

**EXPLORING THE BARRIERS IN IMPLEMENTATION
OF TOTAL QUALITY MANAGEMENT SYSTEM IN
FLYOVER CONSTRUCTION PROJECTS IN
SRI LANKA**

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Degree of Master of Science in Project Management

Department of Building Economics

University of Moratuwa

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the
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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

Exploring the barriers in implementation of Total Quality Management System in Flyover construction Projects in Sri Lanka

The aim of this research is explore the barriers in implementation of Total Quality Management System in flyover construction projects in Sri Lanka. The research model was developed with the help of previous studies to get a guide. Identification of different factors that affect for the implementation of TQM in the construction project were identified with the guide of previous studies and the general discussion had with the experts in the industry.

A comprehensive literature was conducted to acquire knowledge on quality, to understand the quality systems used in the construction sector and to identify different factors/barriers that affect for the quality management and implementation of TQM.

To understand barriers in implementation of TQM, data was collected from employees such as project managers, engineers, surveyors and quantity surveyors who have been participated in flyover projects in Sri Lanka. The data was collected using quantitative survey and using questionnaires that were distributed by hand or through e mail.

The collected data was analyzed by using SPSS for measure the internal consistency (reliability) of the data set collected from the questionnaire survey and it gave grater internal consistency. Descriptive statistics and mean score method have been used to identify critical barriers against the TQM implementation. Based on results, 5 numbers of barriers were identified as low impacted barriers (Green zone), 13 numbers of barriers were identified as moderate impacted barriers (Yellow zone) and 7 numbers of barriers were identified as extreme impacted barriers (Red zone). The framework was developed with control measures against the extreme barriers identified in the study. In the recommendation, Trainings, team work concept, effective communication, continuous improvement, employee empowerment and employee awareness on TQM benefits are identified as major control measures.

Keywords *flyover projects, Quality, Quality Management, Total Quality Management, Barriers in Total Quality Management implementation, framework for managing barriers in TQM.*

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LIST OF ABBREVIATIONS

ISO	- International Organization for Standardization
TQM	- Total Quality Management
ASQ	- American Society for Quality
TQC	- Total Quality Control
QMS	- Quality Management System
PQP	- Project Quality Plan
SPSS	- Statistical Package for the Social Sciences
QA/QC	- Quality Assurance /Quality Control

CHAPTER 01

INTRODUCTION

1.1 Background

Quality management can be processed through Total Quality Management (TQM), which identified as a master of all the existing quality management system, because Total Quality (TQ) includes all aspects of contractor activities that must be managed properly so that the quality of work can satisfy the project owner. As per the study of Chan and Chan, (2004), Belout and Gauvreau, (2004) and Doloi and Lim (2007), resource management is very important to improve quality management, cost control and time. ISO 9001: 2008 is a quality management system that is the principle of TQM system is very popular because of its application detailed and systematic. Moreover, in its there's a need of a periodic internal quality control (Internal Quality Audit).

According to Villamil and Haddix (2015), the risk factors that lead to low quality of projects due to a lack of cooperation within the project team involved, the lack of observation of field supervisors or team, too imposing low cost and fast schedule, inflation and rising material costs. The poor quality of the project is one of the risks that must be addressed, in dealing with the risk of a much-needed project risk management (Haimes, 2005). According to Wiryodiningrat (1997), today, the ISO 9001: 2008 is to be the top choice for contractors who want to implement a quality management system consistently and systematically and ISO 9001: 2008 shows contractors have real evidence that is recognized nationally and internationally that the company actually has implemented quality management in the production process.

Quality costs can be occurred prior or later product or service completion (Love, Smith, & Li, 1999).

Construction industry naturally identifies quality in terms of "fitness for purpose" (Ho, 1995). But this provides only a functional clarification without proper explanation, and this is not a sufficient for a comprehensive QMS investigation.

TQM delivers a realistic offer to upgrade effectiveness of the organization showing how organization processes and currently it is extended to many areas in the society. As per the findings of Watermeyer (2012) and Mohsini and Davidson (1989), It is identified the reasons that are affected the lack in quality of infrastructure related to errors in organization procurement system for the construction work, which is the process of acquisition of the various resources that will realize the planned construction. Gaspersz (2001) states that the notion of quality in terms of conventional definitions generally reflects the characteristics directly from a product such as: reliability, easy to use and the notion of quality in terms of strategic definition, where quality is everything in accordance with the needs and desires of customers.

As observed, in the implementation of construction in flyover projects are encountered many construction/execution failures. Major cause of them is that the construction work is not in accordance with the specified quality standards. Construction companies need to improve the quality of the project in accordance with market needs and technological innovation. Occurrence of damage and the collapse of structures, and so forth, it happened because of the low awareness of construction work that meets the expected qualifications. The results of the investigation, many construction failures caused by failure to apply the standards of quality of the construction and the incompatibility of quality of work which generally do not follow the directives of quality that has been set in the document technical specifications of each job.

In view of the above facts, this study is directed to explore the barriers in implementation of Total Quality Management System in flyover construction projects in Sri Lanka and to establish management strategies.

1.2 Research Problem

All the governments give a due respect to develop the infrastructure facilities of the country as that is considered as an important measure in local economic

development aspects. Therefore, every country has to allocate high capital investment for these types of infrastructure developments and lots of major projects have been introduced to facilitate these developments. Most of the capitals required for these developments have been gained through foreign funds and loans, where the central governments even sign some irrevocable agreements that even the future generations of the country get affected.

Below is the areas and questions that this study expects to answer with a comprehensive literature involvement and the empirical findings of this study.

- What is the present situation of QM and TQM at construction projects?
- What are the quality management systems in construction companies?
- What are the benefits that the construction organizations or construction projects gained from QM implementations?
- What are the barriers against the implementation of TQM in flyover construction projects in Sri Lanka?
- What are the extreme barriers against implementation of TQM in flyover projects in Sri Lanka?
- What are the control measures that can be taken against the barriers of TQM?

1.3 Aim & Objectives

This research is aimed to explore the barriers in implementation of Total Quality Management System in flyover construction projects in Sri Lanka with following objectives.

- To review Total Quality Management (TQM) related to construction industry
- To identify barriers against the implementation of TQM in flyover construction projects in Sri Lanka
- To establish effective control measures in TQM to strengthen in flyover construction projects
- To develop a framework for managing barriers in TQM in flyover construction projects

1.4 Methodology

In order to achieve the above-mentioned aim and objectives following research methodology was adopted.

The research was started with carrying out a comprehensive literature survey by referring a series of journals, articles, books, conference proceedings, dissertations related to the study, government publications and World Wide Web (WWW) to get an understanding and to capture background knowledge on TQM related to the research area. Based on the literature findings, interviews were conducted with the related experts to obtain input towards the questionnaire design, especially towards identifying issues and how to manage them. Then, a detailed questionnaire survey will be carried out to determine the significant TQM issues/barriers with related to the flyover projects. Samples were selected from the professionals who were involved in the flyover construction projects from contractor's side and client's side. The data collected through questionnaire survey will be analyzed by using mean score method. Finally, interviews were conducted in order to extract expert views to confirm the questionnaire findings.

1.5 Scope and Limitations

The study is bounded only for the flyover construction projects that were conducted under separated contracts and then it narrows down to explore the barriers in implementation of Total Quality Management in flyover construction projects in Sri Lanka for certainly conduct the study.

There is only one client and one local contractor for the most of past Flyover construction projects in Sri Lanka, the all respondents are from that specific client and consultant.

1.6 Chapter Breakdown

Chapter 01 - Introduction

This chapter discusses the background to the research topic, research problem, aim and objectives, scope and limitations, methodology in brief and the organization of the report.

Chapter 02 – Literature Review

This chapter reviews the existing literature to identify the concept of TQM, TQM factors, barriers against the TQM implementation with related to the construction projects and benefits of TQM in construction.

Chapter 03 – Research Methodology

This chapter elaborates the methodology adopted for this research describing research approach, data collection and data analysis techniques in detail.

Chapter 04 – Data Analysis and Results

This chapter presents the analysis of the collected data and research findings.

Chapter 05 – Conclusion and Recommendations

This chapter concludes the achievements of research aim and the objectives and further includes recommendations and directions for further researches.

CHAPTER 02

LITERATURE REVIEW

2.1 Introduction

Total Quality Management can be identified as a tool to execute quality management and also it can be identified as a master of all the existing quality management systems, because Total Quality (TQ) includes all aspects of contractor activities that must be managed properly so that the project owner shall be satisfied with the quality of work.

In this chapter, the definitions of quality, its evolution, and brief explanations of quality audits, quality manuals, systems and plans and barriers against the quality management system implementation, are discussed. Further this will discuss an overview of ISO 9000 series and an approach to TQM using ISO as a starting point. A quality system provides a sound basis for further development of TQM.

2.2 Quality

Quality can be expressed as a different way based on the field. Simply it can be defined as being suitable for its intended purpose while satisfying customer expectations.

2.2.1 Quality Definition

According to Pyzdek (1999), quality is not having a single or generally recognized definition. Quality has been described by him with five principals. Those can be listed as below;

1. Transcendent - You know what quality is. It is not in a form to define.
2. Product-based - There is a proportional relationship between changes in quality to changes in the quantity for some preferred characteristic.

3. User based - Quality involves of the capability to fulfil customer needs.
4. Manufacturing-based - Quality (means) conformance to requirements.
5. Value-based - Quality can be defined as the degree of brilliance for a satisfactory price and its variability controlling for a satisfactory cost.

Chung (1999) described that quality is having various modes for different situations or people. it may be used to represent customer satisfaction, compliance with contractual requirements or to prescribe standards in different situations.

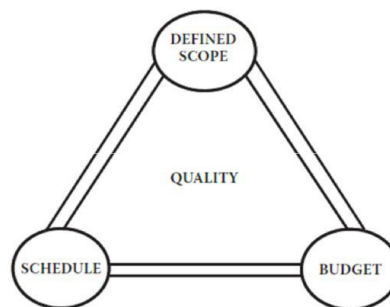


Figure 2.1 Constriction project Trilogy

(Source: A.V Feigenbaum, Total Quality Control, 1991. Reprinted with permission of The McGraw-Hill Companies.)

2.2.2 Quality Inspection

Quality Management was beginning in 1920 with inspection basis. At that time, organization practice was to allocate team of inspectors to test the products and to check whether product standards were satisfied by the product. The target of system was to identify poor quality product and to segregate it from good quality products.

Sometimes the inspection-based system was not able to find out the low-quality products and the related consequences were moved towards the customers. It was notified as a major error in the system. It was notified that inspection-based system was having below characteristics;

- Costly - Inspectors should be allocated and they should be paid and cost for repairing.

- Inefficient - Visual inspection may lead for missing
- Wrong-headed – There is a tendency to bring away the responsibility on quality from inspectors towards their inspection (Kanji and Asher, 1993).

2.2.3 Quality Control

As per the view of Feigenbaum (1991), control can be described that a process for entrusting responsibility and authority for a management activity while retaining the means of assuring satisfactory results. Further he mentions that the procedure that are used to achieve the industrial goal is named as “Quality Control” and similarly the procedure used to achieve production and the procedure used to achieve cost goals are named as “Production Control” and “Cost Control” respectively.

Above control can be listed in four steps as below:

1. Establish Standards - It includes the determination of required quality standards for cost, performance, safety and reliability for the products.
2. Evaluating Conformance - It includes the comparison of the conformance of the output (Product or service) with the related standards.
3. Acting on when needed - This includes the rectification of issues and identification of causes for those during full range of the process from design to marking of the product.
4. Arrangement of enhancements - This includes enhancement of an unending effort to improve the standards related to cost, safety, reliability and performance.

As per the findings of Kerzner (2001), QC can be described as a cooperative term for actions and practices, within the process, that are projected to generate precise quality features. Those actions are consisting of continuous monitoring process, identifying and removing issues and its' causes, use of statistical process control to decrease the inconsistency and to promote the efficiency of the process. QC endorses that the quality objectives of the organization are being achieved.

According to Juran and Godfrey (1999), quality control can be seen as a universal managerial process for directing operation, to deliver stability to avoid adverse change, to maintain constancy. The QC process assesses actual performance. Then it compares actual performance with expected targets and act on the difference.

2.2.4 Quality Assurance

According to findings of Kerzner (2001), quality assurance can be defined as the shared term for the recognized actions and managerial processes. Those are planned to ensure the level of quality of the delivered products and services. It is also consisting of efforts outside to these processes to deliver information to improve the internal processes. QA is having a function that tries to integrate the time function, cost function and scope function.

Gryna, Chua, and Defeo (2001) mentioned that QA is a process to deliver indication to ensure confidence to meet quality requirements. QA is a concept that identified as the same concept of the financial audit that delivers assurance of financial veracity.

The ultimate goal of most of construction projects is to ensure owner/user satisfaction. Quality assurance plays a vital role from design to final production or construction. Further it covers the activities like servicing, documentation. Beyond the servicing, it includes quality regulations of raw materials, inspection involvement and assemblies etc. Additionally, the commitment done by the parties such as contractor, consultant, QAQC team and design group etc. to ensure owners satisfaction, are also under coverage of quality assurance scope.

2.2.5 Quality Engineering

Based on the findings of Feigenbaum (1991), quality engineering (QE) can be identified as a body of technical knowledge. It mainly includes policy formulation to

analyze and plan the product quality and its targets to assist the quality system with ensuring full customer satisfaction at lowest cost.

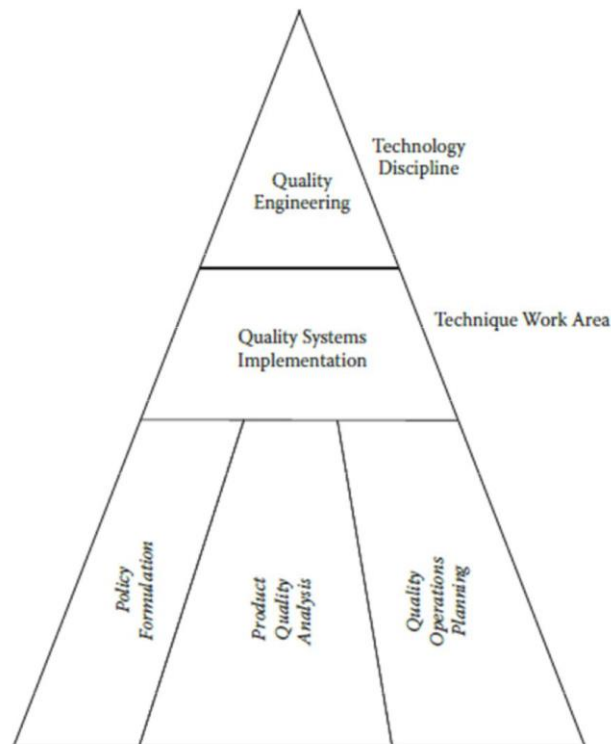


Figure 2.2 Quality Engineering Triangle

(Source: A.V Feigenbaum, *Total Quality Control*, 1991. Reprinted with permission of The McGraw-Hill Companies.)

2.3 Quality Management

According to American Society for Quality (2018), quality management (QM) can be defined by way of “the applicability of QMS in handling a process to reach maximum satisfaction of customers at the lowest possible overall and with continuous improvement process”

Pyzdek (1999) stated there are many numbers of limitations in the evolution of the quality management concept only through quality assurance perspective. The QA scope is mostly limited to the directly controlling activities of the organization such as installation, storage, transportation etc. It is identified that QA does not pay

enough attention in the competition of offerings. It creates a negative impact on the view of profit consideration.

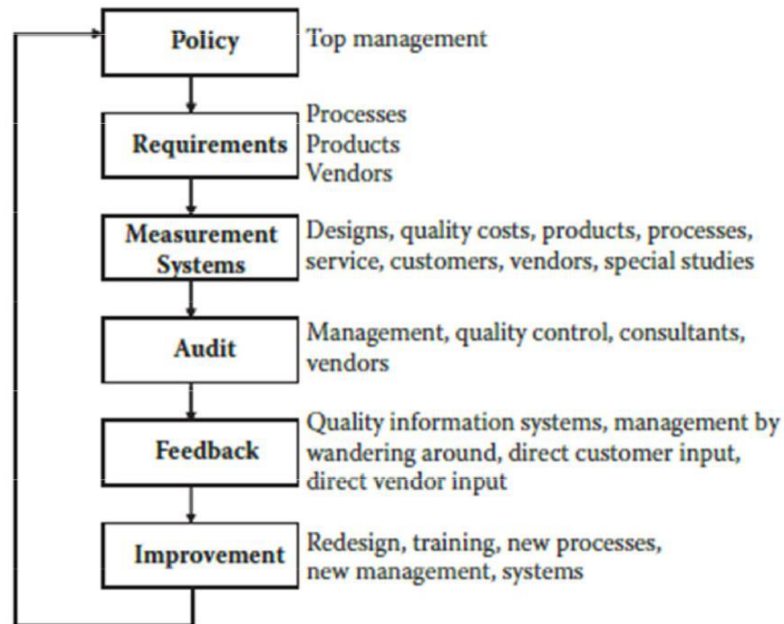


Figure 2.3 Total Quality System

(Source: T.Pyzdek, *Quality Handbook*, 1999. Reprinted with permission from Quality America, Inc.)

Feigenbaum (1991) mentioned that the Systems Engineering and Management can be identified as the basis for Total Quality Control (TQC). Implementation of TQC needs to integrate the many numbers of employee's efforts with higher numbers of machines and large amount of information. Accordingly, it is consisting of systems, questions of substantial magnitudes, and a systems approach that is integral in TQC.

2.4 Total Quality Management (TQM)

Simple way of explaining total quality is to reach required quality at lowest cost. Accordingly, TQM can be expressed as the way of obtaining total quality with the involvement of all members' daily commitment.

The following model shows one representation of this development through the phases of inspection, Quality Control, Quality Assurance & TQM. QC embraces inspection, QA embraces QC and likewise, TQM embraces QA.

