The development and evaluation of best practices for the client’s representative

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THE DEVELOPMENT AND EVALUATION OF
BEST PRACTICES FOR THE Client'S
REPRESENTATIVE

by

L. Jawahar Nesan, B.E.

A Thesis submitted in partial fulfilment of the requirements
for the award of Master of Philosophy of the Loughborough
University of Technology

1995

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TO MY MOTHER LAKSHMI-JAYALAKSHMI
ACKNOWLEDGEMENT

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SYNOPSIS

Current literature and recent research findings have indicated that traditional management systems practised in the construction industry have encouraged poor communications, poor design, lack of buildability, and increased conflicts and disputes between participants. The results of these problems have manifested themselves in cost overruns, projects being not completed on schedule, and poor quality. The reasons for the frequent occurrence of these problems may well be lack of teamwork, poor co-ordination, and poor communications between participants. There has recently been widespread recognition in the construction industry that TQM would help to solve some of these problems. In construction, implementation of TQM must begin with the Client commitment to, and involvement in, providing an environment for other participants to change and improve. Consequently, the role of the Client's Representative must be given due consideration if the required changes are to be successfully implemented.

The main aim of this thesis has been to both: identify the most appropriate contractual arrangement; and establish the role of Client's Representatives when implementing TQM.

The research initially identified 'partnering' as the most appropriate arrangement for implementing TQM on construction. The twelve main responsibilities of the Client's Representative when involved in TQM-based construction projects were identified as: preparing and organising; developing project definition; procurement; organising a joint management team; design management; safety management; measuring and reviewing performance; communications; motivation; co-ordination; documentation; and project post-mortem. The best practices for effectively performing all of these tasks have also been formulated.

The initial observations were tested by conducting a detailed structured questionnaire survey of Client's Representatives in the construction industry. Thirtyeight of the UK's major Client's Representatives' organisations have participated in this survey. The survey results satisfied the three main objectives of this research, and concluded that 'partnering' provides an appropriate relationship to the participants to implement TQM in construction projects. The analysis of the survey data evaluated the importance of the tasks and best practices for Client's Representatives and ranked the tasks in order of importance.
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CHAPTER ONE

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1.2 BACKGROUND
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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION TO SUBJECT

The research presented in this thesis focuses on the role of the Client's Representative on Total Quality Management (TQM) based construction projects. The activities performed by the Client's Representative in order to achieve total quality in construction have also been investigated.

The term "total quality" has been defined within the TQM concept as 'customer satisfaction' and 'continuous improvement' (Burati 1992, ECI 1992). Since TQM is everyone's business, achievement of customer satisfaction and continuous improvement requires: total management commitment; total involvement of all employees; and customers and suppliers working towards a common goal (Oakland 1994, Burati 1992, Chase 1993). These requirements have resulted in management styles emphasising "teamwork" (Chase 1993, Burati 1992, Hellard 1993, Latham 1994).

In order to achieve effective teamwork in construction, several studies (NEDC Working Party 1991, CII 1991) have identified and suggested "partnering arrangements" between participants as a good alternative to traditional approaches. These studies have compared the basic characteristics of TQM with that of partnering, and concluded that partnering arrangements provide a suitable environment for participants to achieve Total Quality Management. The NEDC Working Party stated that the fundamental elements of both TQM and partnering are similar. Also, CII
identified that partnering can be used to achieve: a culture of continuous improvement; and teamwork amongst locations, functions, and departments.

In order to initiate and implement TQM and a team culture into the construction industry, recent publications (Mathews and Burati 1989, Hellard 1993, Latham 1994) have highlighted the importance of Client involvement. There is a general awareness throughout the construction industry that without Client's commitment only few worthwhile changes can be successfully introduced. The important role of the Client's Representative when making changes was also emphasised. In traditional systems, the roles of participants are often based on reactive approaches such as inspection and checking, which can often result in conflicts between participants (Elmes and Wilemon 1988, Fondahl 1991). However, within the TQM framework, the role of Client's Representatives has to be based on "teamwork" philosophy. This argument is supported by Todryk (1990), Elmes and Wilemon (1988), and Fondhal (1991), who suggested that the Client's Representative becomes active in a "team culture" in order to reduce conflicts and increase productivity.

1.2 BACKGROUND

During the past two decades, a number of management alternatives for improving quality have been developed and practised in the construction industry. However, few of these have developed into systems that solve the problems traditionally faced by the construction industry. Despite considerable time and effort being invested in devising various strategies, conflicts and disputes are still inherent in the construction industry. Duffy (1992) characterised this in his statement that:

"everyone in the construction industry is fighting among themselves instead of serving the needs of the Client" (pp. 36).
According to the Building Research Establishment (BRE 1987), two-thirds of 501 examples of poor quality observed on site were caused by design faults. Of these, 130 were caused by unclear or missing project information. Other causes were, lack of design co-ordination, poor constructability, and poor design. This demonstrates that the lack of sufficient information flow and poor co-ordination between participants seriously affects quality in terms of design and construction faults. The participants of a National Workshop on TQM identified the three important problems that faced the construction industry as follows (Chase and Manning 1990):

- lack of teamwork;
- poor communication; and
- inadequate planning and scheduling.

In recent years, the concept of Total Quality Management (TQM) has been accepted by some as the rationale to solve many of the quality problems in the construction industry. Despite the transient nature of construction industry, the following question is often raised (Shilstone 1983):

"why should the construction industry not follow the lead of the manufacturing industry and increase profit by reducing the cost of quality problems through the TQM concept?" (pp. 1 - 6)

Mathews and Burati (1989), and Kearney (1993) demonstrated that TQM has already been effectively applied by both Clients and Contractors in the construction industry. If TQM is to be effectively implemented to the construction project, all participants should be involved in the process and adapt a "team culture" aimed at achieving the goals of TQM (Burati 1992, Deffenbaugh 1993, Chase 1993, ECI 1993). In order to achieve 'teamwork' between participants, 'partnering arrangements' have been adopted on some major projects (CII 1991, NEDC 1991, Chase 1993).
TQM usually starts in construction with the Client’s commitment. According to Chase (1993), in the first workshop conducted by Iowa State University on the use of TQM in design and construction, the participants recommended that Clients lead the way by first adopting TQM, and then insist that other members of the design/construct team follow suit. Furthermore, TQM requires an interdependence between the participants involved in construction project, therefore, participation by the Client is essential. The Client’s involvement also helps to solve problems such as design and construction deviations initiated by the Client, and enhances the quality of the final product (NEDO 1978, Hellard 1993, Latham 1994). Graves (NEDO 1978) pointed out that:

"the standard of service given by the building industry relates closely to the amount of effort expended by the Client in establishing a good brief, and satisfaction at the construction stage is closely linked to the degree of control and supervision by the Client" (p 20).

With respect to Client participation, Hellard (1993) stated that:

"many technical failures stem from the failure to recognise the extent to which the building Client should participate, not only in fully exploring and analysing with the Designer his/her requirements in the early stages of the project, but also, then and subsequently, in making a full case study of the ability, and suitability of the resources of those organisations through which his/her requirements will be fulfilled" (pp. 91).

Both of these statements stress the importance of demonstrable participation by the Client for reducing failures and improving quality in construction. However, whether the Client is naive or sophisticated, the presence of an individual or teams representing the Client is inevitable. It is apparent that, on behalf of the Client, the
participation of Client's Representative is an essential ingredient for any successful project. However, in traditional methods, poor management practices and poor leadership on the part of Client have created many of the problems that the construction industry faces today (Chase 1993). It has been often said that if the concept of TQM was adopted, then these problems would not have occurred (Chase 1993, Burati and Mathews 1992).

1.3 RESEARCH JUSTIFICATION

The foregoing evidence indicates that traditional non-TQM approaches can often encourage problems such as conflict, poor communication, poor design, poor constructability, and poor leadership practices. In order to address these problems, the previous section emphasises both the need for choosing an appropriate contractual arrangement that enhance "teamwork" between all participants and the Client's/Client's Representative's full commitment to and involvement in all stages of the construction process, by adopting the concept of TQM. However, current literature indicates little focus on direct investigation of the Client's Representative's role within the TQM framework. Hensey (1993) states that about 95 per cent of current literature on TQM focuses on: necessities, benefits, advantages; philosophies, concepts, and principles; cultural and operation changes; and successful strategies and firms. In addition, Barrett (1993) calls for research on the role of individuals during the various phases of implementation of TQM.

The importance of both the contractual relationships between participants and the role of Client's Representatives in achieving total quality in construction led to focus this research on: appropriate contractual arrangements for implementing TQM in construction; and the role of Client's Representative in order to achieve total quality in construction. Furthermore, achievement of continuous improvement can also be
obtained through the identification and application of relevant "best practices" (best practices is defined in Chapter 6) to the various process (Graves 1993). The Computer and Automated Systems Association of the Society of Manufacturing Engineers (CASA/SME 1992) and the Department of Trade and Industry (DTI 1992) stated that the application of industry's best practices achieves customer satisfaction and continuous improvement. This led to identify the best practices for Client's Representatives for achieving Total Quality in construction projects.

1.4 AIM AND OBJECTIVES OF THE RESEARCH

The importance of the Client's Representative's involvement when achieving Total Quality in construction projects, led this research to focus mainly on the Client's Representative's activities when adopting TQM. Accordingly, the objectives of the literature review and subsequent investigations were to:

- identify the most appropriate contractual arrangement for implementing TQM in construction projects;
- determine and define the responsibilities of the Client's Representative in construction projects when adopting TQM; and
- establish best practices for the Client's Representatives.

1.5 THE RESEARCH METHODOLOGY

To achieve its objectives, the research was performed in two phases as illustrated in Figure 1.1: phase one involved a literature review and expert opinion; and phase two comprised data collection and analysis using a questionnaire survey.
**Phase One**

Phase one aimed to obtain the initial observations regarding the three objectives developed from the literature review. The following research was performed.

- The roles of Client's Representatives in traditional management systems were established from recent construction management literature. The intention of this review was to obtain an insight into the varying roles of Client's Representatives with respect to different procurement methods, and at the same time identify drawbacks of the traditional systems in solving various problems faced by the construction industry.

- An overview of TQM was developed and its practical application to various business strategies was assessed. This helped to determine how suitable the TQM concept was to the construction industry.

- Traditional procurement systems and the role of Client's Representatives in traditional systems were examined in relation to TQM. This led the identification of the: appropriate contractual arrangement for TQM; important tasks of Client's Representatives in construction projects when involved in TQM; and best practices for achieving total quality in construction.

- Expert opinion was sought and accordingly some alterations were made to the observations developed from literature. Finally, the findings obtained from both the literature review and expert opinion were formulated into three hypotheses. The background for the development of the hypotheses have been discussed in Chapter 5 and 6 respectively. The following three hypotheses evolved from the literature review.

**Hypothesis One (see Chapter 5)**

Partnering arrangements provide the ideal relationship for the participants to implement TQM in construction projects.
Hypothesis Two (see Chapter 6)

The important tasks of Client's Representatives in a TQM-based construction project include: preparing and organising; developing project definition; procurement; organising a Joint Management Team; design management; safety management; measuring and reviewing performance; communications; motivation; co-ordination; documentation; and project post-mortem.

Hypothesis Three (see Chapter 6)

The practices identified for all of the twelve tasks (see Section 6.6) are "best practices" for Client's Representatives to achieve total quality in construction projects.

Phase Two

In order to evaluate the importance and effectiveness of the initial findings obtained from phase one, the following were performed.

- A self administered questionnaire survey was used to investigate the industry's perception on the application of the initial findings to the construction industry. The questionnaire built off the initial findings and was aimed to obtain quantitative data from Client's Representatives. These data were used for testing the hypotheses.

- Once data had been obtained from the survey, a series of statistical tests including frequency analysis, mean score analysis, ANOVA (Analysis Of Variance - Kruskall Wallis test), and Kendall's coefficient of concordance test were performed through SPSS - X (release 3.0) software package to test the hypotheses.
1.6 RESEARCH ACHIEVEMENTS

Solving problems such as rework, revisions, cost/schedule over runs, etc., and improving the quality at all stages of the construction process have become an everlasting challenge faced by the construction industry. In recent years, TQM combined with partnering has become an accepted solution for reducing these problems. Since any initiation and implementation should start with the Client's commitment, the influence of the role of Client and/or Client's Representative should be given due attention. The main achievements of the research include:

- the identification of an appropriate contractual arrangement for implementing TQM in construction project;
- the identification of the important tasks for Client's Representatives when involving in TQM; and
- the establishment of best practices for Client's Representatives to help achieve Total Quality in construction projects.

Several issues regarding the contractual characteristics of TQM and the suitability of partnering for the implementation of TQM in construction were analysed. The important contractual characteristics for TQM were identified as:

- teamwork;
- elimination of administrative barriers such as inspection and protectionism;
- open communication; and
- compatibility of objectives.

Since partnering also helps to achieve these characteristics, it was identified as potentially the most appropriate contractual arrangement for implementing TQM in construction projects.
The important tasks of Client's Representatives on TQM based construction projects were identified through literature as being: preparing and organising; developing project definition; procurement; organising a Joint Management Team; design management; safety management; measuring and reviewing performance; communications; motivation; co-ordination; documentation; and project post-mortem.

In order to help Client's Representatives successfully perform these tasks, the best practices were identified for each of these tasks. The evaluation of the tasks and best practices confirmed the effectiveness and importance for Client's Representatives for achieving Total Quality in construction projects.

1.7 ORGANISATION OF THE THESIS

Chapter Two highlights the procedures and principles involved in the management of the three types of construction projects (i.e. building, civil, and offshore) and describes the relationships between parties involved in various construction procurement methods. This provides an understanding of the working together of parties involved in different procurement methods and in different types of projects.

Chapter Three presents the roles and responsibilities of Client's Representatives in four of the procurement methods practiced in the UK construction industry: traditional; design and build; management contract; and construction management. The confusion of who is the Client's Representative, raised by the previous literature is clarified in this chapter. The importance of Client's Representatives in construction projects is reviewed, and the associated problem of business failures attributed by their roles are highlighted.
Chapter Four reviews the principles and elements involved in TQM, and describes the practical applications of the TQM principles to the construction industry.

Chapter Five discusses the principles and procedures involved in 'partnering arrangements' and identifies the important contractual characteristics required for TQM. The chapter, also, proposes the hypothesis that partnering arrangements provide an ideal relationships for the participants to implement TQM in construction.

Chapter Six identifies, from literature, the Client's Representatives' important tasks when adopting TQM in construction projects and the associated best practices for each of the tasks for achieving total quality in construction. The important tasks and best practices led the formulation of hypothesis one and hypothesis two, upon which further investigations of this research were based.

Chapter Seven discusses the research methodology adopted for this research, presents the data collection and sampling procedure, and discusses the development of the questionnaire.

Chapter Eight presents the analysis of data obtained from the questionnaire survey. The initial findings obtained in phase one were verified by using statistical analysis: frequency, mean score, and ANOVA. Finally, the chapter discusses the empirical results with respect to the three hypotheses which have been set out in Chapter Five and Six.

Chapter Nine presents the findings of the research, recommendations and further research related to the subject matter.
Figure 1.1: Research methodology
CHAPTER TWO

AN OVERVIEW OF THE PROCESSES AND PROCEDURES INVOLVED IN THE MANAGEMENT OF CONSTRUCTION PROJECTS

2.1 INTRODUCTION
2.2 CONSTRUCTION PROJECTS
2.3 BUILDING PROJECTS
2.4 CIVIL ENGINEERING PROJECTS
2.5 OFFSHORE CONSTRUCTION PROJECTS
2.6 RELATIONSHIPS BETWEEN PARTIES INVOLVED IN CONSTRUCTION PROJECTS
2.7 SUMMARY
CHAPTER TWO

AN OVERVIEW OF THE PROCESSES AND PROCEDURES INVOLVED IN THE MANAGEMENT OF CONSTRUCTION PROJECTS

2.1 INTRODUCTION

Construction projects are usually undertaken by a group of firms, the composition of which changes from project to project and reflects the nature, technology and specialist requirements of each project. There is, consequently, considerable variation in the principles and procedures involved in the management of different types of construction project, such as building, civil engineering, offshore, and military. This often leads to the formation of different types of relationships between parties involved in the design and construction process. This chapter highlights the principles involved in the management of three types of construction projects: building; civil engineering; and offshore construction. It also describes the relationships between parties involved under various construction procurement methods.

2.2 CONSTRUCTION PROJECTS

The construction industry is as diversified as the extent of uses and needs of its Clients (Customer). There is no universal consensus on the classification of types of construction. Priestley (1994), for example, defines the construction industry as constituted by building, civil engineering and process plant, mechanical and electrical
engineering construction. Where as Clough and Seers (1991) classified construction as housing, non-residential building, heavy, highway, utility, and industrial. However, Tenah and Guevara (1985), categorised construction projects into five types: residential building construction; non-residential building construction; heavy and highway construction; marine construction; and military construction. The facilities involved in each of these types are detailed below.

*Residential building construction:* includes all single-family homes, condominiums, multi-unit town houses, and low-rise and high-rise apartments.

*No-residential building construction:* includes buildings other than housing, that are erected for commercial and industrial purposes (e.g. stores, offices, warehouses, small manufacturing facilities, hospitals, service stations, shopping centre, educational buildings, and industrial buildings).

*Heavy and highway construction:* in general, the largest category in volume of work (e.g. streets, highways, railroads, airports, tunnels, subways, bridges, dams, canals, hydro-electric work, refineries, chemical plants, power plants, industrial plants, tube and pipelines).

*Marine construction:* also known as water-front construction includes aqueous and sub-aqueous projects (e.g. dredging, jetties, piers, breakwaters, offshore platforms, submarine pipelines, and structures related to navigation and ocean commerce.

*Military construction:* includes everything from military housing to missile bases.

Austen and Neale (1986) categorised construction works into building and civil engineering as follows.
Building: storage building, schools, training centres, housing dispensaries and health centres, factories, offices, shops, store houses, post and telecommunications buildings, etc.

Civil engineering: irrigation (e.g. barrages, canals, and planning), rural access roads, land drainage, hydro electric schemes power stations oil pipelines, roads, railways, ports, telecommunications stations, sewerage and sanitation, and water supply (e.g. dams and bore holes).

All works in the "residential and non-residential building construction, and heavy and highway construction" fall within the two categories as noted by Austen and Neale (1986): building, and civil engineering construction projects. Marine and military construction have their own features, and should not be included in the "building and civil engineering" areas. Hence, the construction projects discussed above, fall under five major divisions: building, civil engineering, industrial, offshore (marine) construction, and military construction. However, in order to obtain an overall understanding of the variation of construction management processes and principles in different types of construction, this chapter discusses only three types of construction projects: building, civil engineering, and offshore construction.

2.3 BUILDING PROJECTS

There are five major participants involved in most building projects: Client; User; Designer; Executor; and Public Authorities and Agency (Austen and Neale 1986).

The Client: may be an individual, such as someone wishing to build a house. The term is more generally used for an organisation or an individual which needs the end
product and has the authority to order and approve it. The term 'Client' is defined in Chapter Three.

The Users: are the individuals who finally use the constructed facility.

The Designers: are the Architects and specialists (such as Structural Engineers, Civil Engineers and Quantity Surveyors etc.) responsible for translating the Client's requirements into reality.

The Executors: undertake the physical construction, who in many cases will be Private Contractors.

Public Authorities and Agencies: all buildings must fulfil statutory requirements regarding construction standards and safety. Bodies such as town councils, ministries of planning, water authority, and so on, ensuring complaints with requirements are referred as Public Authorities and Agencies.

2.3.1 The stages of a building project

There are several stages in a building project starting with the Client's desire to build. However, Austen and Neale (1986) divided the building process into five stages: briefing, design, tendering, construction, and commissioning.

