getting the TQM message to those who matter most; and
- be prepared to reward good performance and share any direct and indirect cost savings on the project.

Obviously different plans will suit different settings and projects. On complex and large projects it is a good idea to actually develop a strategic plan outlining the challenges and articulating the strategies foreshadowed for the project. A strategic plan may also be feasible for groups of small to medium-sized projects which form part of an integrated program of works.

Project Specific Training

When the construction of a project involves complex or technically-complicated activities it is imperative that project-specific training is provided prior to construction. This may involve prior design of the relevant methods and processes, preparation of method statements, site trials and so on (Jaafari & Schub 1990). For the workers it implies not only having a basic understanding of the works to be constructed but participation in the decision-making process and an understanding of the operational improvements to be achieved through the continuous improvement process, while meeting the quality assurance and statutory obligations. Where there is no complexity on works to be constructed the idea of training and empowering workers is still applicable, as it allows establishment of benchmarks for productivity and efficiency considerations, particularly when large repetitive operations are involved. Overall achievement of continuous improvement on construction projects will be feasible if *(Jaafari, 1996)*:

- The rank and file (staff and workers) are generally convinced of the value and necessity of achieving continuous improvement in general;
- The system and its implementation (particularly on construction methods & standards of work to be achieved) are developed with full workers' participation in a responsive manner and following the time-honored hierarchical order within the rank and file;

- It is correctly pitched and presented in terms of the language and style; and finally,
- It is coupled with on-going specific training to facilitate workers' empowerment.

It is important to note that the project body corporate will only be successful if the rank and staffs of the workforce have had broad awareness and prior general training in their own skills and working in a QA/CI environment. The project specific training will thus concentrate on the unique construction features or stipulated requirements of a given project.

Case Study 2

A total of ten contracting organizations were approached for the nature of the research. Eight expressed an interest and a meeting was then arranged with the general manager and other senior managers to discuss the research and objectives. The contractors used for the study were considered to be well-established contractors who are capable of procuring a wide range of construction facilities *(Love and Treloar).*

The ability of the supplier to satisfy customer expectations is primarily influenced by three basic interacting factors: *people, systems and variation.* An understanding of the relationship between these interacting factors is conveyed through three principles:

1. All people serve customers through and within a system.
2. All systems are adversely affected by variation.
3. Variation impedes the ability of people in the system to satisfy customers.

These three concepts of TQM require the adoption of seven management imperatives for developing and maintaining a competitive advantage:

1. Quality is defined in terms of customer perceptions.
2. The system is improved by improving processes within the system.
3. Suppliers and contractors are treated as partners in the system.
4. Statistical thinking and methods are used to manage and reduce variation.
5. All people are creatively involved in continuous improvement of the system.

6. Continuous improvement activities are integrated within the strategic and annual planning cycle.
7. Continuous improvement is led, managed and supported at all levels in the organization.

The major findings from the case study are presented and focus on the following:

- motivation for embarking on TQM;
- planning and implementing of TQM; and
- benefits and barriers of TQM;

Motivation for embarking on TQM

The reasons for implementing TQM varied between the contractors. However, the main reason for some contractors for embarking on some form of TQM process was attributable to environmental pressures rather than the value-laden philosophy of being customer driven. This is an interesting finding since the importance of customers is part of any contemporary definition of TQM (e.g. Oakland and Sohal, 1996). Goodstein and Burke (1991) made a similar observation in their research stating that organizations tend to change primarily because of external pressure rather than an internal desire for change. Despite variations in the primary reason for adopting TQM and in some cases several attempts at its introduction, none of the contractors have disbanded TQM.

According to Low and Chan (1998) it is difficult to introduce any organizational change program (particularly TQM) without having senior leadership support. The distinguishing feature of leadership support in these cases was that these managers were passionate in their belief that TQM was strategy for gaining and sustaining a strategic competitive advantage in their marketplace. Each MD, however, reported that there was initially resistance from employees to the changes required by TQM, which meant that considerable time and effort of was spent leading (driving in some instances) the change initiative.

All of the contracting organizations viewed TQM initiatives as part of the means to respond to the competitive environment in which they were operating in and part on an on-going process to improve their organizational performance. There was also recognition that to compete effectively, the organization should first focus on issues such as improving the way in which they managed projects, marketing (specifically service quality) and increasing employee autonomy through empowerment initiatives. Essentially, it was perceived by senior management that TQM was a means to obtain such improvements.