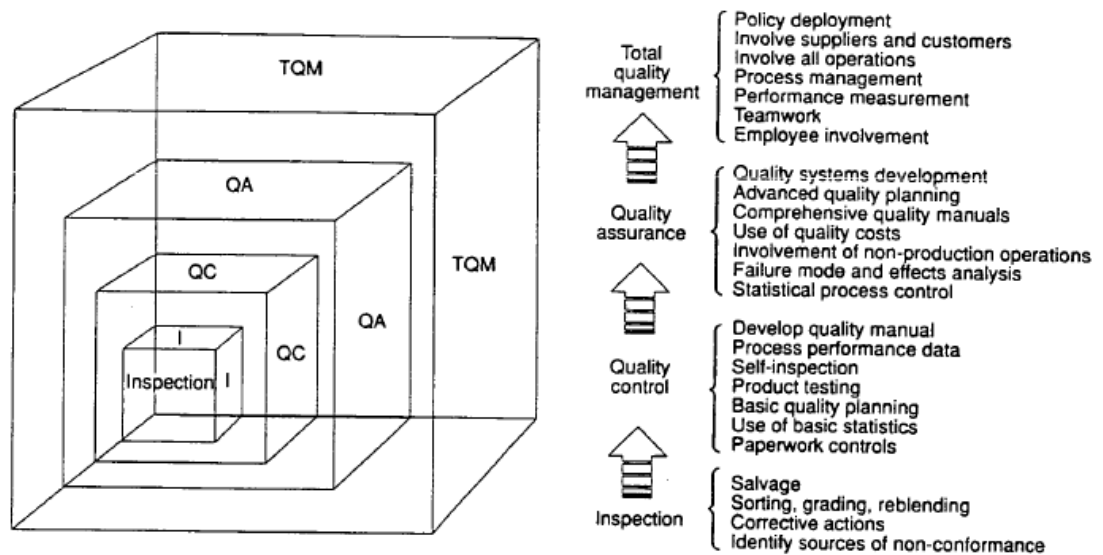


Figure 2.4 Evolution of TQM.

(Source: Dale and Cooper 1992)

According to Wilkinson (1994), total quality management can be identified as a philosophy that is derived by management from the work of the quality gurus. Basically, it includes 3 principles such as customer orientation, process orientation and continuous improvement.

Customer orientation means that TQM is oriented to fulfill customer needs and wants. Process orientation means that the input and output processes to be performed with long life improvement called continuous improvement.

Street and Fernie (1993) state that the validation added to the Total Quality Management is mainly considered the TQM benefits and how those benefits effects for the organization later. Those validations and justification for the organization are to develop total quality

2.4.1 TQM and customer satisfaction

Fox (1995) mentioned that organization can get to know about their organization, about their products, their customers and their competition with others using total customer satisfaction and further the described the way as follows;

- **Identify your customers: -**

Customers are a kind of stakeholders who deal with the products and services that are related to external or internal manner. get to know your customers. It is necessary to identify the target customers out of all customer list for better customer satisfaction. Target customers' needs and expectations are very important to be identified in the process of customer satisfaction. Continuous improvements should be adopted for the methodology of customer satisfaction since their expectations are self-motivated.

- **Clearly Understand the needs and expectations of the customer: -**

First and important part of recognizing customer's needs and expectation, is to listen carefully to the customer. The identification process should be systematic

- **Changing customer needs: -**

Customers are having dynamic nature. Hence their needs are changing always. Hence it is necessary to monitor continuously to ensure that the customer is still gratified with the product or services delivered to them.

- **Develop customer relationships: -**

Customer relationship plays a vigorous role in the process of satisfaction of customers. It is needed to pay continuous attention towards the customers and need to maintain effective communication with them. Responsiveness and supporting to customers are also crucial factor to have a continuous relationship with customers.

2.4.2 Peoples' Involvement in TQM

As per the view of Costin (1994), when employees have the authority for decision making, they will enhance their commitment to achieve organizational objectives and goals. Meanwhile Hoyle (1994) mentioned that the team of employee in the organization is the essence. Full involvement of them with their skills helps to get maximum benefits towards the organization. Hence, it is necessary to motivate all the employees for their involvement and to use their skills.

According to the studies done by Cotton (1993), it was identified that employee's participation is not well consistent on productivity. But majority of those studies found that there is a relationship between participation of employees in decision making process and their job satisfaction.

Cherrington (1995) mentioned that satisfaction of employee means the degree that employees are happy to work in their jobs. Further emphasize that the employee satisfaction must be a key performance indicator (KPI) in the organization. Interviews and questionnaire are identified as the most famous methods to measure employee satisfaction. Interviews and questionnaire surveys are identified as the methods that are used to measure the satisfaction of employees. Questionnaire survey is identified as the most effective way to measure the satisfaction of employees since it needs short time and it can be done for large number of employees at once.

2.4.3 TQM and continuous improvement

According to the studies of Round and Chi (1985), It is notified that TQM can be used as a tool to establish continuous improvement in the construction projects. The key areas for continuous improvement can be listed as below,

- It is necessary to study how to work as a team in smooth way.
- Need to proactively identify future changes and prepare to face for those without waiting last moment.

- The only goal should be met client's needs and wants. Accordingly process improvement should be aimed.
- Benchmarks are needed to set at the process enhancement to systems and monitoring should be carried out. or subsystems and implement/monitor programs.
- Root causes are needed to be identified during the diagnosis process of bottlenecks in the project.
- It is necessary to identify codependent and the integrated nature of project system and its parts.

According to Hele (2003), One of the perpetual objectives of any organization is to maintain continuous improvement of the performance of the organization. It is common for any kind of organization to survive in the business. It is necessary to take permanent actions to enhance organization's overall performance and while those actions the processes of the organizations will be more efficient and effective.

Continuous improvement can be described as a set of actions that an organization regularly implement in order to improve its aptitude to achieve the requirements. It can be met by data analyzing, processing corrective or preventive actions, performance reviewing etc. Those ways can be used to evaluate customer satisfaction as measurable tools.

2.5 Quality Management System

According to the findings of some authors such as Munns and Bjeirmi (1996), Roldao (2007), Lewis (2007) and Navas (2008), definition of the project is an activity that is unique and has a start time and end of the project, activities are not repeated, and has the goal of having a cost effective, time efficient, and the quality was good. As per the findings of Watermeyer (2012) and Mohsini and Davidson (1989) One of the factors that are identified for the low quality in the infrastructure related to errors is the procurement for the construction work, which is the process of

acquisition of the various resources that will realize the planned construction. Gaspersz (2001) states that the notion of quality in terms of conventional definitions generally reflects the characteristics directly from a product such as: reliability, easy to use and the notion of quality in terms of strategic definition, where quality is everything in accordance with the needs and desires of customers. According to Harbuck, (2004), the risk factors that affect the quality is the problem the design, specification ambiguous, construction issues, and issues a third party. Design changes caused by errors and changes in scope and specifications of the work. Kalayjian (2000) states that the project risk factors that often happens is that the project scope is ambiguous, inaccurate estimates, the boundary is not clearly, and inflation. According to Pires, Teixeira and Moura (2007), failures in construction projects due to risks related to quality. According to Gaspersz (2001), the quality management system focused on the consistency of the work process, quality management system based on prevention of mistakes that would arise, the quality management system includes Clauses: objectives, customer, output, processes, input, suppliers, and measurements for feedback and feed forward. Chau (2004) sates the things which affecting the project quality are the stakeholder's involvement for the project. Quality management systems often referred to as Quality Control and Quality Assurance. Quality Control is engineering activities and activity monitor, evaluate and follow-up order to the terms that have been set is reached, while the term QA means all planned and systematic actions applied, to reassure customers that the process of the work the contractor will meet the requirements.

2.5.1 ISO 9001: 2008

ISO 9001:2008 consists of eight clauses as follows:

- 1) Clause One: Scope in terms of this clause has emphasized the standard requirements to meet customer satisfaction
- 2) Clause Two: Normative References. This clause only contains references to be prepared by the contractor, namely:

- a. Government Regulation
 - b. The manuals on quality
- 3) Clause Three: Terms and Definitions. This Clause states that the terms and definitions given in ISO 9001: 2008 is to establish, document, implement, maintain of measures for implementation of quality management system ISO 9001: 2008 and the need for continuous improvement.
 - 4) Clause Four: Quality Management System. The general requirements in lead and run an organization needs systematic management
 - 5) Clause Five: Management Responsibility. The verse emphasizes the commitment of top management. Associated with customers, top management must ensure that customer satisfaction has been met
 - 6) Clause Six: Resource Management, Resource provider. Organizations must be able to facilitate the requirement of the resources to carryout and maintain a QMS ISO 9001, accordingly always improve customer satisfaction.
 - 7) Clause Seven: Product realization in terms of product realization planning organizations must ensure that the product realization processes are under control, in order to meet product requirements.
 - 8) Clause Eight: Measurement analysis and improvement. The general requirements in Clause 8 of the measurement, analysis and improvement, which the organization should establish a strategy and carrying out process measurement, analysis, related monitoring and related improvements to ensure product's conformity.

2.5.2 Benefits of ISO 9001: 2008 Implementation

“The QMS ISO 9001 2008. The revised outline of ISO 9001: 2008 is not too much different from its predecessor ISO 9001: 2008. As for the differences between versions 2000 and 2008 were significantly more emphasis on the effectiveness of the processes implemented within the organization” (Syukur, 2010).

Gaspersz, (2001) states that ISO 9001: 2008 is not a product standard, ISO 9001: 2008 can be called only a QMS standard and decreasing quality because of inflation factor, and also the economic cycle and in times of prosperity and the benefits of implementing ISO 9001: 2008 has acquired many companies including the following;

- Increase customer confidence and satisfaction through quality assurance of organized and systematic;
- Companies that have been certified ISO 9001: 2008 are permitted to advertise to the mass media;
- Improving the quality and productivity of management through cooperation and better communication;
- Improving the quality awareness within the company.

2.6 Quality Management System in Construction

ISO (8402) defines quality management (QM) as all doings of the throughout management function that identify objectives, quality policy and responsibilities, and carryout those for successful quality planning (QP), quality control (QC), quality assurance (QA) and quality improvement (QI), within the quality system.

ISO (8402) described quality system is that the organizational structure, responsibilities, procedures and resources needed to implement quality management.

Hence Quality Management System = Quality Management + Quality System.

Hence accordingly QMS can be described as the collaboration of people, processes, documentation etc. to fulfill the stated and implied needs of the customers. The implementation of QMS will be helpful to receive benefits such as cost savings, waste reduction, working practice and morale improvements and the better market share.

2.6.1 Company Based QMS

The various authors such as Low and Goh (1994), Low and Hennie (1997), and Abdulaziz and Tawfiq (1999) had notified the benefits receiving to the construction companies which were having ISO 9000 certification and some authors had focused their studies at the issues encountered by the organizations and they had found that most of issues were raised at the initial stage of the implementation of ISO 9000. General benefits received by the construction companies can be listed as below;

- Improving communication;
- Reduction on rework;
- Savings on time and money;
- Improve performance of the working;
- More opportunity to increase market share.

Some authors such as Low and Hennie (1997), McCabe (1996), Oakland (2000) and Giles (1997) have recognized some barriers identified in the construction industry, during ISO 9000 implementation. Those can be summarized as below;

- Employees do not like to change their way of working (Resistance to change);
- Quality is kept on a place where secondary/apart to their business;
- It looks so complex for understanding of ISO 9000;
- It has to be spent high initial cost;
- Additional time spending for new system learnings;
- Employees see it as an additional workload beyond their regular duties;
- No inspiration from the construction

It is observed that most of studies are based on company based QMS. It is literally proven that ISO certified construction companies are getting benefits with the implementation of their QMS.

2.6.2 Project Based QMS

Project-based QMS- ISO 9000 is a virtual term since QM or TQM is organizational based. The origin of most of quality processes are from manufacturing industry and those quality processes were company based. But it cannot be applied for construction industry since most the constructions are based on project basis with the involvement of different parties

According to Barrett and Grower (1998), The quality of the product or service done by the companies that have achieved certification, is relatively high from client's point of view and further the certification does not care the factors like personal appearance, technical excellency from the client, communication frequency, personal interest, supporting politeness, presentation standard, supporting staff appearance etc.

Netto, Low, & Lo (1997) mentioned that the contract agreement is the document that used traditionally to manage the relationship among the parties incorporated with the construction project and those agreements involves the traditionally accepted roles by the industry.

Low and Goh (1994) mentioned that the modification can be applied on the existing contract as Nesan (1995) highlighted as structure of the contract which fitting the associating arrangement, should be advanced to provide the environment of TQM.

Although there are some complications on the implementation of QMS in a construction project, it does not imply that quality management system should not be applied at the project level. Implementation of TQM by the certified organizations give the evidences that those organizations are enjoying with the benefits and advantages of TQM implementation.

2.6.3 Project Quality Plan (PQP)

Project quality plan is designed and used to ensure that the quality processes are well functioned at project level. It seems that quality management system and project quality plan are having approximately same content for individual organizations. Even though as a practice, POP is prepared to enhance quality management at project level. The objective of the project and responsibilities of the parties involved, should be corresponded with the definition of the quality for effective implementation of project quality plan.

Stebbing (1993) mentioned that QMS can be divided into two categories as per the below figure 2.5 called the organization quality system and project quality plan. Company quality system includes company quality manual and procedures. Those procedures are created according to the requirements of the company and its client. Similarly, project quality plan is created according to the work scope of the contract and company procedures.

It is needful to get a clear picture of the quality manual to prepare project quality plan. As Stebbing (1993) mentioned project quality plan consists of same contents as quality manual even though POP may be incorporating with some additional procedures and some documents.

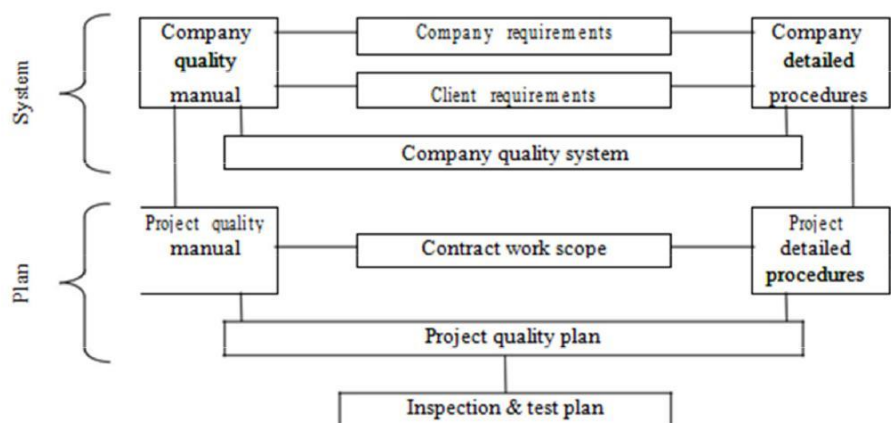


Figure 2.5 Organization Quality System and Plan

(Source: Stebbing, 1993)

Stebbing (1993) mentioned that the project quality manual should be incorporated with below points;

- The organization should be related to the project and customer representation should be included;
- Project manager or contract manager must sign on the quality policy of the specific project;
- Requirements of the project should be reflected by the definition of the responsibilities;
- Quality policy of the project should be reflected by the policy statement;
- The amendments of the contract or reissuing of the contract should be fulfilled the requirements of the contract;
- Applicable criteria of the quality standard will be addressed by the system outlines;
- The procedures that are related to the contract, will be recognized by the procedure index.

2.6.4 The Quality Planning Steps

According to Juran & Godfrey (1999), It is found that the 12 steps of quality planning as below;

Step 1 - Quality planning should be started with the project establishment.

Step 2 - Secondly related customers should identify.

Step 3 - Needs and wants of the identified customers should be captured.

Step 4 - Accordingly, analysis should be done and customer needs should be prioritized.

Step 5 - A product should be created to fulfill customer needs.

Step 6 - Product features should be optimized to meet customer satisfaction and product range of the organization.

Step 7 - The process and its goals are needed to identify.

Step 8 - The process should be developed to create that product.

Step 9: Goals and process features should be optimized.

Step 10 - It is needed to get confirmed that the product can be created through the process and under above operating condition.

Step 11 - Further control measures should be detected.

Step 12 - Finally, process should be transferred to the operation mode.

2.7 Barriers against the implementation of Quality Management System

The barriers against the implementation of Quality Management System identified in the literature study can be described as below;

2.7.1 Organizational culture barriers

Oakland (2000) mentioned that the culture of the organization is consisting of behaviors and those behaviors are coming from norms coming from working teams, rules followed by the organization, interactions of the people in the organization and through leading values endorsed by the organization.

AI-Khalifa and Aspinwall (2000) states that an organization's culture creates a platform for establishing and amending behaviors and values estimation is very useful to strengthen the structure of the organization.

According to Dale (1999), the cultural barriers are the most critical barriers to restrain to have effective implementation of total quality management in the organization.

2.7.2 Lack of Information and communication

Goetsch and Davis (2000) described the communication is that the transmission of a message such as information, idea, reaction, intent and sense that is both acknowledged and understood.

Daft (1997) highlighted the organizational communication is that the process by which information is swapped and understood by more than one person, usually with the intent to motivate or inspiration behavior".

Samson (1997) states that when there is a lack of information sharing between management and their employees to carry out improvement activities, it is identified as a barrier for TQM implementation.

Brown (1993) mentioned that one of foremost barriers to implement total quality management system is identified as the lack of incorporation between quality information system and existing management information system.

2.7.3 Lack of customer satisfaction

Milakovich (1990) mentioned that customer satisfaction plays a vital role in successful TQM implementation. Further customer satisfaction can be considered as an approach to emphasize total satisfaction using continuous improvement.

As per the findings of Hellard (1993), Maloney (2002) and Fewing (2005), it is emphasized the customer satisfaction and the use of it to appraise the quality through the perspective of the customer.

Construction companies use total quality management to enhance their effectiveness of work and the performance. Customer satisfaction measurement is a key factor to evaluate that the implementation of total quality management is effective or not.