Briefing

The stage in which the Client's requirements are established. To enable the Client to specify project functions and permissible costs, the Architects, Engineers, Quantity Surveyors and other members of the design team assist and interpret the Client's wishes and provide a cost estimate.
Design
The stage in which the brief is translated into specifications and drawings. The design team prepares the necessary production information, including working drawings and specifications, required to complete all arrangements for obtaining tenders. Depending on the nature and the complexity of the project, the design team usually includes: the Project Manager; Architect; Quantity Surveyor; Structural, Mechanical, and Electrical Engineers; Specialists such as Health or School Planners, Organisational Planners, and Health and Safety Officials.

Tendering
The stage in which a suitable Contractor is selected and an acceptable offer obtained. At this stage the Client's Project team may be expected to give technical support by: providing the necessary contract documents; providing a basis for pre-qualification of Tenderers; checking that the tenders are arithmetically correct and confirm to tender requirements.

Construction
The stage in which the design is translated into reality. The main participants are the Client's project team and the Contractor. Direct responsibility of construction, normally rests with the Contractor. It is also usual for Sub-contractors to be directly responsible to the Contractor. The Client's project team arranges for adequate supervision of the work to ensure adherence to quality standards and statutory requirements.

Commissioning
The stage after practical completion of construction, in which all outstanding contractual obligations are discharged. The activities include (Austen and Neale 1986): preparing "as-built" records; inspect the building thoroughly and have defects
remedied; test for water tightness; start up, test and adjust all services; prepare operating instructions and maintenance manuals; settling the final account etc.

2.4 CIVIL ENGINEERING PROJECTS

Civil engineering projects are more concerned with controlling the natural environment to provide the infrastructure: e.g. roads, dams and airports. The major participants involved in civil engineering projects include: Promoter; Engineer; Contractor; and Public Authorities and Agencies (Institution of Civil Engineers 1986).

The Promoter: may be a sole trader, a partnership, a limited company or part of local or central government.

The Engineer: refers to the organisation which provides professional advice on the investigation for, and the design and construction of civil works. The Civil Engineer will usually play a leading role in the design team and the other members of the design team may include specialists such as Hydrologists, and Geologists.

The contractor: undertakes the physical construction.

Public Authorities and Agencies: include the Planning Authorities and other Government departments play a major, perhaps dominant part in the project.
2.4.1 The stages of a civil engineering project.

The stages of a civil engineering project may be divided into stages similar to those described for a building project. The principles involved in the managerial framework for building projects also applies to civil engineering projects, with minor changes. The stages involved in a civil engineering project include: briefing or reporting; designing; tendering; constructing and commissioning (Austen and Neale 1986).

**Briefing or reporting stage**

The object of this stage is to enable an objective decision to be made on the feasibility of a project, and to examine the various alternatives. This stage begins with a thorough investigation of the project's technical and economic feasibility. The outcome of this stage is a Feasibility Report, which describes the investigations and analyses that have been done, and describes and evaluates the possible solutions.

**Design stage**

Activities at this stage include: deciding which solution to adopt; undertaking further investigations, if necessary; a scheme design, including cost estimate, detailed design; working drawings; specifications and schedules; bills of quantities; final cost estimates; and a preliminary production programme including time schedule.

**Tendering stage**

The objective of this stage is to obtain tenders from Contractors for the construction of works and to award the contract. In order to ensure that those Contractors invited to tender have adequate knowledge, skills and resources to do the work safely and efficiently, some form of pre-qualification is usually required.
Construction stage

The activities are similar to those of a "building project". Health and safety requirements may be more often met in civil engineering than in building because the hazards are more evident to both management and workers.

Commissioning stage

The commissioning stage of a civil engineering project is essentially concerned with testing the engineering performance of the works. The commissioning activities may include: testing the engineering performance and safety of the whole of the works; remedying all deficiencies; preparing "as-made" drawings and other records; preparing operational instructions and maintenance manual; monitoring performance of works against original requirements.

2.5 OFFSHORE CONSTRUCTION PROJECTS

Most offshore construction projects relate to the oil industry. The five main activities associated with the oil industry are: exploration; exploration drilling; development drilling; production operations; and transportation (Graff 1981). There are many installation units required for offshore oil productions, for example: units for drilling; production; oil storage and loading; gas storage and recovery; gas flaring; accommodation; and units for supporting pipeline manifolds and booster equipments (Department of Energy 1990). The participants involved in providing the construction of these units are, as in most construction projects, the Client, the Designer, Contractors, and Public Authorities and Agencies. However, the roles and responsibilities vary from those of the building and civil engineering projects.

Section 12 of the Mineral Working (Offshore Installation) Act, 1971, defines the Client (referred as Concession Owner in the Act) as the person who has the right to
explore or exploit mineral resources, or store gas, in an area of the sea-bed. The Client, in this case, would be the Owner of various offshore installations (Department of Energy 1990). These include:

- the offshore installation concerned with the actual process of minerals exploration or exploitation or gas storage;
- any installation involved in the conveyance of the minerals or the gas concerned (eg. a pumping platform); and
- any installation which provides accommodation for persons working on any installation falling in the above two categories.

Examples of Public Authorities and Agencies include: The Department of Energy (UK) and Certifying Authorities recognised by the Department of Energy. The Certifying Authorities appointed by the Secretary of state (Department of Energy-UK 1990) include: American Bureau of Shipping; Bureau veritas; Det norske veritas; Germanische Lloyd; Lloyd's Register of Shipping; and Offshore Certification Bureau. The role of the Certification Authorities has been discussed in the respective stages that follow.

2.5.1 The stages of an offshore construction project

Graff (1981) listed out four stages in the design and construction of offshore projects: preliminary phase; design phase; bidding phase; and construction phase.

Preliminary phase

This phase comprised: recognition of need and setting of operational criteria; determination of environmental criteria; feasibility study and cost estimates; and financing arrangements and monetary allotments (Graff 1981). The operational criteria including number of wells to be drilled, the type of drilling equipment and materials to be used, the amount of deck space needed for various operations, and the
mode of oil transportation - whether by tanker, barge, or pipeline - must be determined. After determining the operational criteria, it is then necessary to determine the environment to which all of the equipment will be subjected. Many environmental factors such as water depth, tide conditions, storm wave height, storm wind velocity, current, ice conditions etc., should be assessed. Oceanographers and Meterologists are responsible for this type of investigation.

Design phase

The design phase comprises the following events (Graff 1981):

1. **preliminary studies and special investigations including soil test, size selection for derrick and transportation barges, and conditions relative to corrosion, ice earthquakes, product transportation, and crew transportation**;
2. **design and preparation of engineering drawings including foundation design, structural design, and preparation of drawings etc.; and**
3. **preparation of document including specification, contracts, rental contracts for derrick, transportation barges, tug, and work boats.**

Geologists and specialists in soil mechanics are responsible for collecting data inclusive of the geological history of the area, soil boring data, and results of experimental pile driving. Following the determination of operational, environmental, and foundation characteristics, the analysis and design of the structure is performed. Depending on the design expertise of the Client, Consultants can be appointed for performing the full or part of the design. A case study (Morris and Hough 1987) on "The Fulmar North Sea oil field" stated that the conceptual design was developed by the Client’s own design team, and the detailed design was performed by a Design Contractor under the Client's supervision.

In order to guarantee the structural integrity of the design, all structural elements are checked by independent third party design teams (Dawson 1986). The Offshore
Installations (construction and survey) Regulations (1974), Section 5 (2)(a) also requires an independent assessment on design and method of construction of offshore structures. The purpose of an independent assessment is to ensure, so far as is reasonably practicable, that there is compliance with the Regulations and that all planning criteria and elements of design are brought under independent critical scrutiny to eliminate errors.

The Offshore Installations Regulation 9(2) requires the Certifying Authority (see section 2.5 for Certifying Authorities) to issue a certificate of fitness regarding the design of the installation, the method of its construction, the materials employed in its construction and the environmental factors. The independent assessment is made by or on behalf of the Certifying Authority, which may, at its discretion, accept a report by a third party of an assessment already made.

**Bidding phase**

This phase involves the selection of the construction Contractors. As in building and civil engineering projects, this phase includes events such as selecting bidders, sending and receiving bids, evaluating bids, and awarding contracts etc.

**Construction phase**

The overall activities involved in construction phase include: fabrication onshore; loading for transportation; erection offshore; and acceptance (Graff 1981, Morris and Hough 1987).

Works involved in the construction phase can be broadly categorised into onshore and offshore works. Most of the fabrication occurs in a construction yard onshore. Where as offshore installation is limited to launching and upending the jacket, driving pilings, placing the deck structure, and welding all of these into a single unit. According to the design, the components are pre-fabricated into the largest units at
onshore and then transported to the offshore site. After that the installation and hook-up occurs. Hook-up is the process of installing and connecting the pre-assembled topside facilities on the platform (Morris and Hough 1987). The fabrication, installation and hook-up processes usually require different specialist Contractors. The Fulmar North Sea project illustrates how separate contractors are employed for fabrication and installation and hook-up processes.

Procurement of materials is the major issue in the construction of offshore structures. In the Fulmar North Sea oil project, virtually all the materials and equipment used in the project were purchased by Shell-Expro - the Client. The Client's Project Team was responsible for customs, quality and cost control, hook-up procurement and overall co-ordination. Contractors for fabrication and installation were appointed on a fixed price basis as for as possible (Morris and Hough 1987). In offshore projects, Clients usually have considerable involvement in the management of their projects and generally engage Contractors on a well defined (fixed price) basis.

During construction, the Client should ensure that construction work and the installation of equipment are continuously supervised by competent persons both at the main construction site, and at the places of manufacture of materials, assemblies and during offshore hook-up and commissioning (Department of Energy 1990).
2.6 RELATIONSHIPS BETWEEN PARTIES INVOLVED IN CONSTRUCTION PROJECTS

A construction process, generally involves three major parties: Client, Consultants, and Contractors. Excluding the Client, the UK construction industry is now characterised by two main groups that combine as a "team" to produce a building (Turner 1990):

- **Consultants** that offer design and cost control services and are independent of any commercial interest in construction companies or property companies. They include Architects, Civil, Mechanical, Heating and Ventilation Engineers, Quantity Surveyor/Financial and Cost Consultants, Landscape Architects, Interior and Graphic Designers, Process and production Engineers.

- **Contractors** that are essentially commercial companies that contract to construct buildings.

In the UK, the construction procurement process of each project has a diversity of choice in setting up the Consultancy and Contractor relationships on that project. The growing complexity of the construction process in the construction industry often requires the Consultants (such as Architects, Quantity Surveyor, Project Manager etc.) to offer a variety of management services, regardless of their own professional disciplines. This, in turn produces a variety of contractual relationships between the Client and Consultants, and functional or contractual relationship between Contractors and Consultants.

The construction Client may or may not have in-house project executive skills, and may therefore provide these accordingly by one of the three options as illustrated in 38.
Figure 2.1: This figure depicts the overall range of organisational variations for a Client, where, it can be seen that the three major procurement options of design and build, traditional, and management, themselves form different variations.

Figure 2.1: Range of organisational variations for project management, design and construction


2.6.1 Traditional approach

The contractual relationship between the participants is shown in Figure 2.2. The Client makes separate contracts for services with the Consultants taking part in design and for construction with the Main Contractor. The Main Contractor has again signed contracts with his/her own Sub-contractors and nominated Sub-contractors selected by the Client.
In the traditional system, design is often separated from construction. Consultants are appointed for design and cost control, and the Contractor is only responsible for construction work. In this system, the Architect, as an independent Designer and head of the design team, produces alternative sketches, and the Quantity Surveyor estimates costs on which the Client bases decisions (Hurn 1992). As the drawings and specifications are prepared, the Quantity Surveyor evaluates the cost of alternatives and prepares bills of quantities. On completion, design documents and bills of quantities are usually sent to selected Contractors to tender. The Contractor that wins the competitive tendering enters into a contract with the Client and performs the construction works.

Some disadvantages of the traditional system have been discussed below (Franks 1991).

- **The design should be fully developed before bills of quantities and, subsequently, tenders are prepared. If not, excessive variations and disruption of the works are likely to occur. Such an arrangement frequently requires a longer overall project period than is necessary if both design and construction are able to proceed concurrently.**

- **As the length of the project period increases, so does the project cost, because the Client usually incurs financing charges on money that has been invested in land purchase, interim payments to the Contractor and the other members of the building team.**

- **Many Contractors are of the opinion that their ability to organise and control the work of nominated Sub-contractors is undermined by the nomination process, because such Sub-Contractors have less loyalty to the Contractor than to the Architect/Client who nominated them.**

- **The separation of the design and construction processes tends to foster a 'them and us' attitude between the Designers and Contractors which reduces**
the team spirit that experience has shown to be vital for the satisfactory conclusion of a building project.

- Lines of communication between the parties tend to be tenuous and the interests of all may suffer as a consequence.
- The traditional system has proved to be unsatisfactory for some large and complex projects which require advanced management systems, structures and skills.

Figure 2.2: Contractual relationships between parties in traditional procurement

2.6.2 Design and build approach

The design and build approach has several variations such as design and build, develop and construct, and turnkey or package deal (see Figure 2.1). In 'design and build', the Contractor assumes responsibility and seeks to design and build whatever type of building the Client needs. In 'develop and construct', the Consultants design the building required to a partial stage, often called a 'scope design' then obtains
competitive tenders from Contractors that develop and complete the design and then construct the building. A Package deal is the term used more in Britain and Turnkey in North America (Hum 1992). Turnkey is a term meaning package deal. The key is perhaps to symbolise the Client's only required action, in addition to paying for the project. A package deal may include the procurement of suitable site and even arranging the financing. Speculative, private housing is a prime example of a turnkey approach (Turner 1990).

In design and build systems (Figure 2.3), the Client is under contract with Advisers and Consultants for services and has only one additional agreement with the design and build Contractor. The Contractor again has separate contracts, totally independent of the Client, with his/her Consultants, Sub-contractors and material Suppliers.

The following are important characteristics of most design and build systems (Turner 1990, Franks 1991, and Huru 1992).

- The Contractor is responsible for design, construction, organisation and control, which means that these activities may proceed simultaneously in the most advantageous way.
- The Client has direct contact with the Contractor. This improves lines of communications.
- The nature of design and build contracts tends to restrict changes during construction because of the disruptive and relatively high price to the Contractor and Client.
- The nature of the system should promote the creation of an integrated design and construction team.
- The closer involvement of Architects in the building process should lead to designs which have a greater appreciation of construction methods; i.e. improved buildability.
Competition between Contractors on both design and or price may be advantageous to a Client, but design costs of unsuccessful tenders may be very significant.

The Client's Representatives may supervise the works and ensure that the Contractor's proposals are complied with and that the work is not skimped.

![Diagram of contractual relationship between parties in design and build](image)

**Figure 2.3: Contractual relationship between parties in design and build**


**a) British Property Federation system**

In 1983, the British Property Federation published the BPF system for design and construction for building projects. The procurement method (see Figure 2.4) differs somewhat from others and changes the traditional roles of the parties in process. This has been developed mainly to protect the Client's interests. The Client has four different contracts with: the Client's Representative; Design Leader; Supervisor; and...
Contractor. The Main Contractor also has contracts with many Sub-contractors. These parties themselves are under contract with Consultants such as Architect, Structural Engineer, Quantity Surveyor, etc., for design and cost services.

The independent Client's Representative looks after the Client's interests and manages the overall project, but is not involved in design or construction. The Design Leader has overall responsibility for pre-tender design and approval of the Contractor's design. The Client has the opportunity to name Sub-contractors, but if the Contractor does not reach a contractual understanding with the Sub-contractor, especially if the latter has a large role in design, the Contractor may propose another Sub-contractor (BPF 1983). The Contractor completes the design, providing co-ordinated working drawings and takes the responsibility of construction of the project. The Contractor's design is examined and approved by the Design Leader. The Client appoints a Supervisor recommended by (and responsible to) the Client's Representative for monitoring construction work. The Supervisor inspects and records progress against the contract documents and sanctions design.
2.6.3 Management approach

Management approaches comprise three variations: management contracting; construction management; and design and manage (see Figure 2.1).

a) Management contract

In 'management contract', the Client has separate contracts with all consultants (Figure 2.5). Also, the Client has a management contract with the Management Contractor. The Works Contractors submitting competitive tenders to the Management Contractor are bound by contract to the latter. However, the Management Contractor is liable to the Client only for the co-ordination and
management of the work between Work Contractors (Birchall 1987). No contractual relationship exists between the Client and Sub-contractors.

![Diagram of contractual relationships]

**Figure 2.5: Contractual relationships between parties in management contracting procurement**


The main characteristics of management contracting include the following (Franks 1991).

1. *The Management Contractor is appointed much earlier than would be possible with the traditional system. He/she is able to become a member of the design team and contribute his/her construction knowledge and management expertise.*
2. *Work can commence as soon as design proposals have been accepted by the Client.*
3. *'Them and us' attitudes are reduced and lines of communications are improved.*
The Management Contractor finds it easier to identify with the Client's needs and interests 'integration of team' becomes possible and practical.

Contracts are entered into near the time of commencement of the works making firm-price tenders possible.

Decisions regarding appointment of Sub-contractor are made jointly (by Designers and Management Contractor) thus making use of wider experience.

b) Construction management

In 'construction management', as shown in Figure 2.6, the Client is in contract with: a Construction Manager; Works Contractors and Suppliers; Consultants for design and/or cost consultancy services. The Construction Manager is only a Consultant to the Client, working for the Client's interests. The Construction Manager has closer involvement in the project through its whole life and is paid on a fee basis. The Works Contractor is responsible for entire construction of the project.

c) Design and manage

In 'design and management', as shown in Figure 2.7, the Client is in contract with a Design and Manage Contractor, and (possibly) a scope Designer. The Design and Manage Contractor, will in addition to the contract with the Client, have a contract with both a Consultant for design and/or cost consultancy services and a Works Contractor for construction. In this approach, the Client will need to have in-house skills or obtain them in order to: prepare 'Client's requirements'; and perform his/her responsibilities in the Contract or devolve these to a Client's Representative.
The characteristics of this system include the following (Turner 1990).

- The same criteria considered for the Management Contractor would apply to the Design and Manage Contractor. In addition, in selecting organisations to tender, their particular design record in the area of expertise involved is likely to be significant.

- One difference from 'design and build' is that the initial price is not known when commitment to a 'design and manage' organisation is made - as with the management contracting system, the Works Contractors are selected and paid at prices agreed by the Client and the design/management organisation.

- A Client has to define the project’s functional requirements very clearly and then be prepared to leave the design and management to the appointed Contractor or Consultant in an area of building that is quite specialised.

Figure 2.6: Contractual relationships between parties in construction management procurement

Source: CIRIA, (1992). The UK construction industry: A continental view, Special publication 82 (pp. 50).
2.7 SUMMARY

The chapter has described various processes and participants involved in different types of construction project including building, civil engineering, and offshore construction, and discussed various relationships between participants of construction project in different types of procurement method.

The stages of both building and civil engineering projects can be classified as briefing, design, construction, and commissioning. *Briefing* is the stage in which the Client's requirements are established. *Design* is the stage in which the brief is translated into building terms in terms of construction informations, including working drawings and specifications. *Tendering* involves selecting a suitable Contractor and obtaining an acceptable offer. *Construction* is the translation of the design into the completed works. *Commissioning* is the stage in which all outstanding contractual obligations are discharged. In offshore construction projects, the
construction phase involves fabrication onshore, loading of transportation, erection or installation offshore, and acceptance. Usually separate Contractors are appointed for fabrication and installation.