Planning and Implementation of TQM

The common factor that had led to their failure was that the responsibility for implementing the TQM process was given to the Quality Manager, who was not part of the line management responsibility within the organization. In addition, it was found that TQM had not been integrated into the strategic planning systems of the organizations. Employees in these construction companies did not perceive the program as being part of the organizations corporate vision for quality and consequently had lacked enthusiasm for change. The reasons why the TQM programs were considered to be ineffective was primarily due to lack of a clearly shared mental model of quality and a lack of shared values and vision amongst employees in both organizations. Some contractors experienced an evolutionary approach to implementing continuous improvement programs by creating an awareness of TQM and encouraging the involvement of employees through the formation of teams. Employees were provided with training about the philosophy of TQM and its related practices. This served not to raise an awareness of the benefits of TQM but also addressed specific issues such as training in team building, process improvement and problem solving skills.

Benefits and Barriers to implementing TQM

A major benefit of initiating a TQM program reported by all contractors was that there was an increasing awareness and focus by all employees on satisfying both internal and external customers. There was an increasing focus by top management on the activities and the needs of lower level employees in the organization. Other benefits reported included improved:

- project performance (e.g. reductions in rework, waste);
- client satisfaction (e.g. repeat clients);
- market share;
- relations with customers/suppliers (e.g. partnering);
- staff morale (training and education);
- measurement of performance (e.g. internal and external benchmarking); and
- organizational competitiveness (e.g. success in bidding).

All contractors reported that the benefits of TQM were not visible during the early stages of implementation. Contractors that had started their TQM initiatives in the late 1980s and early 1990s and had not realized the financial benefits/rewards TQM can offer until the late 1990s and early 2000. Interestingly, no contractor had in place a comprehensive system for accurately measuring total costs and benefits of TQM. Rather the benefits were reported on an ad hoc basis. Employees (particularly those who were site based) showed resistance to the introduction of TQM for a host of reasons, which included fear of the unknown, perceived loss of control, personal uncertainty, 'it may mean more' syndrome, and an unwillingness to take 'ownership' and be committed to change. Other barriers that were identified included:

- perceived threat to foreman and project manager roles;
- disinterest at the site level;
- lack of understanding of what TQM was, particularly on site;
- geographically dispersed sites;
- fear of job losses;
- inadequate training;
- plan not clearly defined;
- employee skepticism; and
- resistance to data collection (rework costs, non-conformances material waste, etc.).

Lessons Learned

The contracting organizations identified a number of lessons learnt from the introduction of a TQM program, which included:

- TQM should be implemented by line managers;
- A quality improvement system has a role in improving the morale of employees;
- There needs to be a link between information technology and quality systems;
- Continued commitment to education and training;
- TQM needs to be defined and integrated with the organizations business strategy; and
- There needs to be complete commitment from the MD and senior manager team to implementing TQM. Management must drive the TQM program and gain the support from all employees by making their leadership visible.

Alignment of culture with TQM

Methods of implementing a new organizational strategy such as TQM initiatives require different change strategies and techniques at the individual, structure/systems and cultural level. It is therefore suggested that an analysis of an organization, using culture-auditing tools may help with the design of a successful TQM implementation program. An important part of the successful implementation of TQM is to review the current practices, behaviors and attitudes in the organization and assess the fit with the TQM philosophy *(Love and Treloar).*

The elements of a TQM program that can be affected by the culture of the organization are:

- Intra and inter organizational cooperation (relationships with internal and external customers and suppliers);
- Use of statistical analysis tools in managing processes and operations (the measurement of rework costs, material waste);
- Providing support and encouragement for continuous improvement (training); and
- Good record keeping and documentation (QA).

The reasons why the contractors adopted TQM, the associated planning and implementation issues encountered, benefits achieved and the limitation and difficulties with its

implementation were identified. The benefits of implementing TQM were found to emerge ten years after the initial decision to adopt TQM. These benefits included reduced rework, increased market share and improved client satisfaction, all of which are important for sustaining a competitive advantage. Most contactors however experienced difficulties with implementing TQM because it was not aligned to the organizations current structure and processes and the behavior and values of employees. Therefore, it was suggested that contractors should perform a cultural audit before implementing TQM so that corporate objectives and behaviors can be aligned to the goals of the TQM program.

Conclusions

Customer satisfaction is an important factor in the development of the construction process and the customer relationship.

Construction companies are adopting TQM to improve their performance.

The case studies represented in this paper were carried out in Australia, which is not considered a developing country; the lessons learned are very relevant to developing countries because they face the same problems when introducing TQM.

The processes of communication within the industry as a whole or within projects remain poor and neglected. The case study shows how the construction industry and projects should approach TQM.

Another case study offers a learning opportunity for contractors who are, or in the process of adopting TQM.

Customer orientation and communication skills play an important role in the overall satisfaction of the customer in the construction industry.

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