Milakovich (1990) sates that it is management responsibility to determine customers' needs and wants and then it is necessary to convert them to TQM

requirements under customer satisfaction. Further he mentioned that It is important to communicate the achievement of customer requirement all over the organization.

2.7.4 Organizational culture and its change

The organizational culture can be described as how employees of the organization behave with the revolution of a present management system.

Ghobadian and Gallear (1997) highlighted that culture of an organization can be affected with some barriers as below;

- Policies and procedures' regular revisions;
- Training programs and improve education;
- Behavior of the top management;
- Communication programs' improvements;
- Evaluation system's adjustments and reward system's adjustments;
- Involvement of the employee to their job.

Low and Winifredo (2000, p.134) states that the working of quality departments in construction projects can be affected by the cross- cultural influences. How cross

cultural influences are affected to the quality department can be illustrated as below;

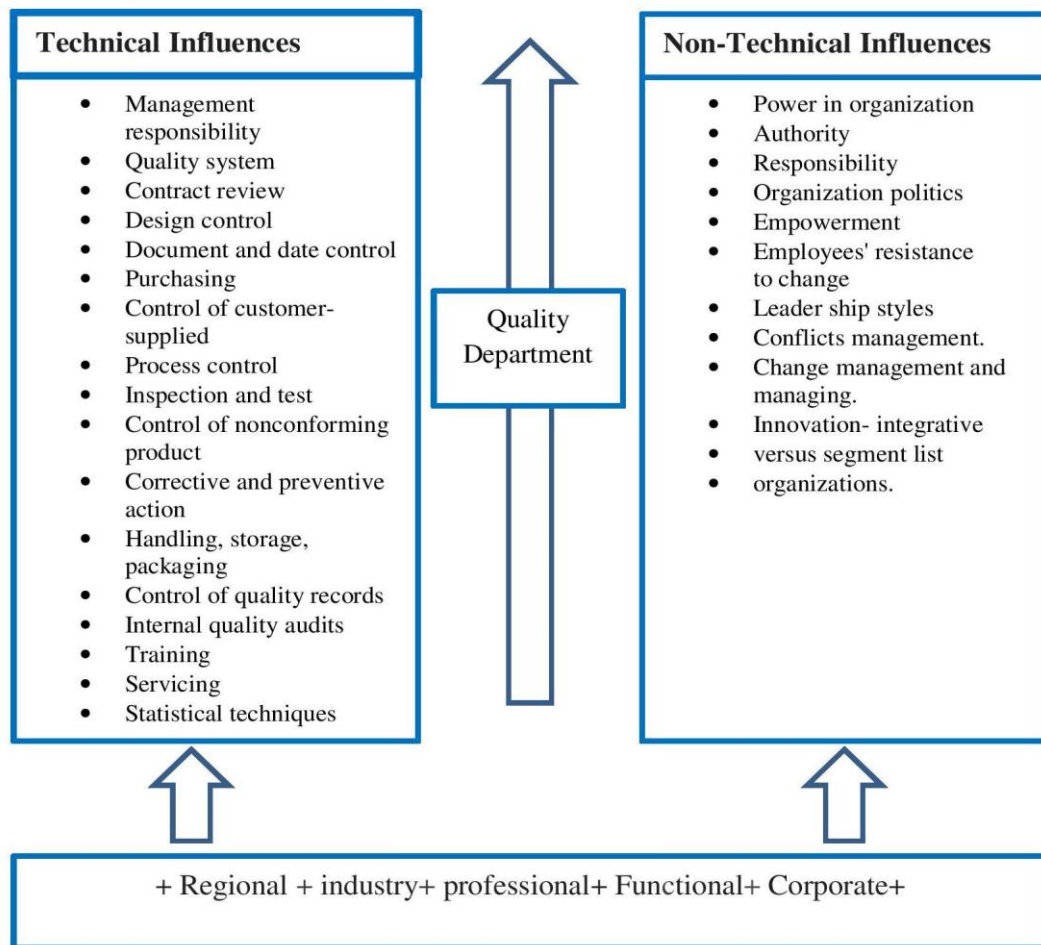


Figure 2.6 Cross- cultural influences on quality department

(Source: Low and Winifredo, 2000)

As per the findings of Brown (1995), organizational culture can be used as an influential tool to enhance performance of the organization. Further it can be used as a crucial factor to effective leadership and towards development of the organization.

2.7.5 Lack of motivation system and reward

Ellerker (1998) mentioned that the motivation system can be separated into two techniques as tangible technique and intangible technique. The meaning of tangible is to show the levels of gratitude of the commitment made to the work, the behavior appreciated by management and the attitude of the organization towards performance and individual achievements. The staff, especially in the areas of work of greater competition.

Low and Pan (2004) highlighted some findings using the study done on Singapore organizations that when an employee is not treated with enough recognition, admiration and reward for a respectable commitment made to reach quality objectives, it will be a cause to create a barrier for effective implementation of ISO 9001 :2000.

Ngai and Cheng (1997) identified that in many organizations, lack of recognition and fugacious reward systems create more barriers in the implementation of total quality management. Those make disturbances when new managerial approach and associated quality practices are going to be implemented.

CHAPTER 03**RESEARCH METHODOLOGY**

3.1 Introduction

Through this chapter, it is discussed the procedure, used for this research study. Further it expands the research process and consequently describes the research design including research approach, data collection and analyzing techniques in detail.

3.2 Research Process

Research process consists of a series of steps in the desired sequence that is necessary for the effective execution the research (Kothari, 2004).

It was started with background study which was helpful to identify the research problem, Aim and Objectives. Then detailed literature survey was carried out. Data collection was carried out as Preliminary Survey, Question are Survey and Expert Interviews. After that data analysis was done based on the results received from surveys. Finally conclusions and recommendations were made based on analysis and interview comments.

Research process for this particular research illustrates using following flow chart.

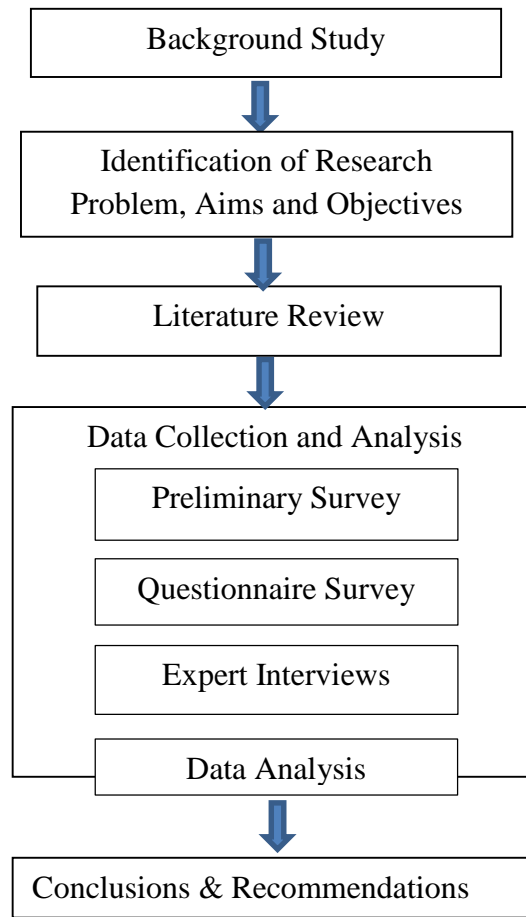


Figure 3.1 Research process

3.3 Research Strategy

Research strategy set up methodical procedure to address the research problems as definitely as possible. It may be either quantitative approach with stress on gathering of arithmetical data and focus on numbers or qualitative approach with emphasis on analysis of complex data in terms of its content or native interpretation (Taylor, 2010). The following sections explain the research design for this research study.

3.3.1 Research approach

Research approaches are classified mainly into two categories namely quantitative approach and qualitative approach. Survey researches and experimental researches are coming under quantitative approach where case study, ethnography, action research and grounded theory approach can be taken under qualitative approaches (Taylor, 2010).

In view of the nature of research problem, it is sensibly highly important to identify the significant total quality management barriers affecting to the flyover projects in Sri Lankan context and to recognize control measures to overcome identified barriers. Accordingly, survey research approach is designated as the most appropriate for this study. It involves data collection from a fraction of population (sample) and then the data findings will be simplified with quantitative descriptions to the population (Kraemer, 2002).

3.3.1.1 Survey Approach

Research problem is the leading criterion of selecting among the various types of research approaches According to Yin (2009). Kraemer (2002) stated that survey research can be used to answer the questions such as “what”, “how much”, “how many” etc. In addition, he mentioned that the survey approach is appropriate when:

- The variables (independent and dependent) are difficult to control;
- The phenomenon should be analyzed at its natural setting;
- The phenomenon which is studied is occurring or has occurred in the recent past.

Rendering to the research, it is significant to quantitatively investigate and identify total quality management barriers which are affecting to the flyover projects and figure out response measures to overcome the barriers. Above mentioned characteristics of survey approach are standing with the characteristics of this research, proving that survey approach is applicable to this research.

It is planned to carry out a questionnaire survey to discover the TQM barriers with related to the flyover construction projects. Following the analysis of questionnaire, interviews were designed to carry out with individual experts in order to confirm the questionnaire survey findings and to find out the response measures for each critical total quality management barriers.

3.3.2 Data collection

3.3.2.1 Preliminary survey

After preparing the draft questionnaire based on the literature findings and preliminary survey which was conducted with contractor's officials and client's officials in order to find out the present dominant condition of TQM in flyover projects and to identify barriers related to flyover projects other than factors identified by the literature survey. For achieving objectives of the research, five experts were selected in the field of flyover construction projects and identified barriers in TQM from the literature survey were discussed with them and from their opinions most relevant factors in the Sri Lankan context were identified.

Below, Table 3.1 shows the identified barriers related to TQM in flyover construction in Sri Lankan context.

Table 3.1 Identified Barriers related to TQM in flyover construction

Issues/Barrier Category	Factors
Policy	Generally, there is a lack of commitment from top management to TQM
	Top management does not wish to adopt the concept of TQM to the project or organization.
	Employee involvement for the management decisions is not enough.
	The industry/organization is not releasing enough time for TQM.
	Managers' promotions are not on the basis of qualifications in the organization.

Requirement	Communication between departments is ineffective
	Cross functional cooperation among departments is not functioning well.
	Quality objectives are not clearly identified to employees.
	TQM gives extra workload to maintain QM (quality management).
	Future strategic vision on TQM is not there in the organization.
Measurement System	Organization is not dealing with adequate technology and well-QM practices
	Implementation and learning of TQM systems are not easy.
	Organizational structure is not developed well for the implementation of TQM.
Audit	The field does not have enough well qualified local TQM consultants.
	The employees see the implementation of TQM system as a tool to criticize their commitment and performance.
	No leadership is observed regarding quality issues in construction sector.
	Different departments have different operating systems.
Feedback	There is no customer feedback system.
	Generally, the organization does not act well on the feedbacks received from the customers.
	The communication from senior management to employee level is not transformed well.
	Employee's attitude is to follow the instructions rather than creating new proposals to enhance the productivity at their jobs.
Improvement	Employees do not receive enough financial funding from top management to apply and to develop quality programs.
	Generally, organization does not reach to training goals.
	Generally, employees are undergoing on training without a clear objective.
	Organizational/project employees resist changes to QMS (Quality Management System) in the organization.

3.3.2.2 Questionnaire survey

Target population

Professionals from contractor's side and client's side including Project Managers, Engineers, Surveyors and Quantity Surveyors who have been participating in flyover construction projects in Sri Lanka are the target population considered to the study.

Sample selection

The sample was selected randomly from the list of project managers, engineers and quantity surveyors who are involved in Flyover projects. The contacts for these professionals were collected from project management division of contractor's side and bridge division of client's side.

This research study approached to the key persons

- having more than 10 years of experience,
- have been involved in flyover projects

Sample profile can be listed as below Table 3.2;

Table 3.2 Sample Profile used for the Questionnaire Survey

Designation	No. of Participants
Project Managers/Project Directors	7
Engineers	20
Surveyors	4
Quantity Surveyors	9

Sample size

The sample size is significant in reflecting the characteristics of the population and in order to use parametric statistics, the size of the sample must be sufficiently large (Taylor, 2010). As thumb rule, it should be at least 30. By considering all these factors and the time limitation the sample size of this research study was 40 selected from project managers, engineers, surveyors and quantity surveyors in flyover projects.

Questionnaire design

The list of appropriate barriers against the implementation of TQM in flyover projects was developed on the basis of preliminary survey details and the detailed literature review. Then, the questionnaire was structured to get the owners' perception with related to flyover projects in Sri Lanka.

The questionnaire consisted of two sections namely 'Section I', 'Section II'.

Section I – Demographic characteristics

The Section I was intended to gather information about the respondents' profile. Accordingly, the questions asked in this section includes the respondent name (Q1), respondent designation (Q2), respondent educational qualification level (Q3), respondent experience in construction industry (Q4) and years of experience in flyover project (Q5).

Section II – Barriers in implementation of TQM

The section II was designed to gather perception on the barriers against implementing TQM in flyover projects in Sri Lanka. These set of questions brings the answers from respondents about the opinion on a range of barriers against the implementation of total quality management at the project and organizational level. Further it would be helpful to get an understanding of the ongoing quality practices within the organization. The questionnaires have used 5 points as below;

- 5 = Strongly Agree
- 4 = Agree
- 3 = Neutral
- 2 = Disagree
- 1 = Strongly Disagree
- 0 = Not Applicable

Conducting questionnaire survey

The final questionnaire was delivered to professionals associated with flyover projects by hand as well as through emails. The completed responses were collected by personally and received through emails and regular postal mails.

3.3.2.3 Expert survey

Following the analysis of questionnaire survey, an expert interview was conducted in order to find the control measures for most significant TQM barriers identified in flyover projects. The interviews were conducted based on extreme barriers in unstructured type. The number of interviews were decided by the consideration of the research objective completion and time allocation. Accordingly, five numbers of interviews were conducted.

3.3.3 Data analysis

The method used for the data analysis is statistical analysis with the help of SPSS software and Mean Score method.

3.3.3.1 Reliability calculation of used data**Cronbach's alpha**

In statistic cronbach's alpha is used to measure the internal constancy or reliability of a psychometric test score for sample of respondents (www.en.wikipedia.org, 2015; Garson, 2002).

A commonly accepted rule of thumb for describing internal consistency is as follows;

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N - 1) \cdot \bar{c}}$$

- N : number of components (items or testlets)
 \bar{v} : average variance of each component (item)
 average of all covariance between the
 \bar{c} : components across the current sample of
 persons

Equation 3.1: Cronbach's alpha

3.3.3.2 Identification of critical barriers

The identification of critical barriers were done using descriptive analysis as described below.

Descriptive analysis

Descriptive statistics is consisting of data arrangement, data summarization, and data presentation, to create meaningful picture to help decision making through graphical techniques such as graphs, charts, percentages, tables and descriptive measures including mode, median, mean, range etc. (Taylor, 2010).

Section B of the questionnaire was analyzed using graphical analysis techniques. The used techniques were clustered column charts and pie charts.

Mean Score Method

Mean score method was used to compute the magnitude of each factor. The formula used for this method is as follows (Tiware & Kulkarni, 2013);

$$\text{Mean Score} = \Sigma (f * s / N)$$

Where, f - frequency of the respondent

s - Score given by the respondent

N - Total number of responses

Above formula was adopted to analyze the data in “section B” of the questionnaire to find the mean score for each barrier.

Scale used to identify Impact of TQM barriers

Table 3.3 shows the scale that used to identify impact levels based on magnitude of mean score and Table 3.4 shows the legend;

Table 3.3 Scale used to identify Impact of TQM barriers

Scale	Impact Level	Impact Zone
0 – 2	Low Impact	Green
2-4	Moderate Impact	Yellow
4 – 5	Extreme Impact	Red

Table 3.4 Legend - Zones Vs Impact of TQM barriers

Green zone	Impacts in this zone are relatively low. Hence it can be ignored
Yellow zone	Impacts in this zone are average. Those can cope with some reasonable steps and developing management strategies in time.
Red zone	Impacts in this zone are very high. These should be handled on top priorities and close attention.

3.4 Summary

This chapter has explained the research methodology that was adopted to meet the aim and objectives of the research study. Through an extensive literature survey, it was studied issues and mitigations and actions related to the construction of construction projects. Identified issues from the literature survey were further discussed with experts of flyover construction projects who are having experience over 10 years and the control measures were also identified.

The research methodology was the survey approach. Data collection was done using questionnaire survey. Further unstructured interviews were carried out for confirmation of findings. The reliability of collected data was tested by using cronbach's alpha. Mean score method was used to recognize the magnitude of the barrier against the implementation of TQM in flyover construction projects.

CHAPTER 04**DATA ANALYSIS AND RESULTS**

4.1 Introduction

Above chapter three described the research methodology adopted for collecting and analyzing data. Through this chapter, it is analyzed the collected data from the questionnaire survey in accordance with the above-mentioned methodology.

This chapter contains main five sections. First section summarizes the findings of the preliminary survey. Second section is for the analysis of respondent information in questionnaire survey. Next section includes the analysis of each barrier against TQM using mean score method to identify the predominant barriers to implement Total Quality Management System in flyover construction projects. Fourth section analyzes the response measures for TQM barriers and last section confirms the questionnaire findings through literature, observations, general discussion with experienced field personals and expert interviews.

4.2 The Questionnaire Survey**4.2.1 Response rate**

The questionnaire survey was carried out by delivering forty (40) questionnaires to project managers, engineers, quantity surveyors who were selected as mentioned in section 3.3.2.2 (Questionnaire survey). Out of forty (40) distributed questionnaires, thirty-six (36) questionnaires were returned however, one of them was not properly completed, thus only 35 were selected to use for the analysis. Accordingly, the response rate of completed questionnaires is 87.5%. Completed questionnaires included the responses from seven Project Managers and Project Directors, Sixteen Engineers, four Surveyors and nine Quantity Surveyors.