Construction project organisation involves three major organisations: the Client; Consultants; and Contractors that combine as a team to undertake a project. The overall range of organisational variations providing different relationships between these three participants usually falls within three different approaches: traditional; design and build; and management. The chapter illustrates that the evolution of these three approaches has been with the aim: design/construction integration; achievement of constructability; and design/construction overlapping. It implicitly indicates that these approaches fail to address people aspects such as sharing of ideas, common interests and objectives, commitment and close involvement of participants. The procedures and principles of construction processes and the contractual relationships between the participants discussed in this chapter should be seen as the basis for understanding on contractual issues and role of Client's Representatives in construction projects to be discussed in Chapters Three, Five and Six.
CHAPTER THREE

CONSTRUCTION INDUSTRY CLIENTS AND THE ROLE OF CLIENT'S REPRESENTATIVES IN CONSTRUCTION PROJECTS

3.1 INTRODUCTION
3.2 CONSTRUCTION CLIENTS
3.3 ROLES OF THE CLIENT
3.4 WHY IS THE CLIENT'S REPRESENTATIVE NEEDED?
3.5 WHO IS THE CLIENT'S REPRESENTATIVE?
3.6 PROJECT RELATED ROLES OF CLIENT'S REPRESENTATIVES
3.7 SUMMARY
CHAPTER THREE

CONSTRUCTION INDUSTRY CLIENTS AND THE ROLE OF CLIENT'S REPRESENTATIVES IN CONSTRUCTION PROJECTS

3.1 INTRODUCTION

Clients have become more demanding and the complexity of construction projects has increased, this has stimulated the evolution of different procurement methods. Some of the major procurement systems practised in the UK construction industry have been discussed in the previous chapter. Some of them have evolved to meet Clients' specific requirements, such as greater speed, more concentration of responsibility, and earlier introduction of construction expertise into the design process.

In the procurement systems discussed in Chapter Two, there is a need for the Client's Representative to manage the project as a separate and distinct member of the construction team. The role of the Client's Representative, their interaction with the Client, Co-professionals, Contractors, Sub-contractors and approving authorities has also changed in parallel with the procurement systems. The traditional assumption that Architects manage the project has become less automatic now with Engineers or Specialist Project Managers etc., being engaged to co-ordinate the project work. In this chapter, the changing role of the Client's Representative are examined with respect to four of the procurement methods - Traditional, Design and Build, Management Contract, and Construction Management.
3.2 CONSTRUCTION CLIENTS

There are many types of Client, ranging from the inexperienced, in terms of previous involvement with construction projects, through to the very experienced, such as property developers, whose prime business is producing buildings. The Chartered Institute of Builders (CIOB 1980) described the 'Client' as the one who represent the organisation, or individuals within that organisation who have the authority to order, approve and pay for the building project.

Clients can be categorised as individuals; groups or partnerships of people; corporate bodies; private and public Clients, etc. Based on the construction knowledge possessed by the Client, Higgin and Jessop (1965) categorise Clients into two groups: i.e. sophisticated, and naive. They suggested that the naive Client's initial move for advice is usually made from a point of some ignorance and whatever his or her decision is it will have a significant effect upon the nature of the building team that follows, and the patterns of communications that will then develop. On the other hand, Newmen et al (1981) specified the following four Client types:

- once in a lifetime/inexperienced;
- regular/repeat;
- expert; and
- special.
3.3 ROLE OF THE CLIENT

The degree of involvement and roles of Clients in the construction process will depend to a large extent upon (Walker 1989):

- the structure of the Client's organisation;
- the Client's knowledge and experience of the construction process;
- the authority vested in the various levels of the Client's organisation; and
- the personal characteristics of the Client's staff who have responsibility for the project.

There is no set solution for the integration of the Client and the construction process. Each mechanism will have to be designed to suit the particular organisation of the Client's body. Because construction is a one-off process and the Client's organisation is a permanent one, the Client cannot be expected to change his/her organisational structure fundamentally in order to suit a particular project. However, the integration of the Client and the construction process is a most significant factor in the success of the project (Banwell Report 1964). In order to integrate itself with the construction process, the Client may well find it necessary to have a small team dedicated to the project. Their areas of responsibility should be clearly defined, so that there is no confusion as to where to go for consultation or approvals. Previous case studies have led towards the identification of three key issues relating to the Client's responsibility (NEDO 1975). These are the:

- nomination of an individual to co-ordinate Client's requirements;
- provision of a clear project brief to the design team; and
- monitoring of the progress of the design and construction teams, and involvement of the Client's Representative in any major strategic decisions that may be required during the course of the design and construction phases.
The first step of the process in which the Client has to perform an active role is to establish the need for a building (Goodacre et al 1982; Graham 1983), which is likely to involve the Client in some form of feasibility study (Salibury 1990). During this study, a detailed investigation of the Client's organisation will be conducted to establish the key criteria and clearly define the problems to be solved.

Once the Client has gone through the process of establishing the need for the project, it may be necessary to appoint some form of adviser to assist the Client in developing project requirements into a comprehensive brief. Advisers can be retained to look after the Client's interest throughout the project, or terminated upon the completion of the brief. The method of appointing such an adviser is greatly influenced by the Client construction experience (Hillebrandt 1984). The key areas in which the Client should retain strategic control over the project, following preparation of the brief, are as follows (NEDO 1975):

- selecting the design team and, in conjunction with the designers and cost advisers, selecting the contractor, and where appropriate nominating contractors;
- agreeing with the design team key dates by which Client decisions relating to the project are required, and ensuring that these are forthcoming;
- collaborating with the design team over the development of the Client's brief into firm design proposals to be agreed by the sponser department or committee;
- monitoring, against an agreed programme, the progress of the design and construction phases;
- meeting the design team leader to discuss progress and outstanding problems and ensure that, if required, any remedial action is taken; and
- restricting Client initiation of major alterations to a minimum and ensuring that any essential variations introduced after the letting of the contract are priced when issued and paid for at the time of execution.
3.4 WHY IS THE CLIENT'S REPRESENTATIVE NEEDED?

The term 'Client's Representative' is one that is often used in the construction industry, but frequently without much thought as to its meaning. It is expressed in different ways; for example 'Customer Representative' (NEDO 1988) and Employer's Agent' (Stanger 1989). However, for the context of this thesis, the term 'Client's Representative' is adopted.

A Client wishing to undertake a construction project will normally have an idea about its requirements and constraints; for example, performance, completion date and cost. The Client appoints a construction company to transform these requirements into reality. In the absence of an in-house or outside professionals to represent the Client, the Client's tasks would probably include(Stanger 1989):

- conveying ideas and requirements to the Contractor;
- preparing and/or agreeing contract documentation which sets out these ideas and requirements;
- clarifying for the Contractor any ambiguity or lack of detail in the contract documentation;
- during the course of the contract, making known his/her requirements in relation to any items which have not been fully defined at the outset;
- making changes to the original requirements and instructing the Contractor to this effect;
- giving instructions to the Contractor in the event of unforeseen circumstances, planning difficulties, ground conditions, antiquities, etc;
- monitoring the work of the Contractor to ensure quality and adherence to the contract;
- giving instructions for the removal or remedy of defective work;
- evaluating work carried out for the purpose of making interim payments;
considering and evaluating the Contractor's claims for extension of time and/or extra money;

if more than one Contractor is appointed, ensuring proper co-ordination/integration of their activities and work;

confirming when the job is "practically complete";

issuing instructions for making good defects and monitoring the making good;

agreeing final accounts with the Contractor; and

generally liaising with and instructing the Contractor as necessary throughout the project.

In order to perform most of the above tasks, the obvious solution for the Client is to appoint someone who has the appropriate experience to act as a representative. It is the representative's job to look after the Client's interests in connection with the project, and act as the focal point of communications between the Client and the construction Contractor.
3.5 Who is the Client's Representative?

During the last two decades, construction projects have become larger and more complex. The structure of the industry and the relationships between the parties involved have become much more variable. The client-architect-builder system sometimes becomes inadequate to complete the project within cost budgets and tight time schedules. There appeared a need for someone to manage the project as client's representative. The term "client's representative" was adopted by the British Property Federation (BPF) in 1983 when devising the BPF system in preference to project manager (Franks 1991). The traditional role of the Architect as the Client's Representative has to some extent been diminished by the same services offered by the other professionals such as project manager, construction manager, quantity surveyor, and consultants. Because of the increasing fluidity in the way in which projects are being run, the Client's Representative can be from any origin. It would be difficult to predict exactly who is the Client's Representative in construction projects, because it depends on the nature and type of the project and type of the Client. For instance, if the project is large, a project team will be required to act as Client's Representative, whereas, if it is small and not complex an individual can act as client's representative. However, NEDO (1988) stated that the Client's Representative (referred to in the report as "Customer Representative") can be found among Architects, Engineers, Surveyors, Project Managers, or in contracting companies with management and/or design skills as well as those of construction. Research by Franks (1991) confirmed that Architects, persons who are employed full-time by Client as Project Managers, and those who are engaged as consultant project managers as the principal points of contact. Whichever title is used, the role is to ensure that all of the Client's needs are satisfied, and to also act as the contact point between Client and the other teams associated with the project.
In the more usual contractual arrangement the following commonly act as the Client's Representative (Stanger 1989).

- In a *traditional* building project: an Architect and/or a project Manager.
- In a *design and build* project: a Designer, Quantity Surveyor or Project Manager.
- In a *management contract* arrangement: the Management Contractor and/or a Designer.
- In a *construction management* arrangement: the Construction Manager and/or a Designer.

There are no hard and fast rules; therefore, depending on the types of the procurement method, Client's Representatives can be selected from any of the professional organisations. It is apparent that the nature of the contractual arrangement plays an important part in deciding who should perform the role of the Client's Representative. The choice of the contractual arrangements will in turn depend on the nature of the project and the constraints imposed by the Client.

### 3.6 PROJECT RELATED ROLES OF CLIENT'S REPRESENTATIVES

Some of the tasks the Client would have to perform if he/she did not appoint a representative were listed in section 3.4. It is the same tasks which the Client might reasonably require his/her representative to perform on his/her behalf. In order to perform those tasks Client's Representatives must possess a number of skills. According to Stanger (1989) these include:
Technical skills
The representative has to convey the Client's ideas and requirements to the Contractor. At the outset, the Client's ideas and requirements are likely to be vague and incomplete. The representative has to translate these into a precise definition of what is required. This definition is conveyed through the medium of drawings and specifications. The process of translation therefore involves a large element of design.

Legal/contract skills
The representative is required to prepare and/or agree the contract documentation which will bind the Contractor to meet the defined requirements.

Administrative skills
The representative has to ensure that the administrative procedures under the contract are complied with, that instructions are given and information is provided when required, that certificates are issued, that any notices are given and that proper records are kept.

Quality control skills
The representative has to monitor the work of the Contractor to ensure quality and adherence to the contract.

Management skills
These will be particularly vital where more than one Contractor is appointed and their activities need to be co-ordinated.

Financial skills
Needed to evaluate work carried out for the purpose of making interim payments and to agree final accounts.
The role of the Client's Representative in construction projects varies considerably from one who is simply a monitor to one who exercises total authority and full responsibility for the design and execution of the project. However, the general managerial responsibility will be the same. This managerial responsibility entails responsibility for planning, organising, co-ordinating, staffing, leading, major decision making, motivating personnel, monitoring and controlling operations on the project (Young, 1987). The role of the Client's Representative has been discussed in the following sections with respect to:

- the availability of Clients' resources such as in-house experts; and
- the type of procurement method adopted.

3.6.1 Availability of Client's in-house resources

Figure 3.1 depicts three organisations involved in a typical construction project. In this figure, Organisation A is the principal customer, or Client, who wants the project. If Organisation A does not have the resources and expertise to perform tasks such as feasibility study, planning, preparation of the necessary contract documents and general supervision of project execution, then it engages Organisation B to undertake these activities for a fee. Organisation B may be an architectural firm, engineering consultants, or a firm specialising in project management, depending on the nature and scope of the project. Organisation C is the third party who actually constructs the facility. If Organisation A was of such size and possessed all the resources to plan, design, supervise and construct the project by itself then there would be no need for Organisation B and C. Otherwise, if Organisation A had the resources and expertise to plan, design and supervise the project, then Organisation B would not be needed. Either by tendering or by negotiation, a contractual relation is established between the Client, Organisation A, and the Contractor, Organisation C. Organisation B then acts on behalf of Organisation A to supervise the project.
All three organisations have representatives involved in the project. In this figure they were designated as Project Managers - PM.A, PM.B, and PM.C - respectively for Organisation A, Organisation B, and Organisation C. PM.A and PM.B can be treated as Client's Representatives. Young (1987) described PM.A's duty as:

- to keep the top management of Organisation A informed on progress, expenditure, and likely delays on the project;
- to approve progress payments by his/her organisation for work satisfactorily completed by Organisation C on the recommendations of the representative from Organisation B;
- to handle public relations for the project;
- to act as the key contact person in his/her organisation on all matters relating to the project.

PM.B's role would be (Young, 1987): to prepare feasibility study; to advise the Client on best choice; to plan and design; to prepare contract documents; to analyse and recommend tenders; to administer contract; to check quality and progress; and to exercise general supervision over the project.

PM.C's role is the one most directly involved with the actual execution of the project on behalf of the Contractor. He/she is an employee of the Contractor, discussing their role is outside the scope of this research.
Figure 3.1: Different roles of the Project Managers in three organisations involved in a construction project

Source: Young (1987)
3.6.2 Different types of procurement methods

This section describes the role of the Client's representative with respect to the four major types of procurement methods practised in the UK construction industry: traditional contract, design and build, management contract, and construction management. The extent of the responsibilities of the Client's Representatives in construction projects vary from one method to another, depending upon the extent of responsibility provided to the contractor in each method.

a) Traditional procurement method

In the traditional system, the Client appoints the Designer who becomes the Client's main adviser. In most building projects this will be the Architect (see Section 3.5). The main Designer becomes the leader of the team and advises the Client on the appointment of other members of the design team. The Quantity Surveyor (QS) who is responsible for cost advice and for drawing up contract documents. The Designer and often the Quantity Surveyor advises the Client on the selection and appointment of the Contractor and may decide to nominate Sub-contractors.

Whether it is a building construction or civil engineering project, the Client appoints a contractor to construct the project. Where certain duties are generally created which must be performed by the Client or on his/her behalf in order to ensure that the project is completed on time, within the budget and perhaps more importantly, with qualities as designed and specified. Whoever performs these duties is called the Client's Representative. According to the FIDIC conditions of contract, their duties are generally concerned with the following functions (Bunni 1991):
Design - The philosophy and practical calculations of the design are best known by the Client's Representative (e.g. Architect), who develops the design of the accepted proposal. This will probably entail consultations with specialist engineers (e.g. Quantity Surveyor, Structural Engineer, Building Services Engineer etc.) and negotiations with Specialist Contractors.

Quality control - The design is expressed through drawings and specifications which set out the required quality to be achieved. Quality has to be monitored by someone familiar with the original concepts and parameters of the design.

Administration and management - Administrative services during the construction are generally limited to performance of intermittent field visitations and certain contract administration functions such as review of shop drawings, evaluation of contractor claims, interpretation of plans and specifications during construction, change order request, and final inspection.

Cost accountancy and certification - The contract may be based on interim payments being made periodically, mostly on a monthly basis, by the Client to the Contractor. The Client's Representatives must possess the necessary knowledge to evaluate the Contractor's work, periodically and ultimately in a final certificate.

In the traditional method, the Architect/Engineer served as Client's Representative. Their professional service during construction are generally limited to performance of intermittent field visits and certain contract administration functions such as shop drawings and specifications, interpretation of plans and specification during construction, review of contractors payments, and final inspection.
The functions set out above are detailed in no less than 51 out of the 72 clauses of Part 1 of the fourth edition of 'The FIDIC form of contract' (in this form the Client's Representative has been referred as 'Engineer'). These are clauses: 1, 2, 4, 5, 6, 7, 12, 13, 14, 15, 16, 17, 18, 19, 20, 27, 30, 31, 33, 34(Part 2), 35, 36, 37, 38, 39, 40, 41, 42, 44, 45, 46, 48, 50, 51, 52, 53, 54, 56, 57, 58, 59, 60, 62, 63, 64, 65, 67, 68, 69, and 70. However, clauses 1 and 2 are the principal clauses with respect to setting out the duties and authority of the Engineer and in particular his/her role as the Client's Representative.

b) Design and build procurement method

The key principle of design and build, as against the other frameworks, is that it simplifies the central contractual position to that between the Client and Contractor, without any Consultants as mediator. The design responsibility is taken by the Contractor. According to the JCT (Joint Contract Tribunal) with Contractor's design (CD 81), the placement of Client's Representatives (such as the Architect, QS, etc.) is optional, because it is of course possible for each party (Client and Contractor) to a design and build contract to go it alone without consultants. However, in practice, the Client's Representatives are still needed for effective functioning of this method (Turner 1988; Pain 1988). Because, on the Client's side, the function of the Client's Representative is important over design checking, instructing changes in the scheme, extensions of time, price adjustments and payments.

The position of the Client's Representative under design and build arrangement varies with respect to two approaches: the Contractor takes over design of the whole project at some stage, briefing or beyond; and the Contractor takes over design on only a section of the project (Turner 1990).
Design of the whole project

This is the pure design and build concept, in that the Contractor assumes responsibility for the whole design. The Client's Representative is likely to prepare the brief and produce some of the design.

In general, the role of the Client's Representative in design and build with Contractor's Design form is to receive or issue applications, consents, instructions, notices, requests or statements or to otherwise act for the Client (Franks 1991). Article 3; Clauses 30, 18, and 27 of the JCT with Contractor's Design (1981) state the involvement of the Client's Representatives with respect to this role.

In addition to those activities, according to Turner (1990), the Client's Representatives (Designer and Quantity Surveyor) will be involved in:

- drawing the brief out of the Client, formulating it for presentation to the Contractor, and then assessing the Contractor's scheme prepared in response;
- establishing the budget, i.e. a cost plan which will be of value to both parties (Client and Contractor);
- calculating interim payments and final adjustments to the contract sum;
- inspecting the works during progress over quality, and instructing on behalf of the Client over defective work or materials; and
- advising the Client over the reasonableness of the provision.

Design of part of the project

This is the situation, where the whole scheme is co-ordinated by the Client's Representatives, with part of the design by them and part by the Contractor as a package within the rest. The BPF (1983) system provides more suitable environment for the Client's Representatives to perform design of the project partly and co-ordinate the whole scheme throughout the project.
The BPF system, excluding the Client, identifies three major roles acting for the Client:

- the Client's Representative, who is responsible for all aspects of management;
- the Supervisor, who monitors design and construction on behalf of the Client's Representative;
- the Design Leader, who is responsible for the Client's input.

The duties of the Client's Representative are to control time, cost, standards, and building performance, and advises the Client on the selection of Consultants and Contractors. He/she should resolve prioritising various options, issue all necessary instructions, and certify all payments on behalf of the Client.

The supervisor is appointed to assist the Client's Representative in monitoring the technical aspects of the work throughout the various stages. He/she reports to the Client's Representative when any work does not comply with the requirements of the previous stage.

A single main Consultant is appointed as Design Leader to take total responsibility for all the Client's design in accordance with the brief. The main responsibility of the Design Leader is to:

- manage the production of pre-contract design information for the project;
- co-ordinate the work of all Consultants, obtaining statutory approvals, and direct design work; and
- provide design advice on variations and to sanction the Contractor's design work.

The Design Leader has no authority to issue orders to the Consultants which will vary the work from the brief or lead to increased cost or delay. The Design Leader is authorised to give instructions to the Contractor only in an emergency.
Management Contracting

Management Contracting covers a wide range of differing roles and responsibilities. According to Dearle and Henderson (1988) the major parties involved in this arrangement are: the Client; Designer (Architect); Quantity Surveyor; and the Management Contractor. The roles of these parties vary considerably with respect to the design and management in different forms of Management Contracting (see Section 2.6.3 for different forms of management contracting). In pure management contracting, the Architect takes the design responsibility; on the other hand, in "Design and Manage" system the Contractor itself is responsible for the design (Elton 1984 and Birchall 1987).