4.2.2 Reliability of the used data

As explained in previous chapter Cronbach's Alpha was calculated using a statistical analyzing software called SPSS (Statistical Package for the Social Sciences) for measuring the internal consistency (reliability) of the data set received from the questionnaire survey. Cronbach's alpha is calculated using the received scores for the barriers against to TQM in flyover construction projects in Sri Lanka. According to the test results Cronbach's alpha values is 0.86. Gliem and Gliem (2003) mentioned that if the coefficient of Cronbach's alpha is closer to 1.0 gives good internal consistency of the items in scale.

The results generated by SPSS software, can be shown as below;

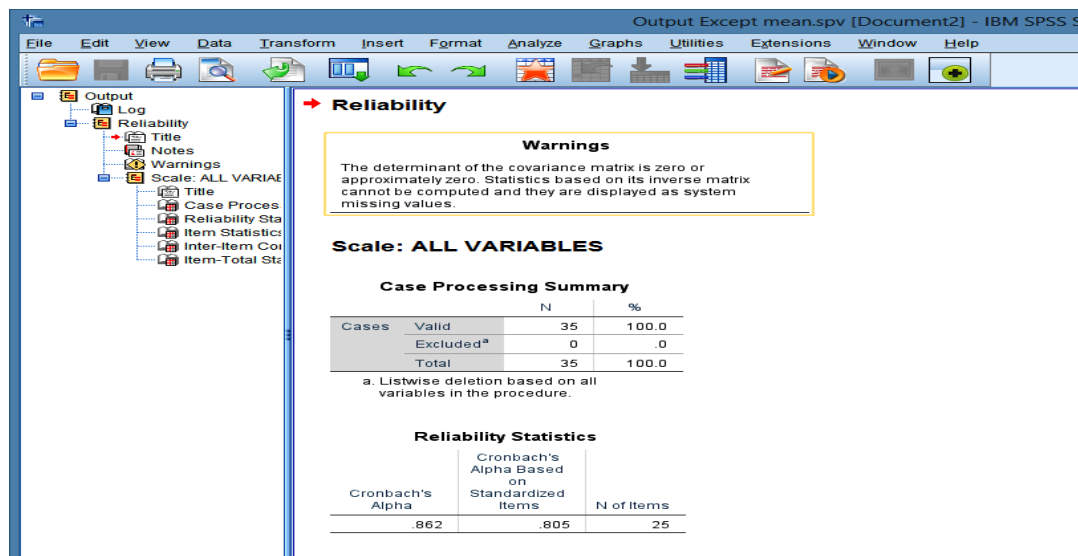


Figure 4.1 Cronbach's alpha value for the Data generated from IBM SPSS Static Data Editor software

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
VAR1.a	57.6286	105.064	.379	.	.859
VAR1.b	58.0571	107.232	.158	.	.867
VAR1.c	55.9429	115.114	-.274	.	.873
VAR1.d	57.4286	106.252	.310	.	.860
VAR1.e	57.6571	107.644	.294	.	.861
VAR2.a	57.4286	111.605	-.024	.	.868
VAR2.b	55.9429	116.408	-.420	.	.874
VAR2.c	57.5143	109.198	.170	.	.863
VAR2.d	58.9714	95.617	.836	.	.843
VAR2.e	57.9429	106.055	.216	.	.865
VAR3.a	58.3714	86.946	.734	.	.844
VAR3.b	58.9714	95.617	.836	.	.843
VAR3.c	58.8286	92.617	.807	.	.842
VAR4.a	58.9714	95.617	.836	.	.843
VAR4.b	58.9429	95.350	.873	.	.842
VAR4.c	58.9143	95.139	.874	.	.842
VAR4.d	55.8857	115.575	-.361	.	.872
VAR5.a	58.5714	99.487	.538	.	.853
VAR5.b	58.9429	95.350	.873	.	.842
VAR5.c	55.8286	110.205	.119	.	.864
VAR5.d	55.7429	111.197	.021	.	.866
VAR6.a	58.8286	94.852	.716	.	.846
VAR6.b	55.9429	112.820	-.119	.	.868
VAR6.c	58.8571	94.891	.785	.	.844
VAR6.d	55.9429	113.114	-.137	.	.869

Figure 4.2 Cronbach's alpha values for each barrier, generated from IBM SPSS Static Data Editor software

4.3 The Expert Survey

4.3.1 Interviewee Information

The detail of the interviewees participated in the interview survey is indicated in Table 4.1 below;

Table 4.1 Details of experts

Ref No	Experience	Number of FF projects Involved	Designation
R1	18 Years	08	Project Manager
R3	20 Years	13	Deputy General Manager
R6	22 Years	12	Project Manager
R9	25 Years	15	QA/QC Manager
R14	25 Years	14	Project Director

4.4 Critical Barriers against TQM in Flyover Construction Projects

Mean score of respondents was calculated for each barrier related to implementation of TQM in flyover construction projects in Sri Lanka. As mentioned in the chapter 03, Table 3.2, it will be categories into few categories based on impact level. The results can be shown by following tables and figures.

4.4.1 Policy Related Barriers

The responses received from questionnaire survey regarding policy related barriers can be listed as follows;

Table 4.2 Policy related barrier's Mean scores

No	Barrier	Mean Score
1.a	Generally, there is a lack of commitment from top management to TQM	2.51
1.b	Top management does not wish to adopt the concept of TQM to the project or organization.	2.03
1.c	Employee involvement for the management decisions is not enough.	4.09
1.d	The industry/organization is not releasing enough time for TQM.	2.71
1.e	Managers' promotions are not on the basis of qualifications in the organization.	2.40

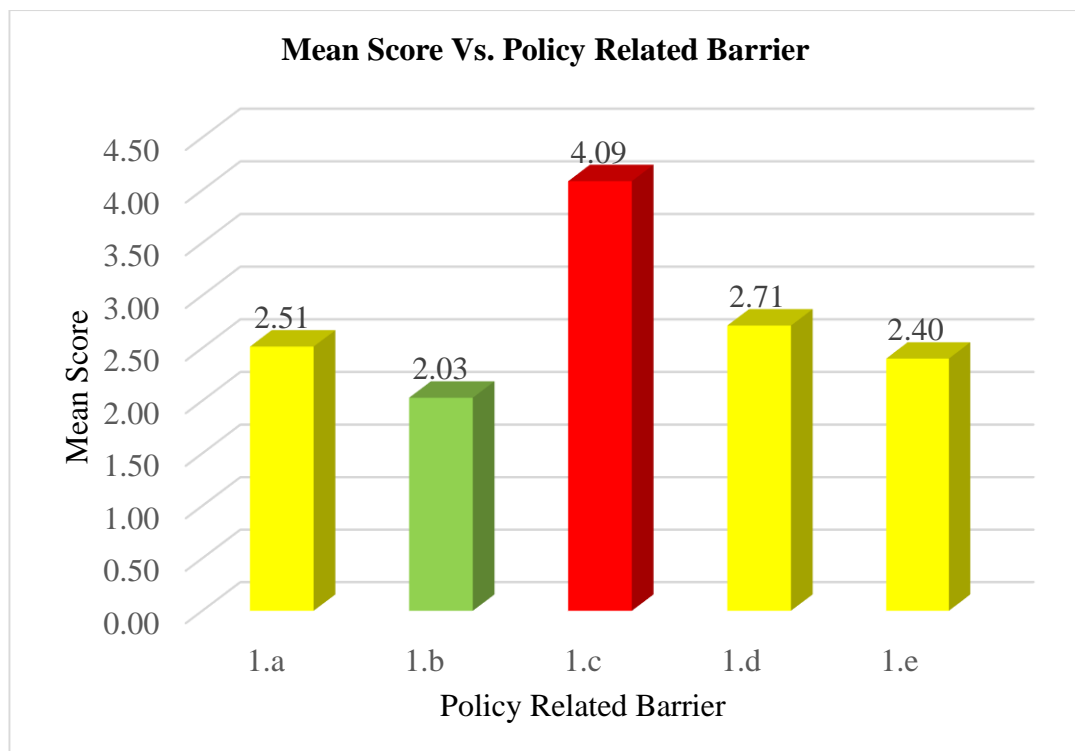


Figure 4.3 Mean scores of policy related barriers

4.4.2 Requirement Related Barriers

The responses received from questionnaire survey regarding requirement related barriers can be listed as follows;

Table 4.3 Requirement related barrier's Mean scores

No	Barrier	Mean Score
2.a	Communication between departments is ineffective	2.77
2.b	Cross functional cooperation among departments is not functioning well.	4.00
2.c	Quality objectives are not clearly identified to employees.	2.57
2.d	TQM gives extra workload to maintain QM (quality management).	1.11
2.e	Future strategic vision on TQM is not there in the organization.	2.09

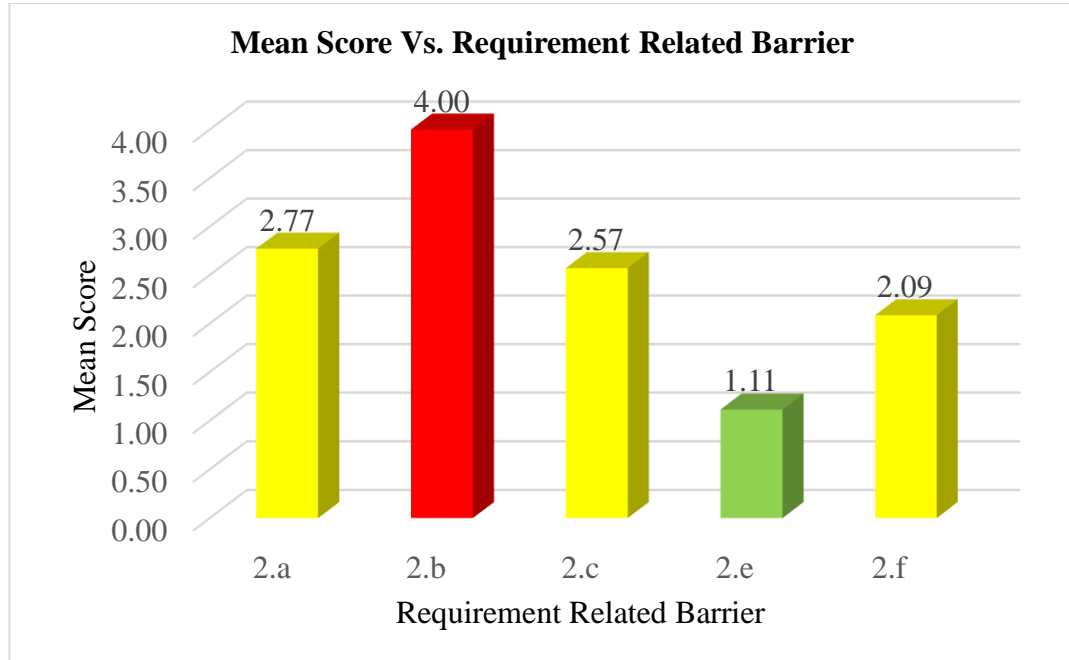


Figure 4.4 Mean scores of Requirement related barriers

4.4.3 Measurement System Related Barriers

The responses received from questionnaire survey regarding measurement related barriers can be listed as follows;

Table 4.4 Measurement related barrier's Mean scores

No	Barrier	Mean Score
3.a	Organization is not dealing with adequate technology and well-QM practices.	1.71
3.b	Implementation and learning of TQM systems are not easy.	1.37
3.c	Organizational structure is not developed well for the implementation of TQM.	2.69

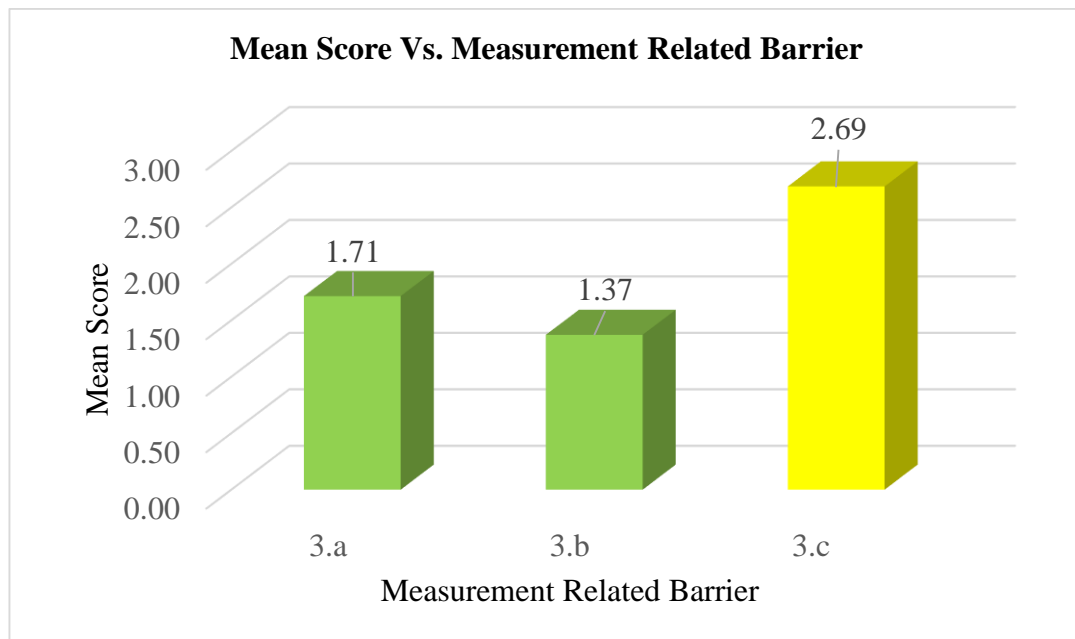


Figure 4.5 Mean scores of Measurement related barriers

4.4.4 Requirement System Related Barriers

The responses received from questionnaire survey regarding requirement related barriers can be listed as follows;

Table 4.5 Requirement related barrier's Mean scores

No	Barrier	Mean Score
4.a	The field does not have enough well qualified local TQM consultants.	2.77
4.b	The employees see the implementation of TQM system as a tool to criticize their commitment and performance.	2.80
4.c	No leadership is observed regarding quality issues in construction sector.	2.94
4.d	Different departments have different operating systems.	4.03

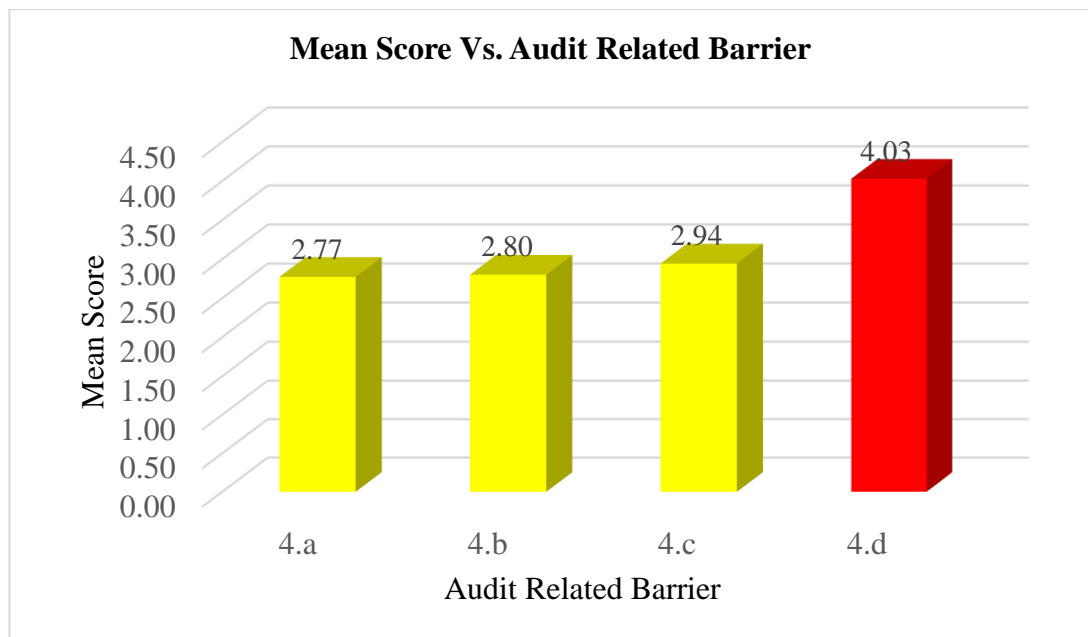


Figure 4.6 Mean scores of Measurement related barriers

4.4.5 Feedback Related Barriers

The responses received from questionnaire survey regarding feedback related barriers can be listed as follows;

Table 4.6 Requirement related barrier's Mean scores

No	Barrier	Mean Score
5.a	There is no customer feedback system.	1.49
5.b	Generally, the organization does not act well on the feedbacks received from the customers.	2.54
5.c	The communication from senior management to employee level is not transformed well.	4.09
5.d	Employee's attitude is to follow the instructions rather than creating new proposals to enhance the productivity at their jobs.	4.23

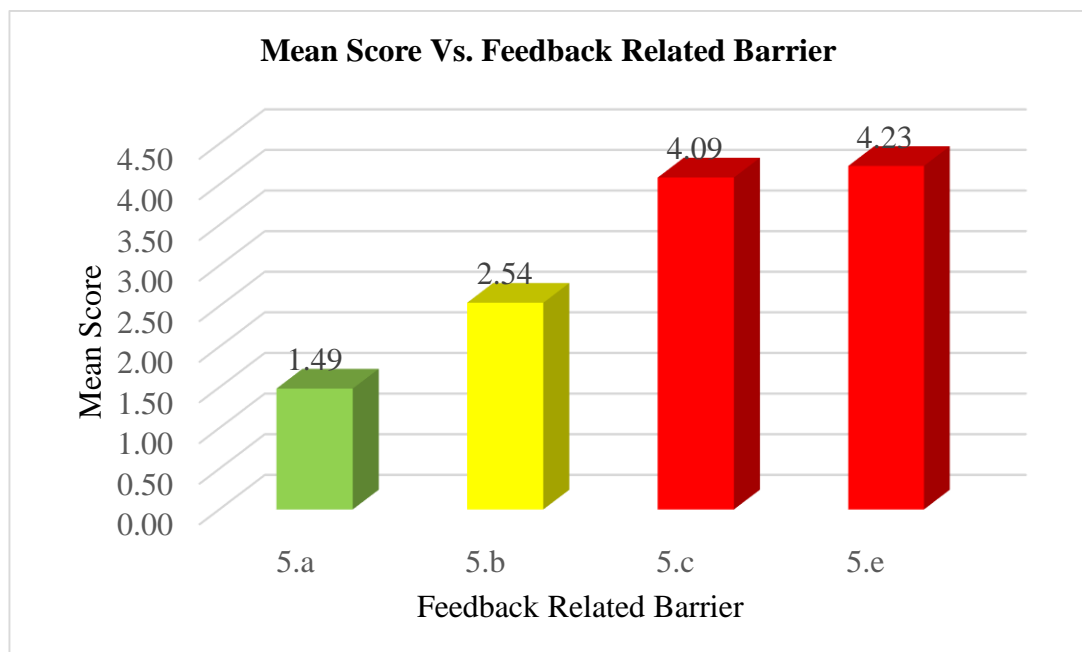


Figure 4.7 Mean scores of Feedback related barriers

4.4.6 Improvement Related Barriers

The responses received from questionnaire survey regarding improvement related barriers can be listed as follows;

Table 4.7 Improvement related barrier's Mean scores

No	Barrier	Mean Score
6.a	Employees do not receive enough financial funding from top management to apply and to develop quality programs.	2.43
6.b	Generally, organization does not reach to training goals.	4.06
6.c	Generally, employees are undergoing on training without a clear objective.	2.34
6.d	Organizational/project employees resist changes to QMS (Quality Management System) in the organization.	4.11

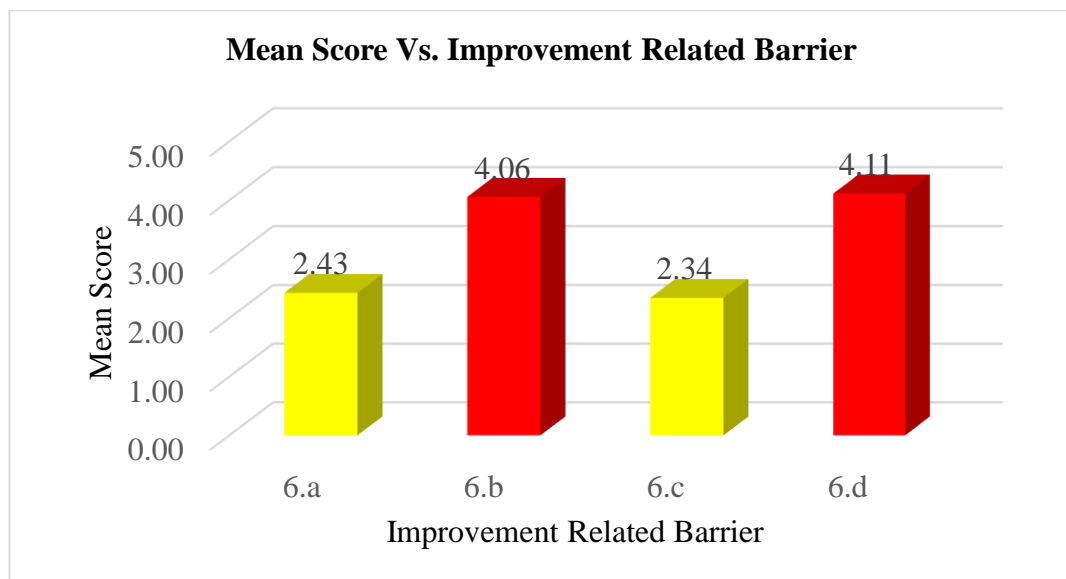


Figure 4.8 Mean scores of Improvement related barriers

4.4.7 Summary of Score Vs Barriers

Summary of the responses received of questionnaire survey can be displayed as below;

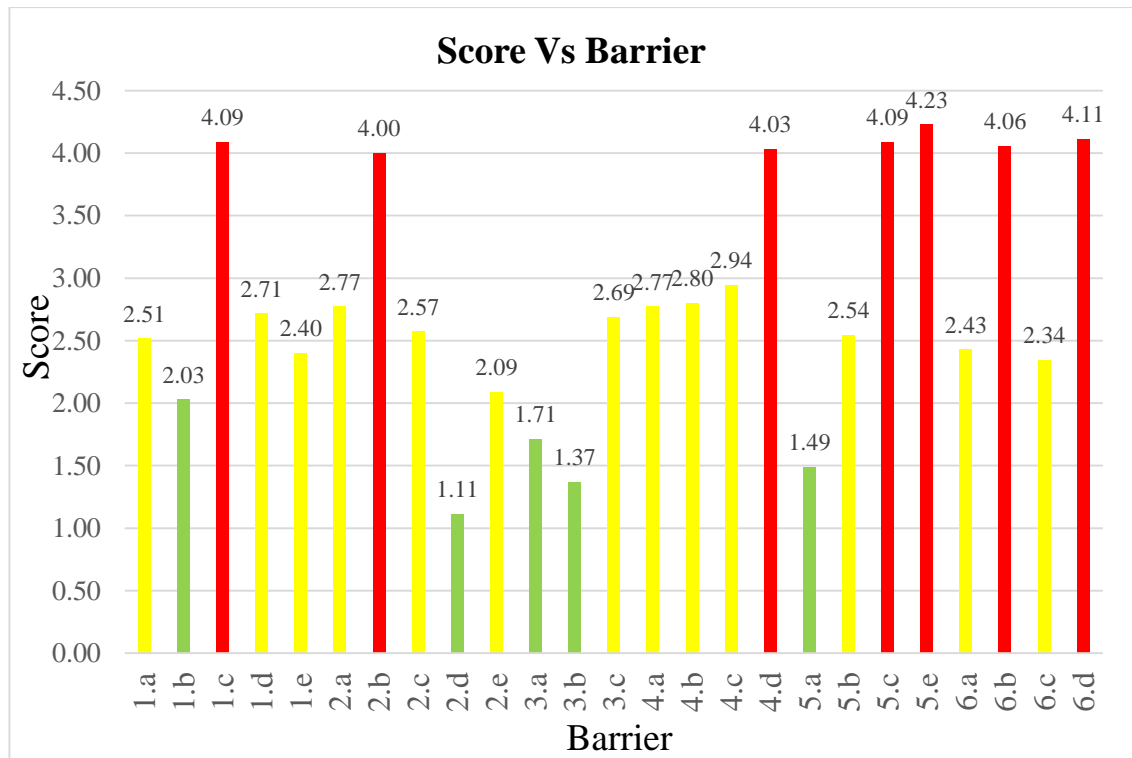


Figure 4.9 Mean scores summary of barriers

4.5 Classification of Identified Barriers

As explained in Table 3.2 in chapter 03, According to mean score, it can be classified the results received from questionnaire survey into 3 categories as,

- Low Impacted Barriers
- Moderate Impacted Barriers
- Extreme Impacted Barriers

Controlled measures for the above-mentioned barriers are identified through Literature, observations, general discussion with experienced field personals and expert interviews. It can be listed as below table;

Table 4.8 Barrier Classification and Method to identify control measure

Barrier Classification	Method to identify control measure
Moderate Impacted Barriers	Literature and General discussion with experienced field personals
Extreme Impacted Barriers	Expert Interviews

4.5.1 Low Impacted Barriers

Low impacted barriers are the barriers which do not make considerable impact and have lesser chance of occurrence as a barrier against the implementation of TQM system in flyover construction projects. As explained in the chapter 03, The Mean score belongs from 0 to 2 is considered as a low impacted barrier. Based on the results, it can be listed as below,

Table 4.9 Low Impacted Barrier

SR#	Barrier
1.b	Top management does not wish to adopt the concept of TQM to the project or organization.
2.d	TQM gives extra workload to maintain QM (quality management).
3.a	Organization is not dealing with adequate technology and well-QM practices.
3.b	Implementation and learning of TQM systems are not easy.
5.a	There is no customer feedback system.

Since impact and occurrence of these barriers are relatively small towards the implementation of TQM. It can be ignored as considering these as barriers to implementation of Total Quality Management.

4.5.2 Moderate Impacted Barriers

Moderate impacted barriers will make sensible impact and occurrence as the barriers against the implementation of TQM system in flyover construction projects. As explained in the chapter 03, The Mean score belongs from 2 to 4 is considered as a moderate impacted barrier. Based on the results, it can be listed as below,

Table 4.10 Moderate Impacted Barrier

SR#	Barrier
1.a	Generally, there is a lack of commitment from top management to TQM
1.d	The industry/organization is not releasing enough time for TQM.
1.e	Managers' promotions are not on the basis of qualifications in the organization.
2.a	Communication between departments is ineffective.
2.c	Quality objectives are not clearly identified to employees.
2.e	Future strategic vision on TQM is not there in the organization.
3.c	Organizational structure is not developed well for the implementation of TQM.
4.a	The field does not have enough well qualified local TQM consultants.
4.b	The employees see the implementation of TQM system as a tool to criticize their commitment and performance.
4.c	No leadership is observed regarding quality issues in construction sector.
5.b	Generally, the organization does not act well on the feedbacks received from the customers.
6.a	Employees do not receive enough financial funding from top management to apply and to develop quality programs.
6.c	Generally, employees are undergoing on training without a clear objective.

1. Generally, there is a lack of commitment from top management to TQM

Above issue can be identified as a common issue for all the projects and this will not be a specified issue for flyover construction projects. According to Al-Zamany, Hoddeii and Savage (2002), TQM can be failed due to non-existence of management commitment.

Hence top management should commit to the quality policy of the organization. The quality policy should be covered the needs and wants of the customers and finally it should ensure the satisfaction of customers. The demonstration of the commitment towards quality by top management, can be done through establishment vision all over the organization. When top management will understand the benefits and advantages of TQM implementation, the success of top management and also the organization will be achieved automatically.

Based on general discussions with experienced field personals, Literature reviews and observations, it can be controlled this barrier with making intensive awareness programs towards top management.

2. The industry/organization is not releasing enough time for TQM

During the questionnaire survey, majority states that this is having a higher occurrence and impact in the industry towards the implementation of TQM. It is observed that the most of private construction companies are profit oriented than quality oriented. Since They pay their main attention towards profit and the completion the project as fast as possible. This allows only a small window for employees to make their attention towards the total quality management.

With the discussion had with the experienced personals it was observed that Kelaniya Flyover is one of the examples that the project did not pay its time to have good quality management rather for fast completion. Due to that matter still, users are suffering a lot and it costs so much of money and time for the rectifications.

Hence the only control point of this barrier is to provide required time and resource allocation for quality management from the beginning of the project.

3. Managers' promotions are not on the basis of qualifications in the organization

Mostly this happens in the private sector as some peoples are getting promoted with the commitment that they have done for the organization over a long time. Here qualification is not considered in depth. But sometimes it gives negative commitments towards the quality of the construction specially in the technical matters.

Construction industry is not an easy arena for any manager to make sure their survival without proper knowledge and qualifications. Hence to control this barrier, it is the management responsibility to promote properly qualified personals as managers to make sure the commitment for the implementation of TQM.

4. Communication between departments is ineffective

This is observed as a common barrier for many organizations especially in construction sector. During general discussion had with the experienced personals in the construction industry, it was notified that most of the departments will only try to complete their duty without keeping effective communication with their related departments. Different departments should not have different objectives or aims. Aim or objective should be a common thing for an organization or a project as per the cooperate plan.

According to Glover and Siu (2000), When every departments of an organization are only dealing with the individual responsibilities without any cross functional communication, it will release negative performance results of the organization.

The control measure against this barrier is that there should be a separate personal or a department to make sure a well coordination among the departments.

5. Quality objectives are not clearly identified to employees

Through the questionnaire survey, observations and general discussions had with the employees, it was observed that most of employees are just involving their work without knowing quality objective of their work. This guides the quality objective of the project to be difficult to achieve. The control measures can be listed as below against the above-mentioned barrier;

- The awareness programs of the employees should be directed to highlight the importance of the quality system.
- Quality objectives and quality policy should be well displayed all the possible/suitable locations for employees to have better accessibility and to read and understand it on easy manner.

6. Future strategic vision on TQM is not there in the organization

Most of the organizations are having clear vision for the future about TQM. But once it moves in to project level, employees will feel that there is no such future strategic vision on TQM. With the discussion had with the experienced personals in flyover projects, it was observed that strategic vision for the future about TOM is not executed well at site level.

The employees should have good understanding on the long-term plan of the organization and organizational objectives. Otherwise employees will not have appropriate vision. Therefore, organizational structure should be developed to transfer proper knowledge and vision on TQM towards the employees.

Managers and people who act leading characters in the organization, should involve in the preparation of the quality policy. Further reviewing, monitoring and continual

improvement should be carried out to ensure that it provides the appropriate understanding to all levels of employees in the organization.

Finally, it is clear that It is management responsibility to establish clear strategic vision for future about TQM to control this barrier.

7. Organizational structure is not developed well for the implementation of TQM

It was identified during the discussions that There is proper organizational structure in the quality plan of projects like Rajagiriya, Ganemulla, Pogahawela and Nugegoda flyovers. When it comes to an operational level, that structure is not executed well due to unavailability of resources and lack of concentration at that. But it was observed that some of flyovers like Kelaniya and Paliyagoda were not having properly developed organizational structure to implement TQM. Further they clearly stated that quality failures in paliyagoda flyover is one of best examples that it did not have a proper organizational structure.

As a control point, it is needed to in cooperate properly developed organizational structure in the quality manual of each projects and it is management responsibility to make sure it's well execution in the operational level to implement TQM.

8. The field does not have enough well qualified local TQM consultants

This is observed as a common barrier that was not only affected for flyover construction projects; it is affected for all projects in Sri Lanka. The main reason behind this is that most of experts are being migrated to European and Middle East countries. It creates a huge scarcity in Sri Lankan construction industry specially in quality management sector. Some of the flyover project like Rajagiriya, Ganemulla and Polgahawela, Foreign consultation involvement was there during the technical issues raised in the construction phase.

It is notified that University of Moratuwa also involved to solve in many quality issues raised in the flyover constructions as a local consultant. According to the general discussion had with experienced personals in the field, some of them stated that availability of properly qualified local consultations on TQM is still yet to be fulfilled.

As a control point, it is a government responsibility to keep experts within the country and required no of local consultants needs to be released from the institutions for every year.

9. The employees see the implementation of TQM system as a tool to criticize their commitment and performance

This can be seen is a wrong practice especially in some private organizations and some projects. Some managers have used to control their employees using quality aspects as a tool when employees are keeping extra progress at projects. In the same manner some employees see progress in the first priority and quality is on second.

With the discussion had with the experienced personals, most of them clearly stated that sometimes upper management used TQM system as a tool to censure their commitment and performance. It makes a negative impact on their morale and implementation of total quality management project level.

Hence to control this barrier, It is management responsibility to reward their employees at their best performance and not to use QM system as a tool to censure employees' commitment and performance.

10. No leadership is observed regarding quality issues in construction sector

Previous studies clearly documented that when top management's intention is not there to implement total quality management system in their organizations, quality management programs will not be successful due to unavailability of leadership and

commitment from top management. Top management should commit their responsibility and leadership in the activities like policy creations, setting aims and objectives and positioning correct personals for the management positions etc.

According to Ngai and Cheng (1997), authoritative management is identified as a barrier for TQM implementation.

Additionally, it was notified during the discussion had with the managers that some promotion of directors and managers were designated without considering proper qualifications. It is caused to place wrong people on wrong positions. Further they mentioned that “This is observed as a common cultural barrier and it does not show right leadership on quality”. It is notified that those traditional systems are difficult to change and Those managers who promoted without proper qualifications, do not understand the quality issue and they are not in a position to accept suggestions from their bottom level employees who are having more understanding on those quality issues

Hence to control this barrier, top management should handle the quality issues with appointing correct personals for correct position.

11. Generally, the organization does not act well on the feedbacks received from the customers

Most of flyover construction projects are having customer feedback system with the purpose of improving their quality outputs. The issue is that most of the times they have taken customer feedbacks but it stops without any acting upon the customer feedback.

Samson (1997) highlighted that lack of acting upon customer feedback is directed to demotivate long term improvement in quality management, therefore it is notified as a barrier for TQM implementation.

According to discussion had with experience personals regarding above mentioned issue, their opinion is to have a framework to evaluate customer feedbacks, to

execute the effective proposals made by the customers and to monitor its progress. That can be identified by them as a control measure of above-mentioned barrier.

12. Employees do not receive enough financial funding from top management to apply and to develop quality programs

As observed and discussions had with experience personals, this can be accepted up to certain level only. But most of experience personals mentioned that they are not provided enough financial support for the improvement of the quality programs within the project since the top management mostly looks to accelerate the progress of the project than quality achievements.

Flyover construction projects are being done by especially well recognized construction companies in Sri Lanka. Hence it is necessary pump enough financial funds towards the improvement of the quality programs within the project or organization to have long term survival for them to be in the field.

The control measure is that it is management responsibility to provide enough financial funding to employees to develop quality programs.

13. Generally, employees are undergoing on training without a clear objective

As observed during the questionnaire survey, flyover construction projects are organizing enough number of trainings. But it is notified that mostly correct participants are not participating for those trainings due to their tight work schedules at the project levels. Hence human resource management department tends to appoint just a person for the training and sometimes the appointed person does not have direct relationship with the training and his role at project site. At the end, Human Resource department covered the number of trainings without effective outcome.

As per the discussion had with experience personals, they clearly said the it is necessary to have a proper training plan with a clear vison and a mission. Further they stated that it should be tally with the project program to avoid interruption during appointment of trainees for the training programs. Hence it can be identified as the best way to control this barrier during implantation of TQM in flyover construction projects.