As in the traditional procurement method, the Client appoints an Architect and other Consultants to design a building to satisfy his/her needs. The Architect prepares alternative proposals, and the Quantity Surveyor concentrates on drawings and preliminary bills of quantities in order that the Management Contractor candidates may submit tenders on a fee basis. The role of the Management Contractor should be seen as an extension of the Client, not as a separate entity, and that he/she becomes one of the Client's Consultants and is expected to co-ordinate fully with the Client's other Consultants (Weller 1991; Dearle and Henderson 1988; McKenna 1987). This statement, implicitly states that the Management Contractor is also one of the Client's Representatives (refer section 3.5). The main role of the Management Contractor is to manage the design and construction progress of the project, including supervision of the site works. In order to achieve the effectiveness of this system, the Management Contractor is appointed at an early stage of the project, so that his/her know-how of construction and materials procurement are available to the design team.
Client

As the role of the Client is often the key to the success of the project, Clients must be willing to devote people, time and money to secure the benefits of the management contracting. The Client is expected to play a wide role in the approval and guidance aspect of the scheme. The respective role typically cover the following (Elton 1984):

- to define the project;
- to establish the objectives to be met to make the project successful;
- to provide decisions, approval;
- to ensure the provision of adequate funding;
- to define who does what, and who monitors whom; and
- to ensure a site is available.

In developing the 'who does what' list the major headings that need to be considered are: feasibility study; project funding; project plan of execution; conceptual design; engineering and detailed design; evaluation of potential equipment suppliers; evaluation of potential equipment suppliers; evaluation of potential Contractors/Sub-contractors; procurement plan; project planning/estimating/budgeting; project cost control; project schedule control; accounting procedures; construction plan; industrial relation policy at site; commissioning and start up plan; quality assurance programme.

In order to perform the aforesaid areas, the Client needs to appoint the Designer, Quantity Surveyor and the Management Contractor.

Design Consultants

The position of Architects in management contracting is somewhat unclear, as on one hand, he/she is an agent of the Client with a clearly defined duty of care, but on certification, he/she has a duty to act fairly between the two contracting parties. It includes granting extension of time, even if the application by the Management Contractor is not as full and particular as it might be (Russell 1990). He/she must be
able to assess whether any delays were due to late issue of instruction or to the default of either the works Contractor or him/herself. Only in the first case is he/she allowed to grant an extension of time.

The Designer remains responsible for design, but must accept and adopt to a new party, the Management Contractor, which makes the roles of the Designer untraditional. There is still some argument about the responsibility of quality control. However, the Designer should be aware that the Management Contractor's job in performing their responsibilities for co-ordinating and managing the various Contractors, involves an element of quality control (Dearle and Henderson 1988; Huru 1992).

**Consultant Quantity Surveyor**

The Consultant Quantity Surveyor's principal duty is to the Client, which centres around the production, evaluation and financial matters but there are several technical functions within that duty which may be allocated to the Management Contractor. For example, most management contracts require the Management Contractor to prepare and take joint responsibility with the Quantity Surveyor for the accuracy of the Estimate of Prime Cost (Dearle and Henderson 1988). The Prime Cost is the combined cost of all work parcels which are controlled within the budget. According to Dearle and Henderson (1988), the tasks of the Quantity Surveyor during the pre-construction are the:

- development and agreement of the estimated cost plan. This cost plan will be incorporated with the formal contract document. The agreed estimated cost plan will provide a realistic budget for cost control; and

- development and agreement of contract procedures; particularly procedures concerned with packaging, tendering, documentation and other vital tasks to be done by agreed dates.
During the construction period, procedures established during pre-construction will be maintained, and any that are outstanding developed. This is often a joint consultative process between the Consultant Quantity Surveyor and the Management Contractor.

*Management Contractor*

The Management Contractor's main role is to manage the construction and design progress of the project, including supervision of the works on site. During the design stage, the Management Contractor will contribute resources and construction experience to the design team. The biggest contribution from the Management Contractor at the design stage is the knowledge of the market and experience of defining boundaries of responsibility and operational sequence (Carter 1972).

In general, the role of the Management Contractor will include the tasks of programming, administration and monitoring of schedule and cost against the plan and budget for the project overall. The services typically can include the preparation and administration of the following (Elton 1984).

*Project management:* overall project planning, estimating, budgeting; schedule control; cost control; evaluation of project options; location of project home office; project procedure manuals; claim evaluation; project funding.

*Engineering:* drawing control; requisition control; Vendor information control; specification review.

*Procurement:* purchase plan; contract/subcontract plan; preparation of Bidders list; preparation of purchase orders; formulation of contract packages; procurement/delivery status reports; expediting reporting; inspection reports; delivery logistics.
Construction: construction plan; contract/sub-contract plan; plan for, and provision of temporary facility; contract and sub-contract administration; construction scheduling and cost; construction progress reporting; material received reports; conduct of site progress/co-ordination meetings; industrial relations - establishment of policies and monitoring of claim procedures.

Finance and administration: payment of project accounts; cash flow estimates for draw down from project funds; administration of insurance procedures; administration of Contractor invoice approval and payment procedures; letters of credit administration.

Quality assurance: production of project quality assurance plan; production of quality assurance and control manual and procedures; supervision/monitoring of quality control.

d) Construction management

In the Construction Management method of procurement, the primary advantage for the Client is to receive construction related advice from construction management in the design phase and the contracting phase and to a lesser extent, have the whole procurement process managed as expeditiously as possible by the Construction Manager. The Construction Manager is not the only representative to the Client, there are other participants too, who participate in the Client's Procurement team - the Client itself, and Architect or Designer (Birrell 1993 and Stanger 1989). However, this system gives major responsibility to the Construction Manager in acting on behalf of the Client, from the earliest stages of the project to completion.
Construction Manager

The Construction Manager may be an outside firm or a part of the Client’s staff (Stukhart 1987). He/she may also be a firm that has the combined resources necessary to proficiently execute the form and variation of construction management best suited for or selected by the Client (Committee on Construction Management 1987). The Construction Manager’s prime contribution to the success of the project essentially rests in the ability to manage, because successful construction management requires much broader disciplines than those inherent to the sole practise of architecture, engineering, or contracting. Many research findings (Committee on Construction Management 1987 and 1991; Birrell 1993) insist that the Construction Manager should be hired before the design process begins and about the same time as the Architect is hired. The reason behind the early selection of the Construction Manager is to maximise the potential benefits from construction management in terms of design constructability and for systematic optimisation of construction related aspects of a project during the planning, design, procurement, construction, test, and start-up phases (Birrell 1993).

Skills of Construction Manager

In order to be engaged by a Client, Construction Managers should possess experience and a high degree of competence in the following (Committee on Construction Management 1987):

- planning, organising, directing, and controlling construction;
- the latest construction technology;
- materials management, including availability and cost;
- quality management;
- labour availability, use and productivity;
- cost engineering, including estimating and scheduling;
- contracting strategy;
- value engineering; and
- risk management.
Services of a Construction Manager

The services to be provided by the Construction Manager or Construction Management organisation are determined by the construction management form of contract selected by the Client. All services should be described in Client/Construction Manager agreement. Recent research work (Birrell 1993), funded by the State of Florida's Building Construction Industry Advisory Committee, identified the following services of a Construction Manager. These services will also include the supporting services required for the construction management offered by the other members of the Client's project team.

. Client's parameters and values

The Client's parameters on the end product and which will set the boundary conditions for its procurement should be established. Also, the relative weighting of these parameters one to another should be extracted from the Client and set down in writing.

. Team concepts and approach

Construction management requires the setting up and maintenance of a team spirit among those who will manage and participate in the procurement process. This will be facilitated by clearly establishing roles, their duties and the appropriate lines of communication between all roles.

. Early major decisions

A number of early major decisions have to be made by the Client's project team to format the procurement process most suitable for the building at hand. Each of these decisions should be derived from the Client's parameters and their values to provide harmony throughout procurement. Some of the areas on which decisions should be made include: hiring the Architect and Construction Manager; Client's capability to handle entrepreneurial risk; pure construction Management or Quasi Contractor Construction Management; to fast track or not to fast track.
Plan the best procurement process
The construction management project team should plan out the most appropriate procurement process comprising - sequential and or parallel works given all the circumstances surrounding its situation. All of the construction management services required within and between each phase of the procurement process should be listed. Then, what sequence these services should occur in should be established.

Execute and expedite that best procurement process
The Construction Manager, either within his/her own services, or as a member of the Client's project team, or by default of no one being appointed to do so, may be called upon to carry out the management of the procurement plan. This will require gathering information ahead of time which is needed to perform each individual service process, set up meetings of all parties involved as beneficial to that service and ensure execution of the work involved in that service.

Scheduling the procurement process
The whole procurement process should be scheduled within the duration available for the procurement process as laid out by the Client's parameters.

Advice on building costs
The Construction Manager's services relating to project cost tend to be in three major groups: providing an estimate of the expected overall project price very early in the procurement process; providing a comparative cost estimate in terms of different design concepts, different contractual work packages etc; and advising the Client on the controlling of cost of the project at all sub-phases of the procurement process.
. Knowledge of local building market place
This local knowledge appears in two major parts: local construction costs; and volume and nature of construction work ongoing now and in the future in that market place.

. Constructability of the project design
The Construction Manager should provide advice on simplifying the major features of the building to simplify the construction process. This can be achieved by creating features and details in the design which minimise interaction between trade contract packages and maximise continuity of work flows within each trade contract package.

. Quality of the project.
A Construction Manager can and should provide valid advice on project quality. He/she should suggest materials of equal quality to those suggested by the Architect but which have a lower construction cost or may suggest a different layout of features of the building which provide equal design performances but cause less inhibitions on the construction process.

. Packaging trade contract
The Construction Manager should be the major role creating both the scope and detailed documents for each trade/sub contract for each work package.

. Contracts for long lead materials
If there is a need to perform the procurement of the building with great speed, it is probable that the Client's project team (Construction Manager) can expedite faster construction by placing orders for materials that require a long lead time prior to the selection of the trade Contractor.
Finding qualified Trade/Sub-contractors

Prior to or whilst setting up of, the array of trade/sub-contract packages for the whole project, the Construction Manager should be seeking out qualified Trade/Sub-contractors in the construction industry.

Managing the bidding and contracting processes

The Construction Manager should be capable of setting up, managing, and completing the bidding and contracting for all trade/sub-contracts for the required construction work. Pre-bid meetings to clarify any questions may have to be arranged and performed and a subsequent addenda issued to all bidders.

Managing the construction process

Major input to this process will include the construction schedule created earlier to express the needs of the Client and the procurement of this building and the array of trade contracts. The work of the contractors should be monitored regularly and compared to the expected progress in the schedule. He/she should monitor the quality of works in harmony with the Architect so that these two members do not conflict or overlap, or omit their interests and work in this respect. All disputes should be handled fairly and quickly to minimise their effect on the progress.

Handling of money flows for the construction process

This can begin by rearranging the pre-construction total estimate to a cash flow per trade package per unit of time based on the construction schedule produced before the contracting phase begins. This will enable the Client to not only arrange for the appropriate total amount of financing needed for construction but also enable the planning of cash flow per month that can be expected to be paid out during the construction process.
3.7 SUMMARY

The term "Client's Representative" has been often used in the construction industry without much thought as to its meaning. In order to clarify this confusion and obtain a generic understanding of this term, Sections 3.4 and 3.5 have described who is the Client's Representative?, why the Client's Representative is needed?, and What is the position of the Client's Representative in construction projects. From those discussions, the term "Client's Representative" can be conceptually defined as follows.

The Client's Representative is a professional body (an individual or a firm, and in-house or outside to Client's organisation), who has been delegated by the Client to advice and act on his or her behalf, as a distinct member of the project team within the limit provided by the Client, in making decisions, solving disputes and coordinating various parties of the project to achieve Client's requirements successfully.

The role of Client's Representative varies with respect to two important factors: the availability of Client's resources such as in-house experts; and the types of procurement methods. When the Client organisation does not have the resources and expertise to perform such tasks as feasibility study, planning, preparation of the necessary contract documents and general supervision, then it usually engages an external organisation to undertake these activities at an agreed fee. This organisation is said to be the Client's Representative; its role would be to: prepare feasibility study; advise the Client on best choice; plan and design; prepare contract documents; analyse and recommend tenders; administer contract; check quality and progress; and exercise general supervision over the project. In order to show that various types of procurement method and the characteristics of their contractual relationships control the involvement and activities of Client's Representatives in construction projects, this chapter described the role of Client's Representatives in four of the major procurement methods adopted in UK.
The procurement systems include: traditional; design and build; management contracting; and construction management.

The role of the Client's Representative discussed in this chapter provided a foundation to embark upon analysing and determining the important activities and tasks of Client's Representatives in construction project with respect to TQM framework (see Chapter Six).
CHAPTER FOUR

TOTAL QUALITY MANAGEMENT

4.1 INTRODUCTION
4.2 UNDERSTANDING QUALITY
4.3 WHAT IS TQM?
4.4 EVOLUTION OF TQM
4.5 TQM AND QUALITY ASSURANCE (QA)
4.6 THE PRINCIPLES OF TQM
4.7 THE ELEMENTS OF TQM
4.8 IMPLEMENTING TQM IN ENGINEERING AND CONSTRUCTION
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CHAPTER FOUR

TOTAL QUALITY MANAGEMENT

4.1 INTRODUCTION

Cost reduction, improved productivity and continuous improvement are essential if any organisation is to survive. Total Quality Management (TQM) is a never ending improvement process aimed at customer satisfaction. It provides an organisation with the opportunity to achieve cost reduction, productivity and continuous improvement. It is a way of managing business processes to ensure complete 'Customer' satisfaction at every stage, both internally and externally. This chapter reviews the principles and components of TQM, and its applicability to construction industry.

4.2 UNDERSTANDING QUALITY

Two distinct types of quality have emerged - Quality in Fact and Quality in Perception (Townsend 1990). The provider of a product or service who performs up to its own specifications achieves Quality in Fact. Crosby (1979) defines quality as "conformance to requirements". Juran's (1989) definition of quality states that it is "fitness for use". These two definitions leave unclear whose requirements and fitness dominates - whether the Producer or the Customer. Their definitions fall within the boundary of production. However, Deming (1982) taught that "the Customer is the most important part of the production line", and was concerned with delighting rather than merely satisfying the Customer. Customer satisfaction can be determined only when they impart full involvement in the production life cycle. This is related to Quality in
Perception - quality as the Customer sees it. A product or service achieves Quality in perception when it meets the Customer's expectations. In management terms, quality can simply be defined as "satisfying the Customer requirements", and this has been defined in many ways by many authors.

The quality of an organisation's products, services, and other outputs is defined by the satisfaction of the Customers who use them and is determined by the effectiveness and efficiency of the processes by which they are created and supported (BS 7850, pp. 3)

Meeting the customer's needs and expectations at a price he/she is prepared to pay [Pike and Barnes 1994, pp. 19].

4.3 What is TQM?

TQM has been defined in many different way, but the theme of all definitions concentrate at two basic principles: customer satisfaction and continuous improvement.

Drummond (1992) stated that:

TQM is a business philosophy based on Customer satisfaction. It requires continuous improvement.

QPMA (Quality and Productivity Management Association 1993) defined TQM as follows.

Total Quality is a Client-focused, strategic and systematic approach to the continuous improvement of performance (pp. 444).
The ECI TQM Task Force (1993), in its definition stressed the involvement of all employees for achieving Customer satisfaction and continuous improvement:

TQM is a management-led process to obtain the involvement of all employees, in the continuous improvement of the performances of all activities, as part of normal business, to meet the needs and satisfaction of the Customer whether internal or external (pp. 15).

TQM is not another management programme to be replaced. In the words of Burati (1991), "it is a culture and philosophy that must permeate an organisation as the method of management".

4.4 EVOLUTION OF TQM

Quality management systems have been growing rapidly in recent years. During the past forty years, quality was thought to be achievable via by several management practices. The progression of the quality journey started simply from inspection activities, replaced or supplemented by quality control, quality assurance, and presently culminated at Total Quality Management. Dale and Plunkett (1990) have presented the evolution of four levels of quality management - Inspection, Quality Control, Quality Management, and Total Quality Management - in a graphical form (see Figure 4.1).

An inspection-based system includes examining, measuring, resting and comparing characteristics of a product with specified requirements. It is mainly performed by staff employed specifically for the purpose. This system is after-the-fact screening process. It do not involve directly Suppliers or Customers.
Quality Control involves operational techniques and activities aimed at monitoring a process and eliminating causes of unsatisfactory performance of relevant stages of the quality loop (quality spiral) in order to result in economic effectiveness (ISO 8402 1986). In a Quality Control system, a greater control over process is achieved, but the main mechanism for preventing failure is achieved by inspection and testing of process and product.

Quality Assurance contains all those planned and systematic actions required to provide adequate confidence that a product or service will satisfy given requirements for quality (ISO 8402 1986). It is a shift of management practice from mere detection towards prevention of non-conformance.
The fourth level is TQM which requires that the principles of quality management to be applied in every branch and at every level in the organisation. It involves all participants working together for a common goal, which includes partnership with suppliers and Customers (Oakland 1994). The present day TQM concept has evolved from the teachings of internationally accepted quality experts such as Crosby (1979), Deming (1982), Feigenbaum (1983), Ishikawa (1985), Juran (1989), Shingo (1986), and Taguchi (1986). Out of all these the teachings of Crosby, Deming, and Juran provide basics for TQM philosophy.

*Crosby*

Crosby's (1979) fourteen steps to quality improvement are as follows:

1. make it clear that management is committed to quality;
2. form quality improvement teams with senior representatives from each department;
3. measure processes to determine where current and potential quality problems lie;
4. evaluate the cost of quality and explain its use as a management tool;
5. raise the quality awareness and personal concern of all employees;
6. take actions to correct problems identified through previous steps;
7. establish progress monitoring for the improvement process;
8. train supervisors to actively carry out their part of the quality improvement programme;
9. hold a Zero Defects Day to let everyone realise that there has been a change and to reaffirm management commitment;
10. encourage individuals to establish improvement goals for themselves and their groups;
11. encourage employees to communicate management the obstacles they face in attaining their improvement goals;
12. recognise and appreciate those who participate;
13. establish Quality Councils to communicate on a regular basis; and
14. do it all over again to emphasise that the quality improvement programme never ends.

Deming

Deming's (1982) 14 points for management are as follows:

1. create constancy of purpose to improve product and services;
2. adopt new philosophy for new economic age by management learning responsibilities and taking leadership for change;
3. cease dependence on inspection to achieve quality; eliminate the need for mass inspection by building quality into the product;
4. end awarding business on price; instead minimise total cost and move towards single suppliers for items;
5. improve quality and forever the system of production and service to improve quality and productivity and to decrease costs;
6. institute training on the job;
7. institute leadership; supervision should be to help do a better job; overhaul supervision of management and production workers;
8. drive out fear so that all may work effectively for the organisation;
9. breakdown barriers between departments; research, design, sales and production must work together to foresee problems in production and use;
10. eliminate slogans, exhortations and numerical targets for the workforce, such as 'zero defects' or new productivity levels. Such exhortations are diversory as the bulk of the problems belong to the system and are beyond the power of the workforce;
11. eliminate quotas or work standards, and management by objectives or numerical goals; substitute leadership;
12. remove barriers that rob people of their right to pride of workmanship; hourly workers, management and engineering; eliminate annual or merit ratings and management by objective;
13. institute a vigorous education and self-improvement programme; and
14. put everyone in the company to work to accomplish the transformation.

Juran

Juran's (1989) steps for quality improvement are as follows:

1. build awareness of the need and opportunity for improvement;
2. set goals for improvement;
3. organise to reach the goals (establish a quality council, identify problems, select projects, appoint teams, designate facilitators);
4. provide training;
5. carry out projects to solve problems;
6. report progress;
7. give recognition;
8. communicate results;
9. keep score;
10. maintain momentum by making annual improvement part of the regular systems and processes of the company.

Crosby's theory is based upon the well known concepts - "do it right first time and zero defects". He strongly believes that if the thing is done right at first time, then it would reduce cost and raise profit. Deming's concept is based on the principle of developing a partnership with the supplier and managing quality with direct statistical measures without cost of quality measures. It stresses the unsupervised work, i.e. the self-management by the processor (operatives) himself/herself. Juran's definition for quality is 'fitness for use', his message had a strong managerial flavour and focused on
planning, organisational issues, management's responsibility for quality, and the need to set goals and targets for improvement. His emphasis is that quality control should be conducted as an integral part of management control.

In order to achieve quality, Crosby recommends a strong management commitment and involvement in: making awareness among people; training and motivating individuals and groups; and measuring progress. His advise is, to a large extent, towards the top management. He does not believe that workers should take prime responsibility for poor quality, instead he believes that workers commit mistakes (defects) because of the improper management followed by the top level management. This indirectly indicates that workers' mistakes are the causes of poor quality, but if they are properly managed, quality can be achieved. This resulted in the most popular terminology "zero defect" management, i.e. prevention (of errors) management in all levels. Whereas, Juran believes that the majority of quality problems are the fault of poor management, rather than poor workmenship (defects or mistakes) of the workers.

Unlike Crosby and Juran, Deming's advise provides a different route for quality. He strongly emphasised both the close working (teamwork) and the elimination of inspection of other's works. However, his tenth point "elimination of slogans" certainly contradict the views of other Quality Gurus. Whereas both Crosby and Juran maintain that publicising achievements encourages people and reaffirm management commitment. It can be seen in the following sections that the principles of TQM are based on the mixture of the advise of the these three Quality Gurus.
4.5 TQM AND QUALITY ASSURANCE (QA)

TQM is an umbrella for continuous improvement, and is also an approach to improving the effectiveness of the organisation as a whole (see Section 4.3). Where as Quality Assurance is about imparting confidence - confidence to the Purchaser and confidence to the management of the organisation itself (see Section 4.2). BS 5750 and ISO series provide excellent quality systems for Quality Assurance. However, TQM is not a substitute for BS 5750 but involves going beyond the requirements of that standard into a situation in which every individual in an organisation, and every activity is part of the quality process (CIRIA 1991). Figure 4.2 may help to make this clear. In this figure, it is clear that the Quality Assurance (BS 5750 PART 1-3, BS 5750 PART 0.2) and TQM may all be regarded as parts of a continuum, or a spectrum and that QA is a part of TQM.

---

**Figure 4.2: The Quality Management spectrum**

Table 4.1: TQM and Quality Assurance - comparison

Source: ECI (1993 pp. 15)

<table>
<thead>
<tr>
<th>QUALITY ASSURANCE</th>
<th>TOTAL QUALITY MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Is only part of Total Quality Management.</em></td>
<td><em>Is a process to obtain continuous improvement of the performance of all activities.</em></td>
</tr>
<tr>
<td><em>Is a systematic approach. Provides adequate confidence. Satisfies given requirements.</em></td>
<td><em>Provides satisfaction of Customers, whether internal or external.</em></td>
</tr>
<tr>
<td></td>
<td><em>Provides principles, tools and techniques.</em></td>
</tr>
<tr>
<td>Part of quality improvement process.</td>
<td>A process for continuous improvement.</td>
</tr>
<tr>
<td>A systematic approach, influences attitudes and working environment.</td>
<td>Changes attitudes and working environment and provides tools, techniques and systems for continuous improvement.</td>
</tr>
<tr>
<td>Aims to ensure Customers' requirements are met every time.</td>
<td>Creates a right first time attitude to delight our Customers.</td>
</tr>
<tr>
<td>Provides a base line for the Customer of the quality of the product or service.</td>
<td>Cost of quality is recognised as vital, and provides measurement for continuous improvement.</td>
</tr>
<tr>
<td>Provides confidence to the Customer of the quality of the product or service.</td>
<td>The Supplier of the product or service is recognised as a quality company by Customers and employees.</td>
</tr>
<tr>
<td>Provides the means to reduce waste.</td>
<td>Seeks to eliminate waste.</td>
</tr>
<tr>
<td>Enhances publicity and image.</td>
<td>Attracts publicity and company used as role model for quality.</td>
</tr>
<tr>
<td>Provides procedures for doing things right.</td>
<td>Provides for doing the right things right.</td>
</tr>
<tr>
<td>Improvement is by eliminating recurring problems.</td>
<td>Improvement is by cultural change based on measurement of performance and elimination of root causes and constraints.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Requires a structured organisation and a statement of key responsibilities.</td>
<td>Creates a culture in the organisation that seeks to continuously improve in all activities.</td>
</tr>
<tr>
<td>It is directive, and provides procedures for all activities and working practices.</td>
<td>Focuses on a full understanding of the various business processes by the day to day involvement of all concerned.</td>
</tr>
<tr>
<td>Provides quality records of all activities.</td>
<td>Uses quality records for measurement and for continuous improvement.</td>
</tr>
<tr>
<td>The system relies on regular monitoring and audits to identify and correct non-confirmances.</td>
<td>Involves getting ideas and suggestions for improvements from everyone.</td>
</tr>
<tr>
<td>Regular management reviews of the procedures and working practices leads to improvement.</td>
<td>Stresses the importance of products and services delivered to the Customer, whether internal or external, meeting requirements whether specified or not.</td>
</tr>
<tr>
<td>Ensures that people are trained and experienced.</td>
<td>Ensures that everybody in the organisation receives education and training to enable them to do their job effectively and achieve personal satisfaction.</td>
</tr>
</tbody>
</table>
4.6 THE PRINCIPLES OF TQM

The fundamental goals of TQM are customer satisfaction and continuous improvement, and are thereby the principles upon which it is based (Mathews and Burati 1989).

4.6.1 Customer satisfaction

The TQM philosophy stresses customer satisfaction rather than quicker responsiveness in fixing customer quality problems. It means emphasising very high quality performance in the development and introduction of new products.

Customers can be either internal and external. Primarily, the Customer will be the ultimate recipient of the service external to the organisation - the Client (Owner). Secondly, a Customer may be a unit within the service organisations - the Designer, Contractor etc. All these Customers have to act as a Processor and Supplier at various stages of a process. Juran's (1988) triple role concept explains this as well. According to him, every party in a process has three roles - Supplier, Processor and Customer. Burati (1992) illustrates this concept in Figure 4.3. The Owner supplies the information of his/her requirements to the Designer, receives the facility from the Constructor, and processes the Facility's operation. The Designer supplies the plans and specification to the Constructor, receives the brief from the Owner, and processes the design and details. The Constructor supplies the completed facility to the Owner, receives plans and specification from the Designer and processes the construction. According to this principle, all parties are acting as a Customer at one stage, when they become the Supplier they should satisfy the requirements of their immediate Customer. If this chain goes on, it will continue towards the external Customer, the final product is then said to have achieved total quality.
4.6.2 Continuous improvement

Construction involves innumerable processes - eg. placing of concrete, formwork, and welding - which are performed by number of Internal Customers such as formworker and welder etc. (see Section 4.6.1 for 'Internal Customer'). Within each stage of a process, input changes to output. If a person involved in a particular stage of the process constantly improves the methods and procedures of the process, it will improve the efficiency of the output of the process, consequently the immediate recipient (Internal or External Customer) of the output will be satisfied.

Deming’s Plan-Do-Check-Act (PDCA) cycle, as shown in Figure 4.4 is a systematic procedure for incrementally improving methods and procedures by focusing on correcting and preventing defects (Burati 1992). This is accomplished by removing the root causes of problems and continuously establishing and revising new standards.

There are three basic principles of never-ending improvement (Oakland 1994): focusing on the Customer; understanding the process; and all employees committed to quality.

![Diagram of Juran's Triple role concept applied to construction](image)

**Figure 4.3:** Juran's Triple role concept applied to construction

Take corrective action on the opportunity, standardize, and feed forward to the next plan.

Plan improvements for present practices.

Act

Verify the results of the plan.

Check

Plan

Progress

Do

Implement the plan on a small scale.

**Figure 4.4: PDCA Cycle**


*Focusing on the customer*

An organisation must recognise, throughout its ranks, that the purpose of all work and all efforts to make improvements is to serve the Customers better.

*Understanding the process*

In the successful operation of any process, it is essential to understand what determines performance and outputs. This means understanding process flows to eliminate bottlenecks and reduce waste.

*All employees committed to quality*

Everyone in the organisation, from top to bottom must play their part. Senior management must convince everyone of their own role in total quality.
4.7 THE ELEMENTS OF TQM

Burati and Mathews (1992) have identified seven basic elements of TQM:

- management commitment and leadership;
- training;
- teamwork;
- statistical methods;
- cost of quality;
- supplier involvement; and
- customer service.

4.7.1 Management commitment and leadership

Oswald and Burati (1992) argued that senior management should personally lead the building of quality values into the company's operations. This single finding eclipses all the rest. If this does not happen, quality improvement does not happen. The prime task required for TQM implementation is, thus, management's commitment. The senior management personally establishes new goals and directions for the company and then leads the management team towards the achievement of those goals and directions.

Everyone involved in the process must show their commitment, which enables the participants in the next layer of management to realise the importance of quality. Curtis (1989) stated that their company (Avon Cosmetics Ltd, UK) had followed the following three steps to achieve commitment.

step 1: a sense of belonging created by an informed and involved workforce sharing in success.
step 2: engendering a sense of excitement in the job through development of pride, trust and responsibility for results.

step 3: producing confidence in management leadership based on its authority, dedication and competence.

4.7.2 Training

As TQM is a participative, disciplined, organised and a newly framed approach - which is fundamentally about change - training is necessary to all levels of management (Burati and Mathews 1992; Jeffries 1992). The aim of the training process is about helping people to learn. There is no exemption from training. From board room to construction site, all must be trained. Recent research by Burati (1993) indicated that most companies followed the sequence of training the top management first, followed by middle management, and finally the work force. Once the top management receives extensive training in TQM, it retains the responsibility for getting the training down through the organisation. Jeffries (1992) described the TQM training process in four stages as shown in Figure 4.5.

Diagnosing

Diagnosing training needs is about performing a detailed analysis to ensure that any subsequent training or learning experience is focused and contributes to improved performance. During this stage the type of training, the individual, team, department or organisation is in need is assessed. Jeffries mentioned three types of training needs:

- Reactive: where a problem exists and training is required to remove the problem;
- Flexibility based: where training is needed to enable people to undertake a range of new tasks as well as their existing ones; and
Developmental: involves training people over a period of time in readiness for a future requirement or opportunity.

Figure 4.5: Managing the TQM learning process

Learning events
Once the needs have been identified, then events relating to training needs should be learnt.

Transferring the learning
Applying the learning back in the work place - ie, not only application as part of a training event but also application in the workplace. In order to transfer learning back to workplace effectively, Jeffries suggested that:

- where possible use the workplace as the centre of learning problems with transfer are then circumvented; and
where this is not possible and the training takes place elsewhere, help with the transfer of learning and/or skills back to the workplace.

Evaluating

In the training process, there are two customers: the learner or recipient of the training; and the recipient of the effect of the training - usually the learner's manager. Thus, two sets of Customer success criteria should be taken into account in the evaluation of training.

4.7.3 Teamwork

Teamwork within Total Quality is the use of mixed groups of people to improve the quality of an activity. It is a controllable way of involving people and releasing untapped potential (TQM International 1992).

The complex nature of the construction process requires many professionals, specialists and experts to solve particular problems. Solving such complex problems is beyond the capabilities of any one individual. Oakland (1994) argued that the only efficient way to tackle process improvement or problems is through the use of some form of teamwork. He further highlights the advantages of teamwork as follows.

- A greater variety of complex problems may be tackled - those beyond the capability of anyone individual or even one department - by the pooling of expertise and resources.
- Problems are exposed to a greater diversity of knowledge, skill experience and are solved more efficiently.
- The approach is more satisfying to members, and boosts morale and ownership through participation in problem solving and decision making.
Problems that cross departmental or functional boundaries can be dealt with more easily, and the potential/actual conflicts are more likely to be identified and solved.

The recommendations are more likely to be implemented than individual suggestions, as the quality of decision making in good teams, is high.

Depending on the size of the organisation and the nature of tasks, Quality Teams may be necessary at divisional level and again at departmental level for guiding the TQM effort down through the company. Research by Burati and Mathews (1991) indicated that most of the companies which have implemented TQM had designed their organisational structure as such that the Divisional Managers are members of the 'Executive Steering Committee' and leader of the division level teams. The Departmental Managers are members of the divisional level teams and leaders of the departmental teams. The main objective of integrating such levels of hierarchy in an organisation is to achieve teamwork throughout the organisation - from top to bottom.

One of the main functions of the teamwork is step by step problem solving. When properly managed and developed, teams improve the process of problem solving, producing results quickly and economically (Oakland 1994). TQM International Ltd. (1992) described the step by step problem solving process as shown in Figure 4.6.
Figure 4.6: Step by step problem solving process

Figure 4.6 illustrates the first step for the team as identifying and explaining the nature of the problem; next the team identifies factors contributing to the problem and prioritises them in order of importance. Once this completed, the team determines a specific goal for improvement. Then the team identifies and verifies the root causes of the problem and then develops solutions to the most significant root causes. The final solutions are implemented, their effectiveness checked and ensured that any recurrence of the problem is prevented.
4.7.4 Statistical methods

TQM provides quality systems to perform various activities involved in a process. Unless and until such a system produces results that are 'in control', making changes in the system by incorporating the TQM principles may only worsen the situation. Controlling the system may involve numbers and information which forms the basis for understanding, decisions and actions and a thorough data gathering, recording and presentation. The Japanese Quality Guru, Ishikawa (1985) provided 'seven basic tools', which can be used to interpret and derive the maximum use from data. The seven tools include:

- pareto charts;
- cause and effects diagrams;
- stratification;
- check sheets;
- histograms;
- scatter diagrams; and
- Schewart's control charts and graphs

Success of quality improvement projects is usually enhanced by proper application of these tools and techniques. Statistical methods provide teams with the tools to (Perisco 1989):

- identify and separate causes of quality problems;
- communicate in precise language that can be understood by all team members;
- verify, repeat, and reproduce measurements based on data;
- determine the past, present, and to a lesser degree, the future status of a workprocess; and
- discuss and make decisions on facts that are based on data rather than the opinions and preferences of individuals or groups.
BS 7850 (1992) gives a guidance on how and when to use total quality tools appropriately (see Table 4.2).

**Table 4.2: Use of tools or technique**


<table>
<thead>
<tr>
<th>Tools or Technique</th>
<th>When to select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data collection form.</td>
<td>Gather a variety of data in a systematic fashion for a clear and objective picture of the facts.</td>
</tr>
<tr>
<td><strong>Tools for non-numerical data</strong></td>
<td></td>
</tr>
<tr>
<td>Affinity diagram.</td>
<td>Organise into groupings a large number of ideas, opinions, issues, or other concerns.</td>
</tr>
<tr>
<td>Benchmarking.</td>
<td>Measure your process against those recognised leaders.</td>
</tr>
<tr>
<td>Brainstorming.</td>
<td>Generate, clarify, and evaluate a sizable list ideas, problems, or issues.</td>
</tr>
<tr>
<td>Cause and effect diagram.</td>
<td>Systematically analyse cause and effect relationships and identify potential root causes of a problem.</td>
</tr>
<tr>
<td>Flow chart.</td>
<td>Describe an existing process, develop modification, or design an entirely new process.</td>
</tr>
<tr>
<td>Tree diagram.</td>
<td>Break-down a subject into its basic elements.</td>
</tr>
<tr>
<td><strong>Tools for numerical data</strong></td>
<td></td>
</tr>
</tbody>
</table>
Control chart. Monitor the performance of a process with frequent outputs to determine if its performance reveals normal variations or out-of-control conditions.

Histogram. Display the dispersion or spread of data.

Pareto diagram. Identify major factors and distinguish the most important causes of quality losses from the less significant ones.

Scatter diagram. Discover, confirm, or display relationships between two sets of data.

### 4.7.5 Cost of quality

A competitive product or service, well balanced between quality and cost factors may often be the principle goal of responsible management. In TQM the effectiveness of the quality improvement activities can also be measured in terms of cost. Based on Crosby's theory, Burati (1991) argued that improvement opportunities can be identified by tracking the cost of quality. Quality costs can be broken-down into two categories: costs of prevention and appraisal; and costs of deviations. The breakdown of these costs is shown below (Ledbetter 1989):

\[
\text{quality costs} = \text{quality management costs} + \text{deviation costs};
\]

quality management costs = prevention costs + appraisal costs.

**Prevention costs**

These costs are those associated with the design, implementation and maintenance of the Total Quality Management system. These costs include: determination of requirements and the setting of corresponding specifications; quality planning; creation
and maintenance of the quality system; training; and miscellaneous costs such as clerical, travel, supply, shipping, communication and other general office management.

**Appraisal costs**

These costs are associated with evaluation of purchased materials, processes, intermediates, products and services to assure conformance with the specified requirements. It includes: verification of products and services; quality audits; and in construction terms, design or constructability reviews might be considered prevention costs.

**Deviation costs**

Deviation costs are those resulting from not meeting the requirements. Oakland (1994) subdivide this into: internal failure costs and external failure costs. Internal failure costs occur when the results of work fail to meet pre-determined quality standards, and are detected before transfer takes place. It includes: scrap; waste; rework or rectification; re-inspection; and failure analysis. External failure costs occur when products or services fail to reach design quality standards but are not detected until after transfer to the Customer. It includes: repair and services, claims, complaints, returns, liabilities; and loss of goodwill.
The relationship between the quality related costs of prevention, appraisal and failure and increasing quality awareness and improvement in the organisation is shown in Figure 4.7.

When the quality awareness is low, the total quality related costs are high, where the failure cost is dominating. Quality awareness and improvement requires considerable costs for initial investment in training, this will increase the appraisal costs. As the increased appraisal leads to investigations and further awareness, further investment in prevention is made to improve design features, processes and systems. As the prevention action takes effect, the failure and appraisal costs fall and the total costs reduce.
4.7.6 Supplier involvement

In construction, the quality of the project built by the constructor is directly related to the quality of the plans and specifications of the Designers, the quality of the materials and equipment supplied by the vendors, and the quality of the work performed by the Sub-contractors (Burati 1992). Generally, the main Contractors are treated as the first party to the business. They are more responsible than any one for the finished product to be quality. The quality of the product or service they get from the Supplier or Sub-contractor is also critical to the quality of the finished product. In order to achieve the best economy and quality, Burati suggested a close and long-term relationship with the suppliers to the construction process.

Lascelles (1990) stated that those companies with the best suppliers, and which can make most effective use of their Supplier's capabilities, will have a competitive advantage. To improve the capability of the Suppliers, Customers have offered training courses to the Supplier (Chase 1993). Supplier development requires a fundamental shift in the Customer-Supplier relationship; it requires a company to treat its Suppliers as long-term business partners. Deming (1986) recommend that the number of Suppliers for a particular service or product be reduced, and that price not be the only criteria in Supplier selection. This allows the parties to better understand and meet each other's expectations, and reduce the learning curve.