4.5.3 Extreme Impacted Barriers

Extreme impacted barriers will make hard impact and have high chance of occurrence as obstructers against TQM implementation in flyover construction projects. As explained in the chapter 03, The Mean score belongs from 4 to 5 is considered as an extreme impacted barrier. Based on the results, it can be listed as below,

Table 4.11 Extreme Impacted Barrier

SR#	Barrier
1.c	Employee involvement for the management decisions is not enough.
2.b	Cross functional cooperation among departments is not functioning well.
4.d	Different departments have different operating systems.
5.c	The communication from senior management to employee level is not transformed well.
5.d	Employee's attitude is to follow the instructions rather than creating new proposals to enhance the productivity at their jobs.
6.b	Generally, organization does not reach to training goals.
6.d	Organizational/project employees resist changes to QMS (Quality Management System) in the organization.

1. Employee involvement for the management decisions is not enough

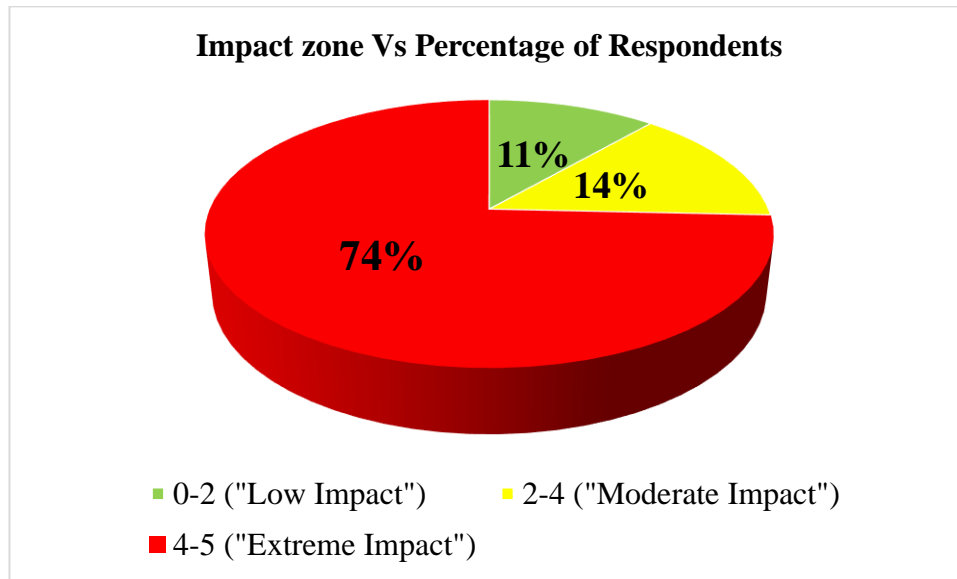


Figure 4.10 Respondent Percentage for the Barrier “Employee involvement for the management decisions is not enough”

This is one of a common issue observed in many construction projects in Sri Lanka. According to above pie chart It is clear that around 74% of questionnaire survey respondents clearly mentioned that the impact from no employee involvement in management decisions is extremely high.

During the expert interviews, the interviewers R1 and R3 mentioned that the insufficient employee education level, low employee skills are being barriers to get better involvement of employees for management decisions. In addition to that the interviewer R6 and R9 stated that All the employees’ co-operation is essential to meet required performance and its improvements. The interviewer R4 mentioned that Employees believed that they were not rewarded from top management although they committed a lot for TQM implementation. Further it was notified that incorrect appointments of employees without enough knowledge in TQM, were lacking in the involvement for decision making process.

Accordingly based on the expert interviews following controls can be identified to overcome these issues;

- Improve communication link between employees and top management through middle management;
- Improvements of employee educational level and skills with arranging proper training programs;
- Avoid appointment of people who do not have enough knowledge and understanding about TQM, for the vacant positions;
- Reward the employee who committed with good ideas to achieve organizational long-term and short-term objectives.

2. Cross functional cooperation among departments is not functioning well

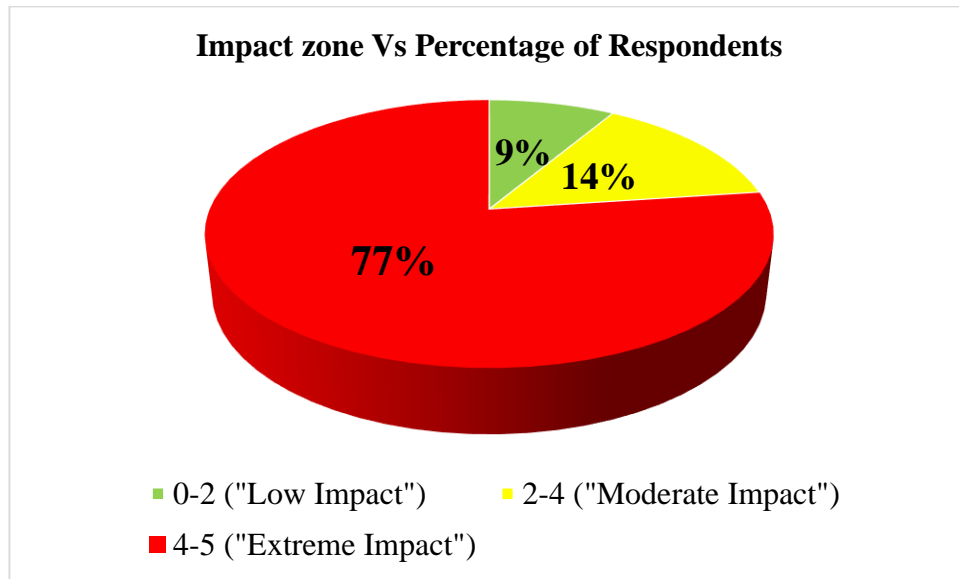


Figure 4.11 Respondent Percentage for the Barrier “Cross functional cooperation among departments is not functioning well”

According to the questionnaire survey, around 77 % of respondents were in a position that the impact of the barrier of “Cross functional cooperation among departments is not functioning well” is extreme.

The interviewers R3 and R6 clearly emphasize that the concept of “Team Work” needs to be improved among the departments. The interviewers R9 and R14 mentioned that organization did not recognize correctly their best employees to train to improve the team working attitude. It can be listed below as the control measures that can be identified to overcome above mentioned barrier through the expert interviews;

- Employee should go through training programs that will improve team work effectively and they should be trained use complex analytic techniques;
- Employees should be empowered to contribute in front-line decision making and to contribute co-operation through teamwork structures;
- Assign sufficient resources for the departments;

- Create a platform for cross-functional teams. That helps to the employees who are from different departments, to work as a team and to improve mutual learning from each other.

3. Different departments have different operating systems

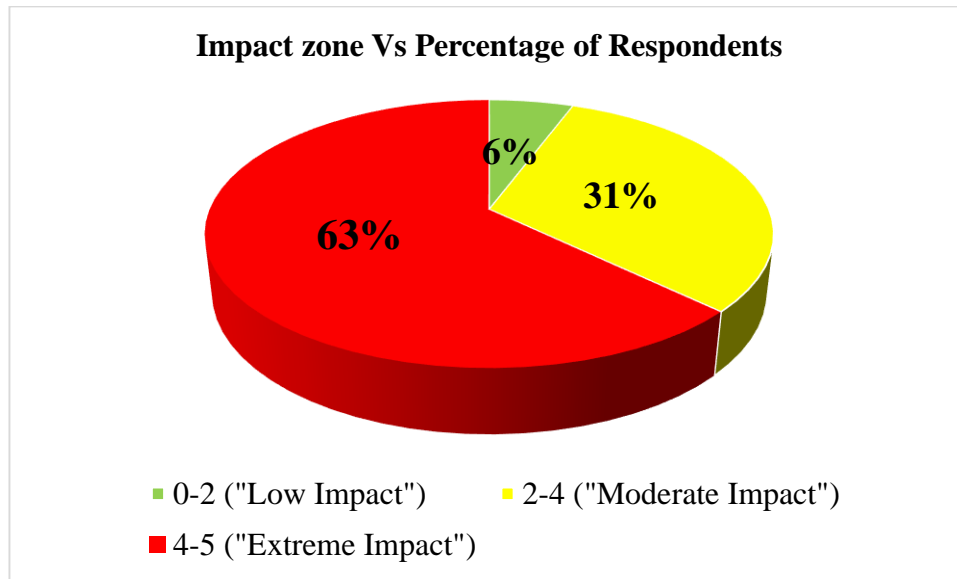


Figure 4.12 Respondent Percentage for the Barrier “Different departments have different operating systems”

Considerable majority of the questionnaire survey respondents clearly stated that the impact of the barrier “Different departments have different operating systems” is extremely affected for the TQM implementation in flyover construction projects.

The interviewer R1 and R6 stated that Most of departments heads are trying to achieve their department numerical targets without considering the overall project or organizational objectives and goals. The interviewer R9 stated an example that Operational team considered only physical progress with lowest time while procurement department seeks best lowest price although it takes time, it may not be much considered. Hence it makes a conflict between departments. Through the interviews, below control points can be proposed to overcome above mentioned barrier;

- Coordination officer to be assigned to regulate all departments together;
- Improve interrelationship between managers of the departments;
- Make an interlink among department operation systems;

- Create a platform for cross-functional teams. That helps to the employees who are from different departments, to work as a team and to improve mutual learning from each other.

4. The communication from senior management to employee level is not transformed well

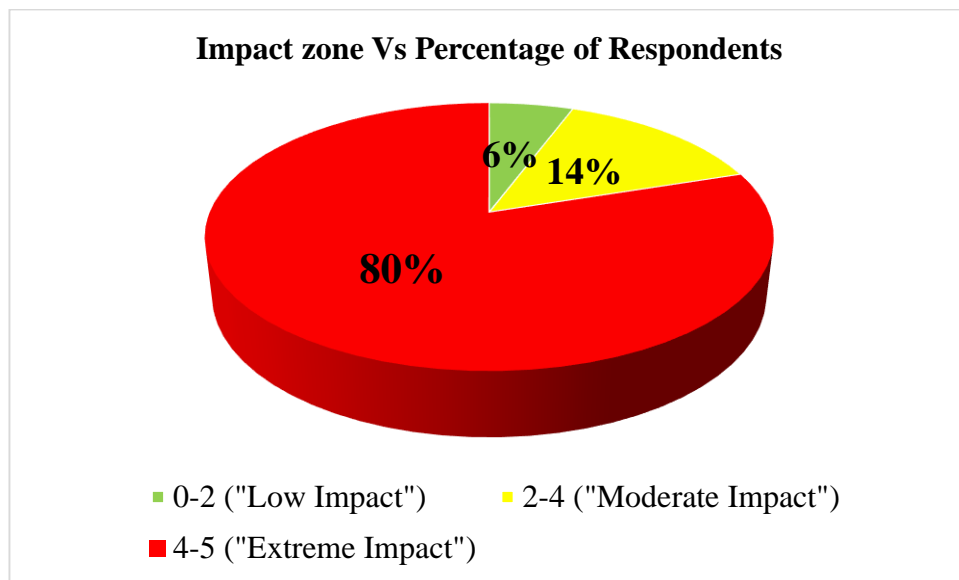


Figure 4.13 Respondent Percentage for the Barrier “The communication from senior management to employee level is not transformed well”

Around 80% of questionnaire survey respondent said that the communication from senior management to employee level is not transformed well and it makes extreme impact on Total Quality Management implementation in flyover construction in Sri Lanka.

The interviewer R1 and R9 stated that Most of management decisions taken by the top management are not well communicated to the bottom level employees through middle management. The interviewer R14 said that some middle managers believed that they should not keep direct communication with bottom level employees, if it is so, it can be a cause to lose their respect from them and it is not good for their superiority and future carrier.

Followings can be proposed through the interviews to control above barrier.

- Improve communication link between employees and top management through middle management;
- Improve manager’s listening skills towards employees;
- Develop internal communication system within the project/ organization.

5. Employee's attitude is to follow the instructions rather than creating new proposals to enhance the productivity at their jobs

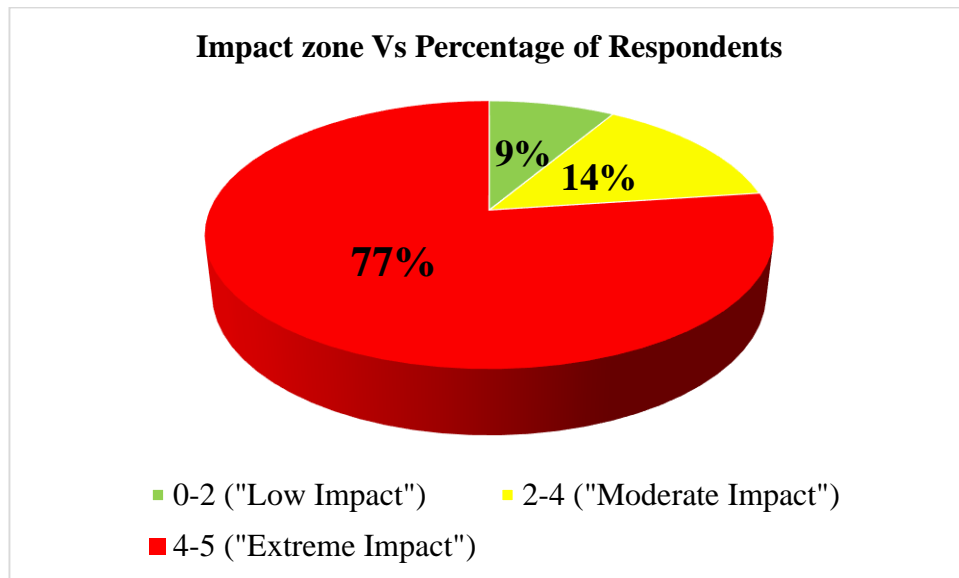


Figure 4.14 Respondent Percentage for the Barrier “Employee’s attitude is to follow the instructions rather than creating new proposals”

It is not only seen in the construction industry. This is one of a common issue observed in many projects/organizations in Sri Lanka. During the questionnaire survey, around 77% of respondent convey that above mentioned barrier is extremely impacted. The interviewers R1, R3, R6, R9 and R14 stated that This is kind of a typical behavior of most of employees and most of employees do not like to take a risk to create proposals in their jobs. Further they pointed that It is very important employees’ proposals since their proposal are incorporated with real work difficulties and it reflected real work scenario. Hence It will be very useful for the effective TQM implementation at flyover projects.

Below pointes can be listed as control measures for the above-mentioned barrier based on the expert interviews;

- Improve flexibility for employees to make free proposals;
- Conduct training programs for employees to improve related technical knowledge and to improve the application of statistical techniques in their quality analysis;

- Motivations and rewards for employees on valued proposals in their jobs;
- Improve teamwork instead of individual work done or performance.

6. Generally, organization does not reach to training goals

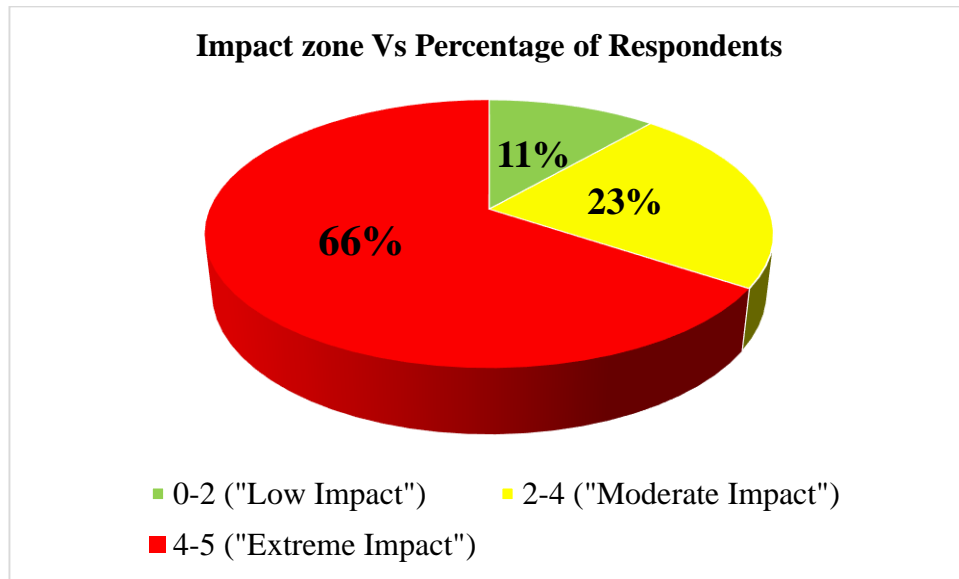


Figure 4.15 Respondent Percentage for the Barrier “Organization does not reach to training goals”

According to the above questionnaire 66% of responders agreed that that the impact of the barrier of training targets are not achieved, makes extreme impact for TQM in flyover construction. The interviewers R1 and R9 stated that Human Resource (HR) Department organized trainings and assigned employees without a clear target. They just want to complete their number of training only. The interviewer R3 and R9 states that HR department do not concentrate on the feedback receiving from the participants. All interviewers R1, R3, R6, R9 and R14 unconditionally agreed that main reason for lack in TQM implementation is ineffective trainings.

The interviewers clearly pointed out below control measures to achieve training targets in the organization.

- Identify required subject area of training;
- Carefully select trainer and trainees according to subject area;
- Design training program efficiently and effectively;
- Prepare flexible schedules to participate for employees;
- Evaluate of training outcomes captured by the employees;
- Review feedback and further improvements in training programs.