The findings of research by Dale (1988) revealed that certain aspects of the Customer-Supplier relationship can act as a barrier to Supplier development. These include: poor communication and feedback; Supplier complacency, misguided Supplier improvement objectives; the credibility of the Customer as viewed by the Supplier and misconceptions regarding purchasing power. Dale suggested that for the improvement of the Supplier, both Customer and Supplier should act to remove those barriers, which will enable the Supplier to supply a quality product or service to the Customer.
4.7.7 Customer service

In TQM, Customer satisfaction becomes a mission that permeates the organisation; and it becomes the ultimate goal of every employee. Customer satisfaction is enhanced by extending the TQM concept to the Customer in the form of joint teams (Burati 1992).

In the design and construction of facilities, more emphasis is placed on defining the Customer's needs and wants, translating these needs and wants into accurate plans and specifications, and then performing construction in such a manner that the Customer's expectations are met. During these processes, unlike the traditional methods, the Client should participate all along the project cycle, in making decisions, giving advise, and selecting participants for the project (Baden 1993).

The customer should improve relationships with their Vendors by establishing standard specification formats and formal feedback mechanisms for the Vendors. Communication with the key Vendors should be constant and not based on specific job performance alone (Strange 1993).

4.8 IMPLEMENTING TQM IN ENGINEERING AND CONSTRUCTION

In the implementation of TQM, the decision, where to begin may be somewhat difficult. It is not just, hiring a ready-made planning procedure from Consultants or from some other sources and implementing in the project. At the initial stage, it needs careful exploration of ideas and understanding of the concept and behaviour of TQM. Oakland (1994) provides 14 steps for implementation of TQM (Figure 4.8). The steps include: understanding quality; commitment and leadership; design for quality; planning for quality; systems for quality; measurement; costs of quality; tools and techniques for
improvement; capability and control; organisation for quality; communications for quality; teamwork for culture change; training for quality; and finally implementation of TQM.

The initial stages of understanding, commitment, and leadership form the foundation of the whole TQM structure. The understanding must be translated into commitment, policies, plans and actions for TQM. A strategy for system, capability and control should be framed for effective implementation, without this, the expended effort will become waste. Once the plans and systems have been put into effect, the need for education, training and communication becomes paramount for following the changed culture. Then the implementation begins with the drawing up of the mission statement, and establishment of organisational structure, both for managing and encouraging
acceptance of quality through teamwork. During the various stages of the implementation process, the true progress is measured and checked.

4.8.1 Implementing TQM in engineering and construction organisations

The Construction Industry Institute (CII) sponsored research in 1989 which identified three phases of implementing TQM: motivation phase; investigation and development phase; and implementation phase. Further research (Oswald and Burati 1993) revealed four phases of implementation:

- exploration and commitment phase;
- planning and preparation phase;
- implementation phase; and
- sustaining phase.

These four phases illustrate that the TQM implementators have put more effort in the implementation process before the actual launching of the TQM process. The exploration and commitment phase indicates that the commitment of top management is the key element to implementing TQM. Development phase has matured into the planning and preparation phase. The improvements achieved in the implementation phase are sustained, and activities leading to further improvements are explored in sustaining phase. Because, without any effort to stabilise and upgrade the newly established system, its decline is inevitable (Imai 1986).

Exploration and commitment phase

In this phase, top management establishes a need for change, and decides to commit to TQM as a company policy. The senior management then investigates the various available approaches, to select and develop one that would best fit the company. At the earlier stage of this phase a steering team headed by the Chief Executive Officer (CEO)
is formed, and the steering team is represented from all sections of the company. The exploration and commitment phase was characterised by (Burati 1993):

- **top management becoming aware of a need for change in the way the organisation is run, to achieve increased profitability of Owners, Contractors, and Suppliers, on a win-win basis;**
- **top management investigating modern Quality Improvement philosophies;**
- **engaging a Consultant to provide basic education concerning the selected Quality Improvement approach;**
- **appointing an in-house co-ordinator;**
- **developing a plan for organisation-wide training; and**
- **basic training of the uppermost tier of management.**

**Planning and preparation phase**

This phase is to ensure that, necessary planning, including commitment of resources, and basic training are in place. Burati (1993) characterise the planning and preparing phase as:

- **developing a strategic quality deployment process and the basic infrastructure within which the TQM process will be pursued;**
- **continuing top management's training, into Quality Improvement tools;**
- **extending training to middle managers and the work force, in that order, with quality awareness training given first at each level, followed by Quality Improvement tools;**
- **developing a network of "champions".**
Implementation phase

During the implementation commitment, planning, and preparation of the two initial phases are translated into action. According to Burati (1993) the major activities included in this phase are:

. extending the infrastructure by creating and chartering teams at various levels, including high-level oversight teams, and action teams to perform a few strategically chosen pilot Quality Improvement projects;
. continuing to realign the reward system to support the desired behaviours;
. training teams, as teams, in the skills and techniques needed to perform their assigned Quality Improvement projects;
. top management rolling out the TQM process, by implementing the results of the pilot project teams, publishing the attendant success stories, and extending the Quality Improvement effort to teams and projects throughout the organisation;
. formally celebrating the implementation results to date; and
. extending the TQM process to Vendors and Suppliers once the in-house program is considered to be progressing satisfactorily.

Sustaining phase

In this phase, the created TQM infrastructure is integrated into the normal management process of the business, and the process is continuously reviewed and planned for continuous improvement. Some of the conditions prevailing in the sustaining phase are (Burati 1993):

. integrating the specially created TQM infrastructure features (organisational elements, processes, etc.) into the normal management processes of the business;
. continuing planning for long-term quality improvement;
continuing and intensifying focus on the improvement of the work processes of the organisation, with the objective of increasing Customer satisfaction;

continuing management commitment to the internal workings of the process, as clearly evidenced by its (management's) attitudes and its behaviour;

continuing action in the training, teamwork, empowerment, and participation of the workforce across the full spectrum of TQM activities;

continuing study and implementation of advanced training and leadership practices; and

continuing active oversight by management of the TQM process, as opposed to "just letting it run itself".

4.8.2 Implementing jobsite quality in construction projects

TQM focuses on two principles: customer satisfaction; and continuous improvement (see Section 4.6). These two principles can be achieved by the participants working together towards a common goal. Since the construction process involves inputs from many participants, teamwork becomes essential and inevitable for improving jobsite quality. The concept of 'teamwork' for improving jobsite quality was emphasised by many researchers and experts (CII 1991; NEDC'S Working Party 1991; Federle and Chase 1993; and Latham Report 1994).

In May of 1992, the Construction Engineering Programme at Iowa State University held its third "Total Quality Management in Building Design and Construction Workshop" in Dallas, Texas. According to Federle and Chase (1993), the main recommendations for the improvement of jobsite quality observed in the workshop were:
conducting pre-construction sessions in order to develop a clear understanding of all parties, and this session includes the Owner, Designer, Contractor and Sub-contractor;

conducting jobsite orientation for all employees. The orientation should address the concept or TQM, safety and quality improvement activities, etc.;

conducting weekly planning meetings to outline work to be accomplished in the following weeks;

establishing work teams in each craft area to pre-plan their own work and determine resource requirements;

making provisions for recognition of quality accomplishments on the jobsite;

developing indicators of jobsite quality;

communicating quality expectations to the craft workers of all trades;

frequently surveying craft workers and requesting them to submit suggestions for improvement;

establishing quality improvement teams in design and craft area; and

providing training to all quality teams for continuous improvement.

Research conducted by CII (1991) and NEDC's Working Party (1991) revealed that many of the companies involved in partnering arrangements (partnering is further discussed in next chapter) had formed Joint Management Teams at a very early stage of individual project to implement jobsite quality. According to NEDC's Working Party, several of the companies such as Dupont/Fluor Daniel, Union Carbide/Bechtel, Procter & Gamble/Kellog, and Shell Oil/Parsons had worked jointly through partnering arrangement for achieving jobsite quality. Prior to forming a Joint Management Team, these partners had conducted a pre-planning session, in which project participants such as the Client or his/her Representatives Contractors and Designers had participated and provided their construction knowledge. Based on the outcome of this session they jointly developed an implementation plan. Through this approach, all parties were informed of the Client's expectations and those of other parties. Input for design
improvements was solicited from construction professionals, and quality expectations and implementation process were selected from previous experience. During the course of construction, the Joint Management Team played an active role in keeping all parties and teams together for achieving continuous improvement and customer satisfaction.

4.9 SUMMARY

This chapter described the principles of TQM and its application to engineering and construction. The concept of TQM as presented in this chapter has provided sufficient information to develop the role of the Client’s Representative in construction projects with respect to TQM framework, which is discussed in Chapter Six. The issues and elements involved in TQM are summarised as below.

TQM is an umbrella for continuous improvement, and it is an approach to improving the effectiveness of the organisation as a whole. The two fundamental principles involved in TQM are: customer satisfaction; and continuous improvement. In order to achieve these goals, the important elements to be considered when implementing TQM are: management commitment and leadership; training; teamwork; statistical methods; cost of quality; supplier involvement; and customer focus.

- Senior management commitment is vital to the success of TQM programme. Commitment coupled with a thorough understanding of TQM will enable the management to lead the company in a quality evolution.

- Training for TQM involves four stages: diagnosing training needs; learning event relating to training needs; applying the learning back in the workplace; and evaluating the progress against the learner's original expectations.

- Teamwork within total quality is the use of mixed groups of people to improve the quality of an activity. It enhances the team to solve the problem effectively.
Success of quality improvement projects is usually enhanced by proper application of statistical tools and techniques. Statistical tools include: affinity diagram; benchmarking; cause and effect diagram; flow chart; tree diagram; control chart; histogram; parreto diagram; and scatter diagram.

Two categories of quality costs are costs of prevention and appraisal and costs of deviation.

\[
\text{Quality costs} = \text{Quality Management costs} + \text{Deviation costs}
\]

\[
\text{Quality management costs} = \text{Prevention costs} + \text{Appraisal costs}.
\]

Poor communications and feedback; Supplier complacency, misguided Supplier improvement objectives; the credibility of the Customer as viewed by the Supplier and misconceptions regarding purchasing power are the aspects of the Customer-Supplier relationship which acts as barrier to Supplier development.

Customers should improve relationships with Vendors by establishing standard specification formats and formal feedback mechanisms for the Vendors.

The four phases of implementing TQM in construction include: exploration and commitment phase; planning and preparation phase; implementation phase; and sustaining phase.

- In exploration and commitment phase a steering team headed by the Chief Executive Officer (CEO) is formed the top management investigates the various available approaches, to select and develop one that would best fit the company.
- Planning and preparation phase ensures that, necessary planning, including commitment of resources, and basic training are in place.
- Implementation phase is that in which the commitment, planning, and preparation of two initial phases are translated into action.
- In sustaining phase the created infrastructure is integrated into the normal management process of the business, and the process is continuously reviewed and planned for continuous improvement.
CHAPTER FIVE

PARTNERING ARRANGEMENT FOR TQM

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5.2 PARTNERING - THE CONCEPT
5.3 VARIATIONS OF PARTNERING
5.4 WHY PARTNERING?
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5.11 SUMMARY

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5.1 INTRODUCTION

The overall objective of the TQM implementation in any business is to achieve the most effective resource utilisation and continuous improvement of the products and services (see Chapter 4). It was seen in the previous chapter that this objective could be achieved successfully through the use of some form of teamwork. Since the construction process involves inputs from many participants, teamwork becomes essential and inevitable for improving jobsite quality. Partnering arrangement is one solution which provides an ideal environment for implementation of team-building exercises in construction projects. Since both TQM and Partnering aim to achieve continuous improvement, many Reports (CII 1991; NEDC 1991) suggest partnering arrangements between participants for effective implementation of TQM. This chapter discusses the principles and procedures involved in 'partnering concept' and identifies the important contractual characteristics required for TQM. Finally, it proposes the hypothesis:

"Partnering arrangements provide the ideal relationship to the participants to implement TQM in construction projects".
5.2 PARTNERING - THE CONCEPT

The Construction Industry Institute (CII 1991) defines partnering as:

"a long-term commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organisational boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services" (pp. 2).

It is implicit, in this definition, that the three key elements necessary for partnering are **trust**, **long-term commitment**, and **shared vision**. Trust helps eliminate the traditional adversarial relationship between the participants. Long-term commitment helps reduce the learning curve for the participants in knowing each other's principles and expectations. Shared vision is the mutual exchange of ideas between the participants, which helps the parties to accomplish the common goal successfully.

In construction, partnering is usually a contractual arrangement between a Client and his/her Contractor. It is simply a relationship where (CII 1991):

- all seek win-win solutions;
- value is placed on long-term relationships;
- trust and openness are norms;
- an environment for long-term profitability exists;
- all are encouraged to openly address any problem;
- all understand that neither benefits from exploitation of the other;
innovation is encouraged;
. each partner is aware of the other’s needs, concerns and objectives;
. interested in helping their partner; and
. overall performance is improved.

5.3 VARIATIONS OF PARTNERING

NEDC’s Working Party (1991) identified, from several case studies, a considerable variation in the degree to which the partnering arrangements are formalised. These variations ranged from relatively loose to the full partnering arrangement. The Working Party categorised this variations into three main categories: pre-selection agreements; co-ordination agreements; and full partnering agreements.

Category 1 - Pre-selection agreement (Figure 5.1)
The Client merely selects one or more Contractors or Suppliers with whom he/she will enter into Contracts at some time in the future. Meanwhile he/she commits himself/herself to providing advance information on his/her requirements to facilitate advance planning by his/her Contractors.

Category 2 - Co-ordination agreement (Figure 5.2)
The relationship is defined by an agreement to co-operate in avoiding problems. This relationship is voluntary and overlaid on a Contract for project implementation.

Category 3 - Full partnering arrangement (Figure 5.3)
Full partnering provides for unsupervised provision of services. Normally the services are supplied by a joint organisation (Joint Management Team) set up for the association. The partnering arrangement is the contract and is not subordinated by any other.
Figure 5.1: Pre-selection agreement

Figure 5.2: Co-ordination agreement
5.3.1 Project Specific Partnering (PSP)

In CII’s (1991) and NEDC’s (1991) perception, one of the characteristics of the partnering can be viewed as a long-term relationship. In PSP the parties to the partnering have a term arrangement that have extended beyond individual projects and have covered maintenance as well as construction. Loraine (1994) identified that this form of partnering was initiated by the US Corps of Engineers in 1987 on the Oliver Lock and Dam project at Tuscaloosa County in Alabama. He said that this has also been undertaken on many projects in the United States, mainly in the public works sector.
According to Loraine, PSP has a more long-term significance than term partnering for several reasons, for example:

- it does not restrict market entry;
- because price features somewhere in the relationship, it allows success and improvement to be more easily monitored; and
- there is still the stimulation of competition.

5.4 WHY PARTNERING?

Before justifying the importance of partnering arrangements to the construction industry, some of the drawbacks inherent in the traditional contractual arrangements have been highlighted.

The traditional procurement system was established early in the nineteenth century and has continued for more than a century and a half (Franks 1991). The most important drawback to the traditional approach, as noted by Higgins and Jessop (1965) is lack of effective communications and co-ordination. They noted that uncertainty can be created through lack of effective communications. The development of alternatives such as management contracting and design and build procurements (see Chapter 2) have, to some extent, enhanced the communications between the participants by integrating the design and construction processes (Franks 1991).

Government commissioned Reports such as Emmerson and Banwell have led the evolution of different forms of contractual arrangements. The Emmerson Report (1962) concluded that the Client suffered as the result of the 'divorce' between the design and construction process. It explicitly expressed the necessity of the integration of the design and construction processes. This Report led to the formation of the Banwell Committee.
The key issue identified by Banwell were as follows.

- Those who spend money on construction work seldom give enough attention at the start to defining their own requirements and preparing a programme of events for meeting them. Insufficient regard is often paid to the importance of time and its proper use.

- As the complexity of construction work increases, the need to form a design team at the outset, with all those participating in the design as full members, becomes vital.

- Design and construction are no longer two separate fields and there are occasions when the main Contractor should join the team at an early stage. The relationship between those responsible for design and those who actually build must be improved through common education.

- Some measure of selective tendering is preferable to 'open' tendering: impediments should be removed and rules for the conduct of selective tendering drawn up for the guidance of local authority.

- The use of unorthodox methods of appointing the Contractor, where appropriate, has advantages which should not be lost to members of the public sector through adherence to outmoded procedures.

- Serial tenders offer great possibilities for continuity of employment; the development of experienced production teams, etc., and the banding together of those who have suitable work in prospect is to be encouraged.

- Negotiated contracts need not be rigidly excluded in the public field; methods of contracting should be examined for the value of the solutions they offer to problems rather than for their orthodoxy.
Many alternatives to the Traditional methods, such as Design and Build, Management Contracting, and Construction Management, were developed in order to satisfy the recommendations of the Banwell Report. These alternatives had a significant effect on the role of the Contractor. For example, these alternatives integrate design and construction by bringing the Contractor, Management Contractor, and Construction Manager as a member of a design-and-build team (see Chapter 2). Even though these systems are effective in achieving constructability and the other recommendations of the Banwell, research by BRE (1987) proves that problems such as design faults, design not working, lack of co-ordination, etc., are still inherent in this systems. Further, CII (1991) listed the following drawbacks of the traditional systems.

- **Suspicion and distrust;** each party wary of the motives of actions by the other.
- **Each party's goals and objectives,** while similar, geared to what is best for them.
- **Communications structured and guarded.**
- **Single project contracting.**
- **Objectivity limited due to fear of reprisal and lack of continuous improvement opportunity.**
- **Limited access with structured procedures and self-preservation taking priority over total optimisation.**
- **Normally limited to project level personnel.**
- **Sharing limited by lack of trust and different objectives.**
- **Routine adversarial relationships for self-protection.**
- **Duplication and/or translation with attendant costs and delays.**

The drawbacks listed above mainly indicate lack of trust, lack of flexible communications, and lack of common objectives, which often generate adversarial situations. NEDC's Working Party (1991) stated that the adversarial relationship established by the traditional contractual arrangements does not stop with the completion of the project. Claims and counter-claims continue often for years
afterwards, exhausting the industry from both energy, resource and cost aspects. Loraine (1994) added that these unsatisfactory solutions exist in the traditional systems because of their difficulty of satisfying the following requirements.

- Full co-operation between Client and Contractor.
- Continuous improvement stimulated by intelligent competition.
- Full application of quality and safety systems.
- No undesirable restriction on market entry.
- Effective monitoring of performance.

Traditional methods encourage the participants to plan and define their own mission separately, and are incapable of solving various kinds of problems faced by the construction industry. Consequently, many of the recent Reports (NEDC 1991; CII 1991; Latham 1994) suggested partnering arrangements between the various participants. If partnering arrangement is adopted the following potential benefits can be obtained (CII 1991).

**Relationships:** Adversarial relationships will be reduced which will allow focus on mutual goals to the benefit of both organisations.

**Responsiveness:** A partner will be more responsive to the short-term emergency, changing project or business needs.

**Rework:** Rework should be reduced as the Owner's requirements become clearer to the Contractor and the partners work together earlier to resolve questions.

**Standards:** The Contractor will better understand the Owner's standards and therefore increase compliance to them. Combined staffs will develop more cost-effective standards.
| Consistency: | The knowledge of quality expectations of the Owner will improve consistency between projects. |
| Communication: | As the partners gain experience with each other, they will develop a common language which will allow a better understanding of requirements. |
| Safety: | Actual safety performance should improve as partners better understand each other and as the knowledge of process and systems improve. |
| Continuous improvement: | With the long-term focus on commitment to quality service, continuous improvement will result. Partnerships enhance a total quality environment. |
| Claims/Disputes: | Disputes can be resolved in a more efficient manner without the adversarial relationship, and are not unduly expended in this effort. |
| Checkout/Startup: | The continuity of resources during the latter project phases of checkout and start-up are better accomplished with a partnering relationship. |
| Continuity: | Partnering allows for the continuity of personnel from project to project, thus reducing the learning curve considerably. Resources understand the culture and needs of partners. |
5.5 PARTNERING AND TQM

Chase (1993) inter-relates TQM and Partnering as follows.