7. Organizational/project employees resist changes to QMS (Quality Management System) in the organization

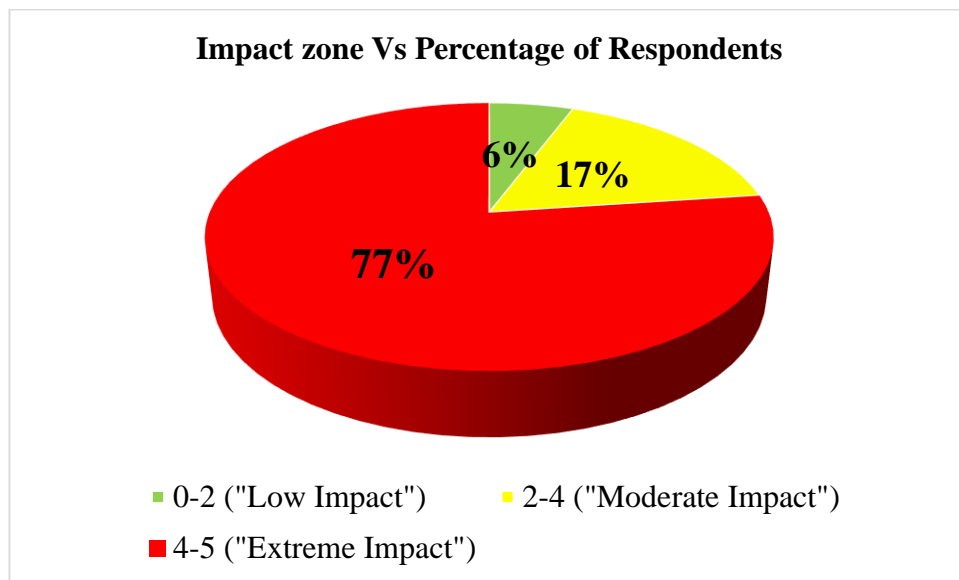


Figure 4.16 Respondent Percentage for the Barrier “Organizational/project employees resist changes to QMS in the organization”

This can be identified as typical behavior of most of employees since most of employees prefer to the routing work without adopting changes to that system. 77% of questioner survey respondent stated that above mentioned barrier makes extreme impact in the implementation of TQM in flyover constructions.

The interviewers R1, and R14 stated that Some middle managers and the employees did not like to accept the responsibilities that were coming from new systems. Hence, they were trying to leave to follow the instruction and procedure that were needed for the new system. According to the interviews, below control measures can be proposed to overcome above mentioned barrier.

- Educate employees on the real TQM requirements;
- Arrange training/awareness programs on new concepts, technologies, methods etc.;
- Improve team work to be change as a team;
- Aware employees on the benefit/value of changing quality system when requires.

4.6 Framework for managing Extreme TQM barriers in Flyover Construction Projects in Sri Lanka

The Framework includes mainly two columns as extreme total quality management barriers and control measures which were identified in the research. Those barriers and control measures are linked using arrows with different color coding as described in the Table 4.12. Accordingly control measures should be initiated and implemented in the relevant construction phase (Design, Planning, Implementation or Close-out) to avoid occurrence of the extreme TQM barrier.

It is very clear that every extreme barrier is incorporated with several control measures on a different construction phases. That gives a clear indication that a well-planned execution of control measures should be essential to avoid occurrence of indicated extreme barriers in the framework.

The Framework for managing extreme TQM barriers in flyover construction projects in Sri Lanka can be displayed as below (Figure 4.17).

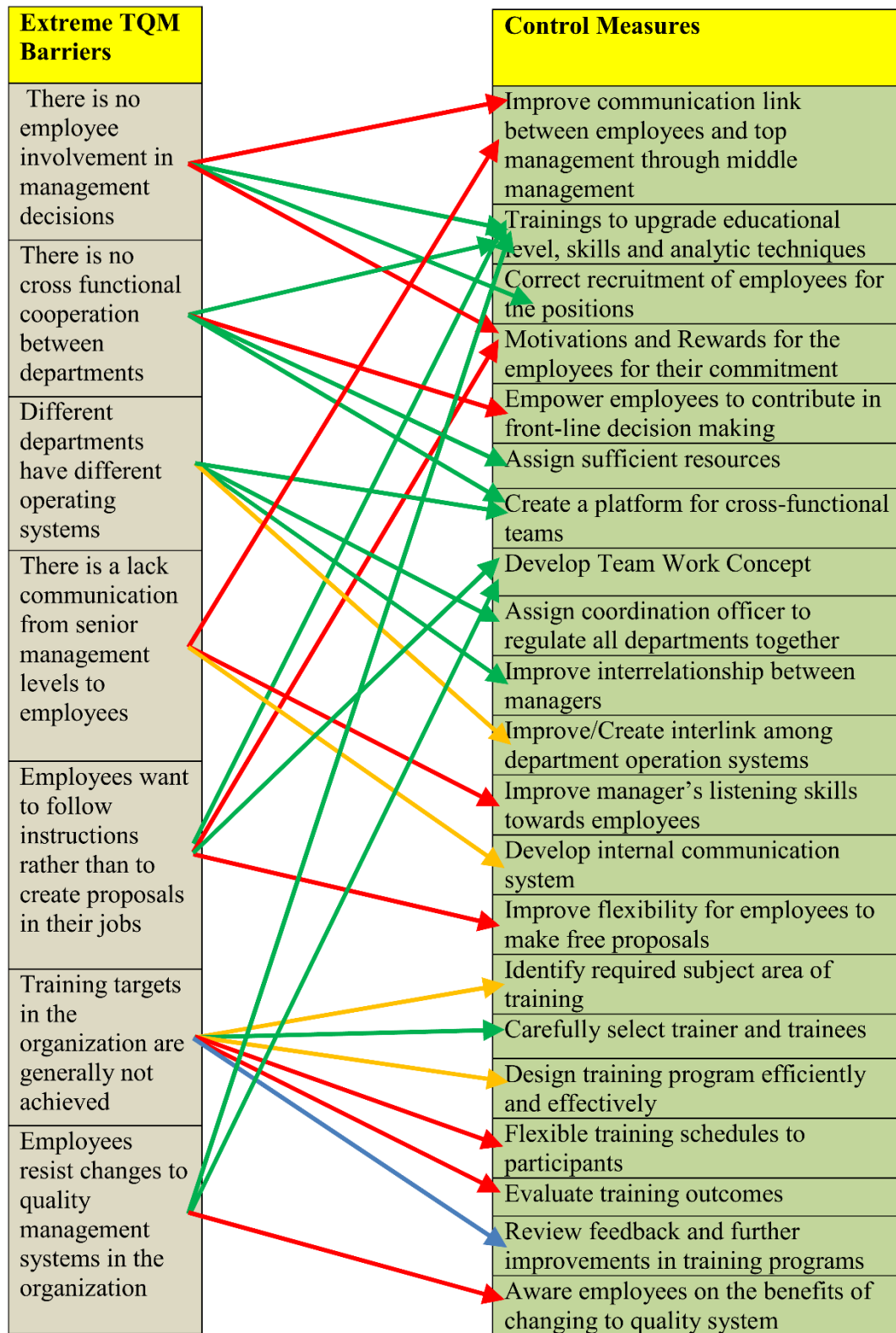






Figure 4.17 Framework for managing Extreme TQM barriers in Flyover Construction Projects in Sri Lanka

Table 4.12 Arrow color code to represent project phase

Arrow Color	Project Construction Phase
	Design Phase
	Planning Phase
	Implementation Phase
	Close out Phase

4.7 Summary

This chapter has discussed the statistical analyses using SPSS software for the data collected from flyover construction projects related organizations in Sri Lanka. The data analyses initiated by examining demographics, carrying out questionnaire survey and moving onto detailed analyses of the variables using mean score method.

Through the results, it was understood that the related organization of foreign founded flyover projects were using TQM but not in wide concept. Through the analysis, it was identified that most of employees were not having proper training (“Lack of Training”). Most of employees were aware about benefits and usage of total quality management. Through that some employees were having good knowledge and some employees did not reach to adequate level. It emphasizes again the requirement of formal training to the employees. It was identified that most of TQM barriers can be controlled if it has good team work. Communication between employees and managers is also very important since it creates much creative proposals towards the successful implantation of TQM at project. Finally, motivation and rewards the employees is also identified as an additional benefit to get maximum output from the employees towards the TQM. The next chapter will be discussed the conclusion, recommendations, limitations and details on further researches.

CHAPTER 05**CONCLUSIONS AND RECOMMENDATIONS**

5.1 Introduction

This chapter is mainly consisting of the research conclusions gained through this study. Further It delivers a brief research assessment. Mainly this chapter contains conclusion of the study, recommendations and the limitations of the research and it is supposed to provide knowledge for future researches at the end.

In this study, the responses were received from senior employees who had good knowledge on QM and TQM. Most of those employees were working in projects and they were responsible for quality aspects also. Majority of the respondents had either diploma, bachelors or master degree, chartered certification as Engineers, Quantity Surveyors and Architects. The knowledge and experience of those respondents on quality aspects were initially estimated by the factors “designation of the employee”, “department of working” and “working experience”.

It is understood that majority of the respondents had basic knowledge about TQM and some respondent were well educated about TQM and its implementation. Through that some employees were there without adequate knowledge about TQM. Majority of them were in a position that they required formal training on TQM to improve their knowledge. The selected case study organization is using ISO widely and currently most of these companies are ISO certified.

Above were the information acknowledged prior to discover the responses about variables in the research. The following section will deliver the conclusion, recommendations, limitations and input for further research on the basis the findings.

5.2 Conclusions

The study initiated with literature reviewing on Total Quality Management and some other related quality models such as ISO 9001:2008. Total Quality Management can be identified as a concept that helps to complete the project within the time frame and to deliver high quality output from the projects with customer satisfaction especially with respect to flyover construction projects in Sri Lanka. TQM is identified as tool by the organizations in construction sector to solve quality issues in flyover construction projects and to achieve the customer satisfaction on prior basis.

In the process of achieving the research's aims and objectives, it began with over-viewing Total Quality Management (TQM) related to the construction which was established as the first objective of the study. TQM has the potential to upgrade outputs of the project with achieving higher orientation towards the customers, greater customer satisfaction, effective team work, higher level of worker involvement and fulfilment and effective management of workers within the project or within the organization.

The second objective of the study is to recognize the barriers against the implementation of TQM in flyover construction projects in Sri Lanka. Based on the literature survey and initial discussion had survey, it was identified 25 numbers of barriers under 6 categories as policy related, requirement related, measurement system related, audit related, feedback related and improvement related barriers. Lack of employee involvement in management decisions, Lack of cross functional cooperation between departments, Different departments have different operating systems, lack of communication from senior management levels to employees, Employee's attitude is to follow the instructions rather than creating new proposals to enhance the productivity at their jobs , Training targets are not achieved and Organizational/project employees resist changes to QMS in the organization, are the barriers that were recognized as extreme barriers against the TQM implementations in flyover construction projects.

The 3rd and 4th objectives are to establish effective control measures in TQM to strengthen in flyover construction projects and to develop a framework for managing barriers in TQM in flyover construction projects. Employees should be well trained and developed for better performance. Accordingly, there should be well designed training programs with well identified subject areas for training. Carefully selecting trainer and trainees, designing training programs efficiently and effectively, Flexible training schedules to participants, evaluating training outcomes and review feedbacks and further improvements in training programs are very important to get effective benefits from training programs.

Well established communication system plays a vital role as a control measure against the extreme barriers of implementation of TQM. It is very important to have effective internal communication, communication among departments and communication link between employees and top management through middle management. Team work concept is one of world recognized concept to overcome most of communication barriers among departments, between managers and It is helpful to make a platform for cross-functional teams. The development of teams facilitates an effective skill mix that will generate creative ideas and improve productivity in the processes.

In addition, one of most prioritized process is to commence correct recruitment of employees for the positions. It is important to ensure that those who are recruited, can be trained and developed to organization culture. That is helpful to establish right system and then to ensure employee retention. Further the organization should motivate the employees with rewards for their commitment and It facilitates a better work environment, making aware employees on the benefits of changing to quality system, empowering employees to contribute in front-line decision making and to contribute co-operation through teamwork structures. Project/Organization would retain these employees over a long time period with high contribution towards organizational performance.

Flyover construction has many issues due to its complicated nature. It deals with different roles and those are involved in the different project phases from design to output. In the process of delivering a quality output, the client, consultants, contractor and subcontractors who are attaching with the project, have their specific role to play for the achievement of a quality end product.

5.3 Recommendations

The research study can be used to for future researches to start those with higher level of knowledge and this study may be useful to re check the rationality of those research's discoveries.

Based on the discoveries of this research, below factors can be highlighted as recommendations for effective TQM implementation in the Flyover construction projects;

1. Trainings to upgrade educational level, skills and analytic techniques

Training is important for successful implementation of TQM. Subject area to be trained for different employee or group of employees should be identified in analytical manner. The quality experts in the field should be appointed to train the selected team with flexible schedules. Additionally, all employees should be trained and developed to manage their soft skills such as scope management, stress management, effective communication, time management, resource management and conflict management etc. Training of the managers should be focused on the proficiencies that are essential for successful quality functional implementation.

Additionally, it is highly recommended to provide a training for all new comers to success of the existing quality system. It makes them comfortable to get adapted to the existing company culture and quality requirements. Accordingly, it can be recommended that the process of recruitment should be streamlined. Further different kinds of recruitment methods should be used for variant positions. This

process will be helpful for improving quality of employees who are recruited for new positions of the project or company.

2. Develop Team Work Concept

The study is full evidence that most of the TQM barriers are interlinking with lacks in the concept of team work. Empirical findings highlighted that team work concept was not well executed in the project or organizational basis. Lacks in team work concept in the project can make result such as lacks in interrelationship between managers, no interlink among department operation systems and no platform for cross-functional teams.

Hence it is recommended to bind all project or organizational members as a team that provides well cooperation among employees, departments and with management to achieve TQM goals.

3. Upgrade communication system

Communication link between employees and top management through middle management is not up to the required level according to the empirical results received from the study. The foreign funded projects have a blend of nationality of employees and management. The joint culture between management and employees helps to avoid confusions when there is a platform for both employees and management to facilitate a two-way dialogue. Therefore, A shared language like English can be used to have communication among employees. When English is not familiar to use for labor level, It is recommended to select a labor who can manage English and his mother tongue as a group leader and then he can transfer manager's instructions to group of labors.

From the outcomes of the above study, it was notified that the empowerment of employees was not focused well. Further management involvement towards the feedback of employee was not up to satisfied level. Sometimes middle management did not allow employees to keep communication with higher management. It gives so much of negative impact for TQM implementation at project level. Hence It is

recommended to have wide range of activities with required frequency such as site visits, face-to face conversation, videos, company brochures and company newsletter etc.

4. Continuous Improvement

The quality of the construction process will positively growth when the continuous improvement revolution is well implanted in total quality management context. When the continuous improvement will be adopted to the system, it will be caused to strengthen the quality chain and it will ensure long term relationship between customer and supplier.

It is recommended to design an effective control mechanism that can be used to monitor the process of TQM. It is important to focus on issues that are confronted during implementation phase in projects. Then it is necessary to make sure that all the identified issues are well discussed and action plans are prepared to avoid same issue again and again. The target should be oriented on preventive action rather than corrective action. The experience and knowledge received from facing previous issues should also be documented for future references. Finally, the lesson learnt in the implementation of TQM should be well documented and evaluation should be done systematically.

5. Motivations and Rewards for the employees for their commitment

From the findings it was also understood motivation and reward system in the organization does not satisfy employees' expectations well. It makes most of the employee's' performance far below their potential. Every manager wishes to accomplish their goals through their team and motivation of team members is the greatest limiting factor for reaching the goal.

It is recommended that reward programs should be designed to recognize correct employees. Further it should not deliver motivation for the fake or pretended achievement and commitment of the employees. That framework should be able to

filter the correct employee and should value the commitment made without keeping all employees on same value level.

6. Aware employees on the benefits of quality system

Empirical findings of the study indicated that employees were not well aware on TQM benefits. Improving levels of understanding and awareness of TQM for employees and organization, will support to determine better processes.

The training programs must be planned to give understanding of the purpose of TQM and its requirements. Further it should convey the advantages and benefits of TQM implementation.

Statistical techniques can be used to illustrate and provide better understanding for the trainees. The principles of total quality management should be communicated effectively to employees. Open discussion, company newsletters and seminars etc. can be used to as communication medium to convey message to the employees. Hence as per the study, it is recommended that the management should be responsible to aware employees on importance of TQM and it is needed to highlight especially the TQM benefits and its usage.

5.4 Limitations

Only one client and one local contractor were considered for data collection; accordingly, all the interviews surveys were carried among the staff of above two organizations.

During the research it was understood that the selected projects and organizations had implemented ISO as the quality standards. Hence, some respondent's responses were based on the TQM experience that they had in previous projects within the organization or outside. Further it was observed that some were lacked in practical knowledge on TQM. Therefore, those just provided their perception on TQM. Therefore, some feedbacks depending on the respondent perception rather than their practical knowledge of TQM usage.

5.5 Future Research

This research is helpful to understand the barriers for the implementation of TQM, effective control measures for those barriers to TQM success and importance of TQM.

Future research should focus on performance comparison of the projects that used factors for TQM success and the projects that did not use factors for TQM success. Additionally, A comparison shall be done for the projects with TQM and without TQM. Further an evaluation shall be carried out before and after TQM implementations for the effectiveness of employees and top management.

This research mainly focused on barriers against the TQM implementation. Future research can be focused on the factors such as identification of level of customer satisfaction using TQM; level of employee training for successful TQM implementation; processes for continuous improvement and procedures for measuring TQM standards etc.

5.6 Summary

This last chapter includes conclusion, recommendations and limitations of the study, and the contribution and link to the future researches. Trainings, team work concept, effective communication, continuous improvement, employee empowerment and employee awareness on TQM benefits are identified as major control measures to be developed to overcome barriers against the successful TQM implementation in flyover construction projects in Sri Lanka.

Data collection was done with limited number of organizations and some of data received from the respondents were based on their perception due to lack of practical knowledge. Those are identified as major limitations in the study.

Performance comparison with and without TQM, level of customer satisfaction/level of training required for the success of TQM and process of continuous improvement are identified as major paths for future researches to be done.

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APPENDIXES

APPENDIX – A

QUESTIONNAIRE

Section A: Demographic Characteristics

Q1. Your Name (Optional):

Q2. Your Designation / Position:

Q3. Educational Qualification Level:(Degree/Diploma/Certificate)

Q4. Your experience in the construction industry: (Number of years)

Q5. How many flyover construction projects have you involved:

.....