"On individual construction projects, the parties may establish a team environment in which the General Contractor, Sub-contractors, Suppliers, Owner's Representatives and Designers all work together. Sometimes this is the result of TQM; other times it is the result of partnering arrangement. Sometimes it is both". (pp. 439)

Partnering enables the parties to effectively utilise the resource and continuously improving the quality of the products and services, hence both CII (1991) and NEDC's Working Party (1991) stated that partnering provides the ideal environment for implementing TQM. Furthermore, NEDC's Working Party stated that the fundamental elements of both the TQM and partnering are similar. Table 5.1 illustrates the similarities between these two concepts.
<table>
<thead>
<tr>
<th>Partnering</th>
<th>TQM</th>
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<tbody>
<tr>
<td>Win-win solutions</td>
<td>Reduce quality costs</td>
</tr>
<tr>
<td>Long-term relationships</td>
<td>TQM is a long-term process</td>
</tr>
<tr>
<td>Trust and openness</td>
<td>Breakdown barriers</td>
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<tr>
<td>Environment for long-term profitability for all</td>
<td>Reduce quality costs</td>
</tr>
<tr>
<td>All are encouraged to address problems openly</td>
<td>Breakdown barriers</td>
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<tr>
<td>All understand that neither benefits from</td>
<td>Breakdown barriers</td>
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<td>exploitation of the other in the long-term</td>
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<tr>
<td>Innovation is encouraged</td>
<td>Continuous improvement</td>
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<tr>
<td>Each partner is aware of the other’s needs and</td>
<td>Understanding Customer needs and</td>
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<td>and is interested in helping their partner to</td>
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<td>meet them</td>
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</table>
5.6  HYPOTHESIS ONE

The discussions of Sections 5.4 and 5.5 led to the following hypothesis being proposed.

"Partnering arrangements provide the ideal relationship for the participants to implement TQM in construction projects".

Further investigation led the formation of the following questions to prove that partnering arrangement is the most appropriate relationship for implementing TQM.

- In what way are 'partnering' arrangements suitable for the implementation of TQM?
- Does the partnering arrangement achieve the characteristics of TQM?
- What are the important characteristics of TQM that a partnering arrangement should satisfy?

In order to answer these questions, it was necessary to identify the important characteristics of TQM for a contractual point of view. After having identified the characteristics, the next step had to be proving that the partnering arrangement achieves the contractual characteristics of TQM. The following section identifies the important contractual characteristics for implementing TQM.
5.7 CHARACTERISTICS OF TQM FOR CONTRACTUAL ARRANGEMENTS

Teamwork
As discussed in Chapter 4, TQM aims to achieve customer satisfaction and continuous improvement. In order to achieve this goal, many researchers (Federle and Chase 1993, Sanders 1993, Chase 1993, Mathews and Burati 1991) identified the importance of:

- total involvement of all employees;
- total management commitment; and
- customer and supplier working together.

In essence, it requires 'teamwork' between participants. In support of this concept, a plethora of literature (e.g. Chase 1993, Sanders 1993, and Deffenbaugh 1993) suggests contractual arrangements to provide interrelated sub-systems, facilitate cross-functional co-operation, and remove barriers between the participants that impede the progress. In construction, these requirements are often characterised by the type of relationship followed by the participants. For example, in Section 2.6 and Section 5.4, it was shown that contractual relationships characterise and control the working together of participants. This mainly depends upon the terms and conditions used in the contract between the entities. In order to achieve 'teamwork' between participants, Latham (1994), ECI's Client Management Task Force (1992), and Deffenbaugh (1993) all recommended appropriate contract conditions, based on teamwork and 'win-win' principles.

Barrier removal
According to Juran (1988), two obstacles that impede establishing joint teams are the state of legal independence between the companies, and their traditional method of working together. In the traditional methods, the paradigm of 'control' is making
working together. In the traditional methods, the paradigm of 'control' is making everyone accountable through specifications and contracts and that it was believed that it could be achieved through punishments and disputes (Strange 1993). Strange argued that this attitude motivated the participants to undertake non-productive activities such as: protectionism (i.e protective notification, protective documentation etc); purposeful misinformation; and structured dispute resolution that removes focus from problem solving. This resulted in everyone undertaking checks and inspections of the same items of work. In order to achieve Total Quality, Deming (1986) advised that inspection strategies should be eliminated. The aim of his philosophy is that quality should not be inspected, but can be achieved through participation. Thus, an effective contractual arrangement should eliminate all of these barriers and enable the participants to work with a common goal.

Communications

Everyone in the TQM process needs to communicate with everyone else to explain what is going on, get their views on the proposed solution, and determine how the best solution is to be implemented. Chase (1993) revealed that improved communications are the key to achieve customer satisfaction, supplier improvement and process improvement. The construction process generally comprises a number of participants such as Clients, Contractors, Sub-contractors etc. The contractual relationship should bind this participants so that information flows freely and effectively between them (Chase 1993). Improved communications between the participants also: provides a good influx of ideas to resolve project related problems; enhances teamwork to complete the project in an effective manner; enables faster processing and resolution of disputes/claims; and improves co-operation on requests for information (CII 1991).

Common objectives

It is understood from the above discussions that the quality of the final product largely depends on the relationship between the parties involved in the project. In Chapter 4, it
was discussed that there are many internal and external customers for a process. They are linked together with respect to sequence of operations involved in a process. In order to achieve quality at every stage of the process, the participants involved in the process are required to satisfy the needs of the next participants in the line who use their output. To achieve this, both the supplier and customer need to share their objectives, resources, and techniques and work jointly with common objectives (Deffenbaugh 1993, Chase 1993). The ECI's Client Management Task Force (1992) recommended the development of contractual arrangements which, as far as possible, allow the participant's mutually compatible objectives to be achieved. The Task Force stated that once the contractual arrangement is finalised, all parties will naturally work together to achieve their mutually compatible objectives and should also seek to assist each other in meeting their other identified individual objectives.

This led to the identification of the following characteristics of TQM that a contractual arrangement should satisfy.

- Teamwork.
- Elimination of administrative barriers such as inspection and protectionism.
- Open communications.
- Compatibility of objectives.

These characteristics were used for testing Hypothesis One (see Chapter 8 and Chapter 9).
Crowley (1994) states that the organisation can be described by the boundaries used in classifying differences and describing interfaces between entities. He further added that differences classified by boundaries include: defining limits of authority, responsibility, and accountability; separating resources and internal cultures; and distinguishing the range of shared and unique objectives. In order to establish stable patterns of behaviour, Mintzberg (1979) stated that the organisational structure should encompass those formal and informal means that organisations use to divide and co-ordinate their work. This indicates that the boundary permeability ensures open exchange of relevant ideas and information. Crowley stated that the partnering arrangement merge and focus the efforts of the project partners. In this arrangement, the boundaries of different organisations ensure open communication between participants.

Figure 5.4 depicts the boundaries which define and separate the three participants involved in a project: the Owner/Client; Designer; and the Builder. In this structure, the individual organisations are illustrated within thick boundary lines, where the participants function separately for their own parent organisation. The partnering organisation shown within a hexagon 'pqrstuv', where the participants work together with a common goal. This shows the project specific work, where the Owner/Client, Designer and Builder could establish a Joint Management Team and work jointly within the limit determined by the Joint Team for a particular project. Consequently, partnering is a matrix of two overlaying organisations, one dealing with the project and the other with the parent organisation (Crowley 1994).
5.9 PARTNERING AND EUROPEAN UNION PROCUREMENT DIRECTIVES

In essence, the NEDC Report (1991) summarised the following conditions for a successful partnering arrangement.

- A significant long-term programme.
- A careful selection of the right partner.
- Trust and confidence in the chosen partner.
- Commitment to a long-term relationship.
- Preparedness to adopt to each other's requirements.
- Willingness to accept and learn from mistakes without pointing the finger of criticism at individuals.

Out of the above list, the condition - selection of the right partner - exerts more consideration under the EU Procurement Directives, which is discussed later in this...
section. In partnering, the participants have to examine with great care the compatibility of their organisations, as to how well both have thought out the implications of partnering, the type of workload to which they have to respond, and what other opportunities they might lose. A relationship with the wrong partner may result in an adversarial situation. In order to choose a right partner, the CII Report (1991) insisted on a negotiated process rather than a competitive bid based on price. Many of the companies such as DuPont/Fluor Daniel, Union Carbide/Bechtel, and Shell Oil/Parsons have developed long-term relationships over the past 15 years. In these relationships, the selection was based on negotiation (NEDC 1991).

5.9.1 EU Procurement policy

There are two areas of EU Law which may impinge on the concept of partnership sourcing, namely, Competition policy (article 85 of the Treaty of Rome) and the Procurement Regime (Lane 1992).

Treaty of Rome

Article 85 of the Treaty of Rome is divided into three sub-articles: 85(1); 85(2); and 85(3) [see Berwin & Co, 1992 (pp. 256), for the sub-articles]. The respective articles are presented as below.

Article 85 (1)
The following shall be prohibited as incompatible with the common market: all agreements between undertakings, decisions by associations of undertakings and concerted practices which may affect trade between member states and which have as their object or effect the prevention, restriction or distortion of competition within the common market, and in particular those which:

- directly or indirectly fix purchase or selling prices or any other trading conditions;
limit or control production, markets, technical development, or investment;
share markets or sources of supply;
apply dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage;
make the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts.

Article 85 (2)
Any agreements or decisions prohibited pursuant to this Article shall be automatically void.

Article 85 (3)
The provisions of paragraph 1 [Article 85 (1)] may, however, be declared inapplicable in the case of:

any agreement or category of agreements between undertakings;
any decision or category of decisions by associations of undertakings;
any concerted practice or category of concerted practices;

which contributes to improving the production or distribution of goods or to promoting technical or economic progress, while allowing consumers a fair share of the resulting benefit, and which does not:

(a) impose on the undertakings concerned restrictions which are not indispensable to the attainment of these objectives;
(b) afford such undertakings the possibility of eliminating competition in respect of a substantial part of the products in question.
EU Procurement Regime

The EU Regulations require the contracting authority, when selecting Tenderes, to use one of the three procedures, namely, the open procedure, the restricted procedure, and the negotiated procedure (Lane 1992). The open procedure is the procedure where there is no pre-selection of bidders. The restricted procedure is that there must, in any event, be not less than five bids nor more than twenty. The negotiated procedure (ie. exceptional circumstances) as listed in Regulation 10(2) allows an authority to use the negotiated procedure in the special circumstances such as works that are to be purely performed for research, lack of appropriate tenders in response to open procedure, technical or artistic reasons, reason for extreme urgency, and where the authority wants a Contractor with whom it has already entered into a contract to perform further work which is a repetition of works. The Regulations only provide two criteria for the award of public contracts for supplies or works. According to Lane (1992) the criteria are:

- lowest price; and
- the most economically advantageous offer to the contracting authority.

5.9.2 Applications of EU Policy to the Partnering

Article 85(1) and(2) state that if there is something which might harm the objective of a single market between states, the EU will not tolerate and that the arrangement which infringe article 85(1) will be void and unenforceable. However, NEDC's (1991) suggested model form of contract and CII's(1991) guidelines on selection of Contractor for a partnering relationship appears to be restrictive of competition, both of them have suggested a long-term relationship and negotiated bidding. These two conditions are to some extent possible under article 85(3), which exempts the party from competition if it proves to the EU the benefits of the arrangement. Lane (1992) states that the Commission will require evidence that partnering will:

- contribute to the improvement of the production or distribution of goods;
- promote technical or economic progress; and
pass on a fair share of the resulting benefits to the consumer.

In the EU Procurement Regime, the Regulations require the contracting authority to use one of the three procedures: open; restricted; and negotiated (see Section 5.8.1). The open procedure is, of course, the procedure where there is no selected bidding. The use of the restricted procedure is of little assistance to the Client wishing to implement partnering. However, regarding the restricted procedure, Lane argued that the condition - not less than five bids nor more than twenty bids - does not accord with the careful selection of a single partner.

Under exceptional circumstances (Regulation 10(2)), the party wishing to partner can use the negotiated procedure, but with several restrictions (see Section 5.8.1). Lane stated that if partnering qualifies for consideration under any of the listed exceptional circumstances it can only be in respect of the 'repeat work' exception. This exception is extremely narrow to use.

The EU Regulations for award of contract give two options: lowest price; and the most economically advantageous offer. Award of contract for lowest price is at complete variance with the concept of partnering described by the CII and NEDC. Even though the second option seems applicable for partnering, Lane argued that in both definitions price is still a determining factor and finally, concludes that the concept of partnership sourcing is largely incompatible with the EU procurement regime. Contrary to the above discussions, Loraine (1992) stated that partnering can confirm to the following EU procurement Regulations.

- Periodic information in the official Journal on intended procurements.
- Prior calls for competition by advertisement in the official Journal.
- Clear statements of the rules of the competition.
- Awards on the basis of the economically most advantageous offer in accordance with pre-disclosed criteria.
Loraine argued that the above mentioned policies could be satisfied if the participants establish a project specific partnering arrangement, without long-term commitment. He also suggested the "co-ordination agreement" form of partnering, identified by NEDC, (see Section 5.3, Category - 2) for Project Specific Partnering.

5.10 PARTNERING - CURRENT PRACTISE IN THE CONSTRUCTION INDUSTRY

In most of the partnerships mentioned in Table 5.2, the survey results of the Task Force (CII 1991), indicated that Clients have generally taken the responsibility for initiating the arrangement, and most of them have choosen the negotiation process to establish their arrangements. Based on the case studies of the partners mentioned in Table 5.2, the Task Force (CII) presented a model flowchart for partnering implementation process (see Figure 5.5). This flow chart reflects the implementation process followed by most of the partnering companies mentioned in Table 5.2.
Table 5.2: Companies involved in partnering arrangement (CII 1991)


<table>
<thead>
<tr>
<th>True partnering relationships</th>
<th>Date started</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell Oil/SIP Engineering</td>
<td>1984</td>
</tr>
<tr>
<td>DuPont/Fluor Daniel</td>
<td>1986</td>
</tr>
<tr>
<td>Procter &amp; Gamble/Fluor Daniel</td>
<td>1986</td>
</tr>
<tr>
<td>Procter &amp; Gamble/BGP</td>
<td>1986</td>
</tr>
<tr>
<td>Shell Oil/Bechtel</td>
<td>1987</td>
</tr>
<tr>
<td>DuPont/MK-Ferguson</td>
<td>1987</td>
</tr>
<tr>
<td>Shell Oil/The Ralph M. Parsons Company</td>
<td>1987</td>
</tr>
<tr>
<td>Alcon/Fluor Daniel</td>
<td>1988</td>
</tr>
<tr>
<td>Union Carbide/Bechtel</td>
<td>1988</td>
</tr>
<tr>
<td>DuPont/Day &amp; Zimmermann</td>
<td>1988</td>
</tr>
<tr>
<td>Great Northern Nekoosa/Rust International</td>
<td>1988</td>
</tr>
<tr>
<td>Pillsbury/Fluor Daniel</td>
<td>1989</td>
</tr>
<tr>
<td>Hoffmann-LaRoche/Day &amp; Zimmermann</td>
<td>1989</td>
</tr>
<tr>
<td>Chevron/Bechtel</td>
<td>1989</td>
</tr>
<tr>
<td>Bethlehem Steel/United Engineers &amp; Constructors</td>
<td>1989</td>
</tr>
<tr>
<td>Procter &amp; Gamble/M.W. Kellogg</td>
<td>1990</td>
</tr>
</tbody>
</table>
The Figure 5.5 illustrates the step by step procedure of implementation of partnering relationships. From the CII's Report (1991), the following are identified as some of the important steps to be followed by the partners.

- The first step should be to put a mutually acceptable agreement in place. During this stage the partnering concepts and expectations must be clearly identified and terms designed to support them.
The second step should be to jointly develop an implementation plan, budget and schedule. The plan should address the involvement of appropriate parties from the two organisations, not only to establish structure, technical resources and procedures/systems, but to present the needs and concerns of all to be impact as well.

Following plan development, the next step should be to configure an organisation and define roles. Personnel roles are designed to avoid duplication. The Client may take a leadership role concerning conceptual and objective issues, while the Contractor may lead on execution issues.

When the staffing of key partnering roles is accomplished, visions, goals and objectives should be jointly developed. Operating procedures and administrative procedures should include many of the same topics addressed under a traditional arrangement for a single project. The contracts, however, should reflect partnering concepts.

In any event, the initiation of work should be accomplished by team building and training in the desired partnering culture.

The performance evaluation is to be of the effectiveness of the work processes of the partnering teams, not individual performance appraisal.

The benefits of partnering encountered by the companies mentioned in Table (5.2) include the following:

- Early involvement in design: helps in avoiding redesign problems; assures design will be buildable; decreases the duration of the project; and produces more active engineering efforts.

- Providing enough resources by the partner: reduces the Client's workforce requirements to oversee projects; reduces total staff required by both parties.

- Improved communications: provide good influx of ideas to resolve project-related problems; enhances teamwork to complete project in an effective manner; enables faster processing and resolution of disputes/claims.
Improvement in quality, cost and schedule.

Difficulties noted in project case histories (Table 5.2) include the following.

- Difficulty in agreeing on issues initially: not enough time devoted to establishing relationship; developing common project team objectives, convincing the employees to believe in the relationship and the objectives; establishment of project-related procedures to be used creates a major barrier at the beginning of the relationship; and rigidity in the design team might threaten the relationship and the final product built.

- Cultural differences: overcoming cultural and procedural differences between the two organisations is essential and difficult; acceptance of mixed-team leadership and taking orders from the other company's Representative are important, but difficult; creating a cultural shift at the working levels of the contract is difficult at the beginning of a relationship.

- Continuity of workload: uncertain workload makes planning difficult in the beginning.

5.11 SUMMARY

This chapter has reviewed the basic concept behind most partnering arrangements and compared their characteristics with that of TQM. Finally, it proposes the hypothesis - partnering arrangements provide the ideal relationship to the participants to implement TQM in construction projects. The contents of this chapter are summarised as follows.

- Partnering is a commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources.

- The three categories of partnering arrangements include the following.
Pre-selection agreement: The Client merely selects one or more Contractors or Suppliers with whom he/she will enter into standard contracts at some time in the future.

Co-ordination agreement: The relationship is defined by an agreement to co-operate in avoiding problems. This relationship is voluntary and is overlaid on a standard contract for project implementation.

Full partnering arrangement: This provides for unsupervised provision of services. The services are supplied by a joint organisation set up for the association.

Since partnering helps to achieve the following advantages, it was proposed as the appropriate contractual arrangement for implementing TQM in construction.

- Win-win solutions
- Long-term relationships
- Trust and openness
- Environment for long-term profitability for all
- All are encouraged to address problems openly
- All understand that neither benefits from exploitation of the other in the long-term
- Innovation is encouraged
- Each partner is aware of the other's needs and is interested in helping their partner to meet them.