Your Signature (Not Compulsory)

Section B - Barriers related to Total Quality Management (TQM) in flyover construction projects

	EXPLORING THE BARRIERS IN IMPLEMENTATION OF TOTAL QUALITY MANAGEMENT SYSTEM IN FLYOVER CONSTRUCTION PROJECTS IN SRILANKA	Score					
		0	1	2	3	4	5
		Not Applicable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.0	Policy						
1.a	Generally, there is a lack of commitment from top management to TQM						
1.b	Top management does not wish to adopt the concept of TQM to the project or organization.						
1.c	Employee involvement for the management decisions is not enough.						
1.d	The industry/organization is not releasing enough time for TQM.						
1.e	Managers' promotions are not on the basis of qualifications in the organization.						
2.0	Requirement						
2.a	Communication between departments is ineffective						
2.b	Cross functional cooperation among departments is not functioning well.						
2.c	Quality objectives are not clearly identified to employees.						
2.d	TQM gives extra workload to maintain QM (quality management).						
2.e	Future strategic vision on TQM is not there in the organization.						
3.0	Measurement System						
3.a	Organization is not dealing with adequate technology and well-QM practices						
3.b	Implementation and learning of TQM systems are not easy.						
3.c	Organizational structure is not developed well for the implementation of TQM.						

	EXPLORING THE BARRIERS IN IMPLEMENTATION OF TOTAL QUALITY MANAGEMENT SYSTEM IN FLYOVER CONSTRUCTION PROJECTS IN SRILANKA	Score					
		0	1	2	3	4	5
		Not Applicable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4.0	Audit						
4.a	The field does not have enough well qualified local TQM consultants.						
4.b	The employees see the implementation of TQM system as a tool to criticize their commitment and performance.						
4.c	No leadership is observed regarding quality issues in construction sector.						
4.d	Different departments have different operating systems.						
5.0	Feedback						
5.a	There is no customer feedback system.						
5.b	Generally, the organization does not act well on the feedbacks received from the customers.						
5.c	The communication from senior management to employee level is not transformed well.						
5.d	Employee's attitude is to follow the instructions rather than creating new proposals to enhance the productivity at their jobs.						
6.0	Improvement						
6.a	Employees do not receive enough financial funding from top management to apply and to develop quality programs.						
6.b	Generally, organization does not reach to training goals.						
6.c	Generally, employees are undergoing on training without a clear objective.						
6.d	Organizational/project employees resist changes to QMS (Quality Management System) in the organization.						

APPENDIX – B

DATA RELIABILITY ANALYSIS RESULTS USING SPSS SOFTWARE

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	35	100.0
	Excluded ^a	0	.0
	Total	35	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.862	.805	25

Item Statistics

	Mean	Std. Deviation	N
VAR1.a	2.5143	.70174	35
VAR1.b	2.0286	.70651	35
VAR1.c	4.0857	1.03955	35

VAR1.d	2.7143	.75035	35
VAR1.e	2.4000	.60391	35
VAR2.a	2.7714	.59832	35
VAR2.b	4.0000	1.02899	35
VAR2.c	2.5714	.60807	35
VAR2.d	1.1143	.93215	35
VAR2.e	2.0857	.91944	35
VAR3.a	1.7143	.82503	35
VAR3.b	1.3714	.68966	35
VAR3.c	2.6857	.75815	35
VAR4.a	2.7714	.68966	35
VAR4.b	2.8000	.75926	35
VAR4.c	2.9429	.80231	35
VAR4.d	4.0286	1.09774	35
VAR5.a	1.4857	.98134	35
VAR5.b	2.5429	.81684	35
VAR5.c	4.0857	.85307	35
VAR5.d	4.2286	1.00252	35
VAR6.a	2.4286	.97877	35
VAR6.b	4.0571	1.18676	35
VAR6.c	2.3429	.80231	35
VAR6.d	4.1143	1.07844	35

Inter-Item Correlation Matrix

	VAR1.a	VAR1.b	VAR1.c	VAR1.d	VAR1.e	VAR2.a	VAR2.b	VAR2.c
VAR1.a	1.000	.200	-.191	.862	.133	-.084	-.225	.239
VAR1.b	.200	1.000	.037	.308	-.298	-.027	.147	-.073
VAR1.c	-.191	.037	1.000	-.195	-.160	-.152	.684	.085
VAR1.d	.862	.308	-.195	1.000	.262	-.006	-.230	.181
VAR1.e	.133	-.298	-.160	.262	1.000	.152	-.364	.114
VAR2.a	-.084	-.027	-.152	-.006	.152	1.000	-.022	.273
VAR2.b	-.225	.147	.684	-.230	-.364	-.022	1.000	-.075
VAR2.c	.239	-.073	.085	.181	.114	.273	-.075	1.000
VAR2.d	.371	.027	-.223	.304	.378	-.075	-.606	.193
VAR2.e	.136	.897	.013	.213	-.288	.113	.118	-.087
VAR3.a	.176	.057	-.296	.132	.337	-.038	-.349	-.068
VAR3.b	.371	.027	-.223	.304	.378	-.075	-.606	.193
VAR3.c	.226	-.056	-.328	.137	.344	-.072	-.666	.121
VAR4.a	.371	.027	-.223	.304	.378	-.075	-.606	.193
VAR4.b	.360	.027	-.334	.283	.364	-.061	-.628	.167
VAR4.c	.337	.025	-.435	.252	.337	-.044	-.629	.135
VAR4.d	-.156	.149	.342	-.116	-.273	.113	.805	.000
VAR5.a	.209	-.095	.193	.154	.386	-.117	.022	.312
VAR5.b	.360	.027	-.334	.283	.364	-.061	-.628	.167
VAR5.c	-.009	.097	.333	-.070	-.082	.007	.605	-.014
VAR5.d	.176	.139	.361	.008	-.103	.009	.425	.192

VAR6.a	.232	.019	-.619	.140	.222	.003	-.539	.037
VAR6.b	-.294	.147	.106	-.300	-.101	.134	.319	-.163
VAR6.c	.268	.021	-.578	.177	.261	-.011	-.578	.067
VAR6.d	-.332	.087	.097	-.402	-.172	.123	.292	-.149

Inter-Item Correlation Matrix

	VAR2.d	VAR2.e	VAR3.a	VAR3.b	VAR3.c	VAR4.a	VAR4.b	VAR4.c
VAR1.a	.371	.136	.176	.371	.226	.371	.360	.337
VAR1.b	.027	.897	.057	.027	-.056	.027	.027	.025
VAR1.c	-.223	.013	-.296	-.223	-.328	-.223	-.334	-.435
VAR1.d	.304	.213	.132	.304	.137	.304	.283	.252
VAR1.e	.378	-.288	.337	.378	.344	.378	.364	.337
VAR2.a	-.075	.113	-.038	-.075	-.072	-.075	-.061	-.044
VAR2.b	-.606	.118	-.349	-.606	-.666	-.606	-.628	-.629
VAR2.c	.193	-.087	-.068	.193	.121	.193	.167	.135
VAR2.d	1.000	.074	.587	1.000	.907	1.000	.983	.934
VAR2.e	.074	1.000	.113	.074	.018	.074	.071	.066
VAR3.a	.587	.113	1.000	.587	.738	.587	.666	.722
VAR3.b	1.000	.074	.587	1.000	.907	1.000	.983	.934
VAR3.c	.907	.018	.738	.907	1.000	.907	.948	.958
VAR4.a	1.000	.074	.587	1.000	.907	1.000	.983	.934
VAR4.b	.983	.071	.666	.983	.948	.983	1.000	.983
VAR4.c	.934	.066	.722	.934	.958	.934	.983	1.000

VAR4.d	-.641	.107	-.205	-.641	-.618	-.641	-.607	-.552
VAR5.a	.423	-.098	.614	.423	.429	.423	.417	.396
VAR5.b	.983	.071	.666	.983	.948	.983	1.000	.983
VAR5.c	-.064	.153	.128	-.064	-.168	-.064	-.082	-.097
VAR5.d	-.197	.068	.048	-.197	-.099	-.197	-.162	-.122
VAR6.a	.675	.044	.755	.675	.840	.675	.798	.895
VAR6.b	-.262	.325	.047	-.262	-.293	-.262	-.276	-.281
VAR6.c	.767	.051	.762	.767	.894	.767	.871	.946
VAR6.d	-.240	.250	.043	-.240	-.268	-.240	-.253	-.257

Inter-Item Correlation Matrix

	VAR4.d	VAR5.a	VAR5.b	VAR5.c	VAR5.d	VAR6.a	VAR6.b	VAR6.c
VAR1.a	-.156	.209	.360	-.009	.176	.232	-.294	.268
VAR1.b	.149	-.095	.027	.097	.139	.019	.147	.021
VAR1.c	.342	.193	-.334	.333	.361	-.619	.106	-.578
VAR1.d	-.116	.154	.283	-.070	.008	.140	-.300	.177
VAR1.e	-.273	.386	.364	-.082	-.103	.222	-.101	.261
VAR2.a	.113	-.117	-.061	.007	.009	.003	.134	-.011
VAR2.b	.805	.022	-.628	.605	.425	-.539	.319	-.578
VAR2.c	.000	.312	.167	-.014	.192	.037	-.163	.067
VAR2.d	-.641	.423	.983	-.064	-.197	.675	-.262	.767
VAR2.e	.107	-.098	.071	.153	.068	.044	.325	.051
VAR3.a	-.205	.614	.666	.128	.048	.755	.047	.762

VAR3.b	-.641	.423	.983	-.064	-.197	.675	-.262	.767
VAR3.c	-.618	.429	.948	-.168	-.099	.840	-.293	.894
VAR4.a	-.641	.423	.983	-.064	-.197	.675	-.262	.767
VAR4.b	-.607	.417	1.000	-.082	-.162	.798	-.276	.871
VAR4.c	-.552	.396	.983	-.097	-.122	.895	-.281	.946
VAR4.d	1.000	.021	-.607	.460	.472	-.336	.201	-.408
VAR5.a	.021	1.000	.417	.469	.148	.287	.022	.326
VAR5.b	-.607	.417	1.000	-.082	-.162	.798	-.276	.871
VAR5.c	.460	.469	-.082	1.000	.099	-.120	.393	-.116
VAR5.d	.472	.148	-.162	.099	1.000	-.004	-.071	-.039
VAR6.a	-.336	.287	.798	-.120	-.004	1.000	-.252	.991
VAR6.b	.201	.022	-.276	.393	-.071	-.252	1.000	-.267
VAR6.c	-.408	.326	.871	-.116	-.039	.991	-.267	1.000
VAR6.d	.184	.020	-.253	.360	-.065	-.231	.915	-.244

Inter-Item Correlation Matrix

VAR6.d

VAR1.a	-.332
VAR1.b	.087
VAR1.c	.097
VAR1.d	-.402
VAR1.e	-.172
VAR2.a	.123

VAR2.b	.292
VAR2.c	-.149
VAR2.d	-.240
VAR2.e	.250
VAR3.a	.043
VAR3.b	-.240
VAR3.c	-.268
VAR4.a	-.240
VAR4.b	-.253
VAR4.c	-.257
VAR4.d	.184
VAR5.a	.020
VAR5.b	-.253
VAR5.c	.360
VAR5.d	-.065
VAR6.a	-.231
VAR6.b	.915
VAR6.c	-.244
VAR6.d	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
VAR1.a	57.6286	105.064	.379	.	.859
VAR1.b	58.0571	107.232	.158	.	.867
VAR1.c	55.9429	115.114	-.274	.	.873
VAR1.d	57.4286	106.252	.310	.	.860
VAR1.e	57.6571	107.644	.294	.	.861
VAR2.a	57.4286	111.605	-.024	.	.868
VAR2.b	55.9429	116.408	-.420	.	.874
VAR2.c	57.5143	109.198	.170	.	.863
VAR2.d	58.9714	95.617	.836	.	.843
VAR2.e	57.9429	106.055	.216	.	.865
VAR3.a	58.3714	86.946	.734	.	.844
VAR3.b	58.9714	95.617	.836	.	.843
VAR3.c	58.8286	92.617	.807	.	.842
VAR4.a	58.9714	95.617	.836	.	.843
VAR4.b	58.9429	95.350	.873	.	.842
VAR4.c	58.9143	95.139	.874	.	.842
VAR4.d	55.8857	115.575	-.361	.	.872
VAR5.a	58.5714	99.487	.538	.	.853
VAR5.b	58.9429	95.350	.873	.	.842
VAR5.c	55.8286	110.205	.119	.	.864

VAR5.d	55.7429	111.197	.021	.	.866
VAR6.a	58.8286	94.852	.716	.	.846
VAR6.b	55.9429	112.820	-.119	.	.868
VAR6.c	58.8571	94.891	.785	.	.844
VAR6.d	55.9429	113.114	-.137	.	.869

APPENDIX – C

MEAN SCORE CALCULATIONS OF QUESTIONNAIRE RESULTS

Barrier SN#	Respondants																														Total	Average							
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30			R31	R32	R33	R34	R35		
1.a	3	2	1	4	2	3	2	2	3	3	2	3	2	3	1	3	2	3	4	3	3	2	2	2	2	2	3	3	2	3	3	2	3	3	2	2	3	88	2.51
1.b	1	2	1	1	2	3	2	1	2	2	2	2	3	3	1	2	2	1	1	2	3	2	1	2	3	3	3	3	2	2	2	2	2	2	2	3	3	71	2.03
1.c	4	3	2	2	2	5	3	5	4	5	4	3	5	4	2	5	4	4	5	4	5	4	3	5	5	4	5	4	5	4	5	4	3	5	4	143	4.09		
1.d	3	2	2	2	2	3	2	4	3	2	4	2	4	2	4	2	3	2	3	2	3	2	2	2	2	2	4	3	3	3	2	4	3	2	4	95	2.71		
1.e	3	2	2	1	2	2	3	2	3	3	2	3	2	3	2	2	2	3	1	3	2	2	2	2	2	2	3	2	3	3	2	3	3	2	3	84	2.40		
2.a	3	3	3	2	2	3	3	2	4	3	2	4	3	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3	2	3	2	4	3	3	97	2.77		
2.b	4	2	3	3	3	5	3	5	3	4	5	3	4	5	3	5	4	3	5	4	3	5	2	5	2	5	2	5	4	5	4	4	4	5	3	140	4.00		
2.c	3	4	2	2	2	3	2	2	3	2	2	2	2	3	2	3	2	3	2	3	2	2	2	2	4	2	3	3	3	2	2	3	2	3	2	90	2.57		
2.d	1	1	1	1	3	0	1	3	1	1	2	1	1	0	4	1	0	1	1	1	0	3	1	1	1	1	1	0	1	1	1	2	1	1	0	39	1.11		
2.e	1	2	1	2	2	3	2	3	1	3	2	2	3	0	2	3	2	1	2	3	3	2	3	2	3	2	3	0	3	2	3	2	2	2	3	0	73	2.09	
3.a	1	3	1	3	2	1	2	2	1	1	2	2	1	3	2	1	0	1	3	1	1	2	2	3	1	3	1	3	1	2	1	2	2	2	1	3	60	1.71	
3.b	2	2	2	2	2	1	3	1	1	2	2	1	0	1	1	1	2	2	1	1	2	2	1	2	2	1	0	1	1	1	1	2	2	1	1	0	48	1.37	
3.c	3	3	1	2	2	3	4	3	2	2	2	2	2	3	2	3	3	2	3	2	3	2	4	3	2	3	3	4	3	2	2	2	4	2	3	94	2.69		
4.a	2	3	3	3	3	2	4	4	3	2	2	2	3	3	2	3	2	2	3	3	2	3	4	3	3	3	3	2	4	3	2	2	4	3	3	97	2.77		
4.b	3	2	3	2	2	3	3	4	3	3	2	3	2	3	4	0	3	3	2	3	2	3	2	3	2	3	4	3	3	3	3	2	3	3	4	98	2.80		
4.c	4	1	4	3	3	3	2	3	3	4	2	3	4	2	3	4	2	3	4	3	3	3	2	1	3	4	3	3	3	3	4	2	3	3	4	103	2.94		
4.d	5	3	3	1	4	5	2	5	5	4	3	5	4	3	5	4	5	3	5	3	5	3	4	3	5	3	5	5	3	5	4	3	5	3	3	141	4.03		
5.a	2	1	1	2	3	1	1	2	1	1	2	4	1	0	3	1	1	2	2	1	3	2	1	1	3	2	1	1	1	1	1	1	1	1	0	52	1.49		
5.b	2	3	1	1	2	3	3	4	2	2	2	4	2	3	2	3	2	2	1	3	3	2	4	3	2	3	3	3	3	2	4	3	2	4	3	89	2.54		
5.c	4	2	4	4	3	5	4	4	5	4	4	4	5	4	3	5	4	4	5	4	3	4	2	5	4	5	4	5	5	5	4	4	3	5	143	4.09			
5.d	5	3	5	2	4	5	5	4	5	4	5	4	5	5	4	5	5	5	5	4	2	5	3	5	3	5	5	5	4	5	3	4	3	2	5	148	4.23		
6.a	2	2	1	3	2	2	3	5	3	3	3	3	2	3	1	1	1	2	3	1	2	5	2	2	3	2	3	2	3	1	3	3	3	2	3	85	2.43		
6.b	5	2	3	5	3	5	2	5	5	4	3	5	5	1	5	4	5	5	5	5	5	3	3	2	5	5	5	5	5	5	4	3	4	3	142	4.06			
6.c	3	2	2	3	2	3	2	4	3	2	1	3	2	3	2	1	2	3	3	1	3	2	4	2	2	3	3	2	1	2	1	3	2	2	3	82	2.34		
6.d	5	3	4	4	3	5	4	5	4	5	5	1	4	5	4	3	5	4	5	4	5	3	4	4	3	5	4	5	5	1	4	3	5	1	144	4.11			