The chapter, finally, identified the important contractual characteristics required for a TQM-approach, which are: teamwork; elimination of administrative barriers such as inspection and protectionism; open communication; compatibility of objectives. These characteristics were used in the questionnaire survey to prove the Hypothesis One (see Chapter Eight).
CHAPTER SIX

TQM - IDENTIFICATION OF THE ROLES AND RESPONSIBILITIES OF THE CLIENT'S REPRESENTATIVE

6.1 INTRODUCTION

6.2 THE ROLE OF THE CLIENT'S REPRESENTATIVE - TRADITIONAL APPROACH

6.3 THE ROLE OF THE CLIENT'S REPRESENTATIVE - TQM APPROACH

6.4 TQM - CHANGING ROLE OF THE CLIENT'S REPRESENTATIVE

6.5 HYPOTHESIS TWO

6.6 IDENTIFICATION OF THE BEST PRACTICES FOR THE CLIENT'S REPRESENTATIVE WHEN IMPLEMENTING TQM IN CONSTRUCTION PROJECTS

6.7 HYPOTHESIS THREE

6.8 SUMMARY

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6.1 INTRODUCTION

In pursuance of the two main objectives of this research, and following the realisation in Chapter 4 and Chapter 5, that partnering arrangements provide a good environment for implementing TQM, this chapter analyses the roles of Client’s Representatives in construction projects. The objective of this chapter is to identify the important responsibilities of Client's Representatives when involving in TQM-based construction projects and produce best practices for Client's Representatives to achieve Total Quality in construction. The identified tasks and best practices will be formulated into hypotheses - i.e. Hypothesis two and Hypothesis three respectively. These Hypotheses form the basis for further investigation of this research which is discussed in subsequent chapters.

6.2 THE ROLE OF THE CLIENT'S REPRESENTATIVES - TRADITIONAL APPROACH

The major tasks for managing construction projects on behalf of the Client include (Warszawski 1984):

- preparation of functional requirements and performance specifications;
evaluation of preliminary schedule;
preparation of budget and schedule;
co-ordination and evaluation of design;
preparation of contract documents and selection of Contractor;
monitoring and control of the construction process;
quality control and valuation of Contractor's work;
planning of operation/maintenance of the completed project; and
performing specific tasks of construction management as needed.

In Chapter 3, it was perceived that the Client's Representatives (such as Project Managers, Architects, Quantity Surveyors, and Engineers) have performed the aforesaid tasks, albeit in a different manner, under different procurement systems. The responsibilities of the Client's Representative in each procurement method varies considerably, from one who simply monitors to one who exercises total authority and full responsibility for the design and execution of the project. It was concluded in Chapter Three that whichever method is used, the overall role of Client's Representatives should be ensuring the needs of Client are satisfied, and acting as the contact point between Client and the other teams of the project.

In the traditional management systems, the 'project control philosophy' adopted by the Client's Representatives for monitoring and controlling the project has caused many problems resulting in litigation, conflicts, design failure, and design not working etc. (Fondahl 1991, Elmes and Wilemon 1988, BRE 1987). The inherent reasons for the occurrence of this kind of problems appear to be the wrong approaches on project control priorities and the attitudes of people involved in the project. For example, in construction, the three major priorities include: cost; time; and quality. In the traditional practices, the controlling philosophy was directed more towards cost and time than quality (Lanfer and Tucker 1987). Mintzberg (1982) supported this concept; he stated that the cost and time are tangible, demonstrable, and economically measurable, quality
is vague and poorly defined. In addition, Hill and Russell (1988) stated that the control objective of the traditional system is to drive progress according to schedule whilst performing control functions which assure that quality is according to specification. These statements have clearly demonstrated that the traditional approach to quality is to ensure the service or product meets the specification. The roles and responsibilities of Client's Representatives in various traditional procurement methods (Discussed in Chapter 3) also ensure that they were developed based on this concept, where it can be seen that the quality was simply inspecting, checking, and ensuring the product according to various standards. This controlling philosophy of the Client's Representatives often leads to the occurrence of disputes and conflicts between the parties. Elmes and Wilemon (1988) stated that a headstrong, reactive approach which attributes project obstacles to another person's "failure" or "stubbornness" may polarise differences, escalate conflict, and make it difficult or impossible to complete the project. This indicated that the proactive role of the Client's Representatives could reduce conflicts between the parties. In addition, Fondahl (1991) stated that litigation often results from inequitable treatment by the Client, unrealistic contract documents, or from the low bidder's efforts to recoup losses resulting from an unrealistic bid. These causes implicitly indicate that they are greatly influenced by the decisions and actions taken by the Client's management during the pre-construction and construction period. In order to avoid these problems, Todryk (1990), Elmes and Wilemon (1988), and Fondhal (1991) insisted on the 'team culture' in the role of Client's Representatives (Project Managers), which is often lacking in the traditional approaches.
6.3 THE ROLE OF THE CLIENT'S REPRESENTATIVE - TQM APPROACH

In traditional approaches, experts such as Mintzberg, Lanfer and Tucker (see Section 6.2) have argued that 'time and cost' are demonstrable and economically measurable and that the control objective should be driven towards progress according to schedule. However, in TQM, quality is the priority. According to Burati and Mathews (1991), if the project is a safe, quality job, then it will more than likely on budget and schedule. In the TQM context, quality is defined as achieving customer satisfaction and continuous improvement (see Chapter 4). According to Oakland (1994), this goals require:

- total involvement of all employees;
- total management commitment;
- customer and supplier working together; and
- objectives, standards and systems which conform to the commitment to total quality.

This clearly suggests that all participants should work together with a common objective. Todryk (1990) stated that the implementation of an effective team-building process, in a project management environment, will measurably reduce schedule delays and cost over-runs while improving the quality of team morale and increasing productivity. Moreover, Hellard (1993) and Latham (1994) suggested the 'teamwork and co-ordination' philosophy for controlling the construction project. Latham recommends a modern contract, which should ensure teamwork, with shared financial motivation to pursue the objectives, in which the roles of Project Manager should be clearly defined as Client's Representatives. This indicates that the roles of Client's Representatives should no longer be based on the traditional approaches, instead, it should reflect the 'teamwork' philosophy by participating in the process. The case studies on partnering companies by NEDC (1991) and CII (1991) prove that the
Client's Representatives have become distinct members of the 'Joint Management Team' comprising members from both the Client and Contractor. The Client's Representatives discharged their duties, through this joint team, to achieve total quality in construction.

6.4 TQM - CHANGING ROLE OF THE CLIENT'S REPRESENTATIVE

The previous sections have stressed the importance of 'teamwork' concept in the roles of the Client's Representative, when involved in TQM. In Chapter Five, it was identified that partnering arrangement - inherently possessing teamwork concept - provides an ideal environment to successfully implement TQM in construction. In the light of the TQM philosophy with partnering arrangement, the roles and responsibilities of the Client's Representative will be analysed in this section.

Ledbetter (1994) defined 'quality management work' as the work undertaken to prevent deviations from occurring or to appraise a product to insure that it meets the requirements. He highlighted the eight activities of quality management as defined by the CII (Construction Industry Institute, USA) as follows.

*Quality systems:* Activities of developing system, program, standards, and goals.

*Supplier qualification:* Activities to investigate and evaluate ability of suppliers, vendors, contractors, subcontractors to perform capably if awarded contract.
### Personnel qualification, testing, and quality training:

Testing personnel to perform quality work according to specified standards; training to perform quality activities; this is not regular training.

### Expediting:

Activities with supplier and vendors before delivery to ensure delivery on schedule and as specified.

### Operability/Safety/Value review:

Activities performed to evaluate operability, safety, or value of design in compliance with Client, industry, and government requirements.

### Constructability review:

Activities to ensure that design and planned construction methods are most efficient.

### Internal examination:

Reviewing, checking, inspecting, testing, and observing products/services already produced internally by others in your organisation.

### External examination:

Reviewing, checking, inspecting, and observing products/services produced externally (outside your organisation) by others.

In the aforesaid quality management activities, it can be seen that some of them are 'traditionally' considered to be normal working practices as the construction industry is in the habit of doing them. In general, these activities seem to have included some of the management tasks: preparing quality system; procuring participants; safety management; design management; and monitoring. Ledbetter states that some of the activities would not be necessary for the perfect world - i.e. TQM. For example, inspection in the form of internal and external examination is eliminated in TQM, and the performance is jointly measured and reviewed for process improvement (CII 1991).
The tasks of Client's Representatives, as quoted by Warszawski (see Section 6.2) indicate that Client's Representatives are involved in most of the above mentioned eight tasks on behalf of the Client. However, in TQM, the way they perform all of these tasks are different. In TQM, total quality is achieved by (Oakland 1990):

1. *conforming to requirements*;
2. *prevention not detection*;
3. *getting it right first time*; and
4. *measuring quality performance*.

It is apparent the Client's Representatives should work together with a philosophy 'prevention not detection'. Oakland stated that this (prevention) concentrates all the attention on the front end of any process, the inputs, and changes the emphasis to making sure the inputs are capable of meeting the requirements of the process.

In Chapter Five, it was seen that the partnering arrangement has provided more suitable environment for implementing TQM in construction. In partnering, the role of the Client's Representative includes some other important tasks such as organising a Joint Management Team, measuring and reviewing performance, co-ordination, motivation and communications etc. Case studies by the NEDC's Working Party (1991) and CII's Task Force (1991) indicated that these tasks are paramount for the Client's Representative to effectively implement TQM and partnering concept in the work. Hensey (1993) highlighted TQM measures for the Client's Representative (referred as Consulting Engineers) from a Client's perspective as follows.

**Client's needs and expectation**

1. *Thorough discovery process (upfront).*
2. *Documentation of scope for project team.*
3. *Contract terms reflect real agreements with Client.*
4. *Surveying Client's perception of job completion/satisfaction.*
Communication during projects

• Regular Client updates on project.
• Effective internal project team communication.
• Honesty in reporting/discussing issues.
• Representing the Client well to regulators.
• Few nasty surprises; quick handling of problems.

Quality of studies and reports

• Well written; no need to re-do.
• Clear Graphics; helpful to regulators.
• Timely; arrive in time to review.
• Examine alternative remedies for situation.
• Involves Client in selection of best solution.
• Cost estimates with appropriate ranges.
• Solution focus versus technical focus.
• Considers impact on Clients’ budget.

Quality of specifications and drawings, if any

• Well organised, easy to follow and use.
• Specification either standard or custom; but not cobbled together.
• Drawing graphics clearly and simply; not overdone.
• Compatible with Clients’ CAD system if.
• Timely; arrive in time to review and stay on schedule.
• No/few errors, omissions, or interferences.
• "Seamless"; well co-ordinated between disciplines (mechanical, electrical, instrumentation, architectural, etc.).
• Specifications for equipment, instruments, hardware, etc., of a quality level congruent with needs and expectations.
• Constructible; easy to build without contractor redesign.
Invoicing for completed work

- Accuracy in completed work, including carry-forward.
- Includes necessary documentation and backup.
- No surprises for extra work and so on.

Project wrap-up and critique

- Get Client's feedback on the degree to which expectations were met.
- Pursue Client's views and suggestions for process improvement.
- Find out how well the Consultants were in terms of:
  - Quality of working relationships;
  - comparing to competitors;
  - using their firms again; and
  - recommending them to others.

These measures generally represent the: project definition; design; communications; coordination; and documentation, and project close-out, but fail to cover the other quality management activities, including the ones specified by Ledbetter such as preparing quality systems, procurement, safety, documentation, and the others such as measuring and reviewing performance, organising a joint management team, motivation, and coordination etc.

In summing up the above discussions, it is concluded that the important responsibilities of the Client's Representative, when implementing TQM in construction projects include the following tasks.

- Preparing and organising
- Developing project definition
- Procurement
- Organising a Joint Management Team
- Design management
In a construction project, there are many other traditional construction management tasks that the Client's Representatives should perform, however, in a TQM-based construction project, the various sources discussed above indicate that these tasks are important for achieving total quality. Some of these tasks are simply the ones which are already being practised in non-TQM construction projects, however, in TQM, the way these tasks being practised are different from the traditional approach.

6.5 HYPOTHESIS TWO

Section 6.4 led to formulate the Hypothesis Two as presented below.

"The important tasks of Client's Representatives in a TQM-based construction project include: preparing and organising; developing project definition; procurement; organising a joint management team; design management; safety management; measuring and reviewing performance; communications; motivation; co-ordination; documentation; and project post-mortem".
6.6 IDENTIFICATION OF THE BEST PRACTICES FOR THE CLIENT'S REPRESENTATIVE WHEN IMPLEMENTING TQM IN CONSTRUCTION PROJECTS

The 'best practice' as defined by "Computer and Automated systems Association of the Society of Manufacturing Engineers" (CAS/A/SME 1992) is:

"a group of most desirable and beneficial day-to-day business actions that result in superior business performance, either by themselves or combined with other actions" (pp. 4).

The CASA/SME states that best practices are those business practices that are best for the people involved and result in the best possible customer satisfaction and business success. It further demonstrates that successful businesses have leveraged their people power in addition to their technology and processes through excellent practices.

Various issues involved in each tasks for achieving customer satisfaction and business success will be discussed in the following sections. Task definitions and associated practices for the improvement of each task will also be proposed.

6.6.1 Preparing and organising

Construction is one-off in nature, where the final product is obtained by involving various participants at various stages. It is also evident that the participants are often new to any individual project. Thus, for Total Quality Management to achieve all of which it is capable, it must be implemented throughout the business chain involved - including the Client (Purchaser), who has an important role to play in ensuring that his/her requirements are fully, clearly and unambiguously expressed (CIRIA 1991). Since TQM is an innovative approach, it may require the construction participants to
have their resources skilled in TQM before implementing in an individual project. For innovative quality services, the skills required for an organisation include: communications; conflict resolution; flexibility to change; and co-ordinated teamwork (Farid and EI-Sharkawy 1993). Research by Mathews and Burati (1989) and Burati and Oswald (1993) indicated that both Clients and Contractors have implemented some kind of TQM programme within their own organisation. They developed their own organisations in TQM-skills before they become involved in a construction project. However, in some cases, as identified by Mathews and Burati (1989), the Contractors did not have previous experience on TQM programme. In these cases, the Clients have helped them start TQM programmes within their own organisations. This indicates that the Client's organisation should be trained, educated, and organised on quality principles for the effective handling of TQM- construction projects.

The preparation stage of any innovative process begins with observation and data collection from a wide variety of sources (Nystrom 1979). This is the stage at which various options are considered before choosing the best approach for implementing TQM. The information collected at this stage enables the creative individual to combine existing ideas into new ones. New combinations of ideas, often rejected by non-creative individuals, are considered in this stage (Badawy 1988). The method of observation and data collection is discussed below.

Bates (1993) stated that the first step in the TQM development process is to assess the basis for planned organisational change. Therefore, before TQM is considered for implementation, the Client's preparedness for adopting the programme should be assessed. Bates added that measuring the organisation's readiness for planned improvement will reveal the focus, concern, and ability levels of the organisation. Research by Sanders (1993) revealed that several of the companies have collected data
and measured their organisation's expertise, before implementing new ideas in four ways:

- literature review to identify the state of the art within the industry;
- appointing external consultants;
- internal assessment to determine their current level of expertise in the particular work process under consideration; and
- visiting other companies who had successfully deployed the particular concept and use their accomplishments.

Based on the data collected at the exploration phase, a quality policy for Client's organisation should be prepared. While preparing the quality plan, outside help from consultants may also be sought, because every initiative at the beginning will need experts for advise (Sanders 1993). A survey of quality and service improvement programme by the Jennings Group (1993) found most of the companies in the survey used outside consultants at some point in developing their programme.

After the organisations readiness for planned change and its strategic direction have been identified and validated, Bates (1993) stated that continuous training to the staff should be given, which included:

- basic and professional skills;
- quality technology skills; and
- team-building skills.

Team-building emphasizes all interpersonal skills, which allow basic and professional skills and the quality technologies to be applied successfully. This training can either be conducted with the assistance of in-house quality expert, or with the external quality consultants. Research by Construction Industry Institute (Burati and Oswald 1993)
indicated that most of the construction companies had in-house quality professionals or co-ordinators, and with the help of external consultant they trained their staff on TQM.

Finally, the organisational structure specific to the quality plan should be developed and the appropriate responsibilities and authority for conducting the particular phase of the quality programme should be delegated to the respective personnel.

Burati and Oswald (1993) identified four major phases for implementing TQM in engineering and construction organisations. They include: exploration and commitment phase; planning and preparation phase; implementation phase; and sustaining phase. The activities involved in all phases have been described in detail in Chapter Four (Section 4.8.1). In all the four phases, some of the important activities of the Chief Executive Officer (CEO) and senior managers include: decision to commit TQM; evaluate basic quality philosophies; define expectations; select consultants; develop strategic quality deployment process; identify champions; form standing team for TQM oversight; training staffs for TQM; conduct long-range planning for continuous improvement. The study (Burati and Oswald) indicated that, in Client organisations, these tasks have been performed by the respective senior management (in-house Client's Representatives). Based on the above, the task definition followed by practices for the improvement of 'preparing and organising' task are proposed as follows.

Preparing and organising - Task definition

The development of the Client's quality programme and organising the Client's organisation for TQM. This includes: forecasting the future; setting objectives; establishing policies to meet objectives; developing organisation structure; and delegating authority and responsibility.
Practices for the improvement of preparing and organising

- Determine the focus, concerns and the ability levels of the Client's organisation for planned improvement, by conducting first party audit.
- Visit companies who had successfully implemented TQM, and consider their accomplishments before preparing a quality plan.
- Appoint Quality Consultants for advice, if necessary.
- Prepare a Quality policy for the Client's organisation.
- Establish organisational structures and responsibilities.
- Prepare education and training requirements for all levels of staff.
- Delegate the in-house quality champion or external quality consultant to train the Client's organisation on professional, quality, technology, and team building skills.
- Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.

6.6.2 Developing project definition

According to Dennis (1987), 'Project definition' is the process of ensuring that the three objectives - performance (quality), timely completion and containment of costs within budgets - are clearly set out before any work starts. Turner (1993) stated that the objectives of the project definition are to:

- provide sufficient definition, including cost and benefits, to allow the business to commit resources to design and appraisal;
- provide a basis for design and appraisal;
- provide senior management with an overview of the projects priority alongside day-to-day operations and other projects (both proposed and on-going);
- communicate the projects' requirements throughout the business; and
- define the commitment of the business to the project.
Project definition is derived from the Client's brief. Gameson (1993) stated that once Clients have gone through the process of establishing a need for building, they need to appoint some form of adviser to assist them in developing their requirements for the building into a comprehensive brief. This is the stage at which Client's Representatives have to involve in assisting the Client to develop his/her brief and thereby develop the project definition. The responsibility of Client's Representatives not only ends with assisting the Client, but also to liaise with the design team and construction professionals and make decisions on behalf of the Client (Parsloe 1993, Latham 1994).

The common cause of complaint by the construction industry is inadequate briefing by the Client presented to the Consultant and/or the Contractor (Latham 1994). This often leads the Client to require changes in the work, with serious implications for cost and programme. Research by Burati and Farrington (1992) indicated that the design and construction changes initiated by the Client have become one of the causes for the quality deviation. In order to avoid this problems, Latham (1994) recommended that all the likely participants should be involved in defining the project. He stated that defining a project in construction is a complex process, which requires inputs from many participants. Participation by Contractor, at this stage, would provide a valuable input for constructability. Gameson (1993) emphasised the close working of the Client's Representatives and construction professionals in establishing specific requirements for the Clients. This promotes the interactive process between each party to contribute its own area of expertise and knowledge to produce a statement which satisfies the Client.

The process of project definition starts with identifying the problem (Client's need) and goes on exploring various options for determining Client's need. The process by which the professionals approach a problem involves a procedure beginning with diagnosis and ending with treatment (Abbott 1988). The diagnosis involves determining the Client's requirements and the treatment being the design. The
diagnosis stage is a critical one, because the requirements of all Clients are not the same, it varies from one to the other, and more over the projects are becoming complex with conflicting demands. Most building projects these days will require information from a wide range of sources often requiring considerable research effort (Zeisel 1984). Quality Function Deployment (QFD) is a method that can be used during early project phases to create more accurate decisions, focus project budgets, define project quality, and be responsive to customer's needs (Mallon 1993). Quality Function Deployment (QFD) as defined by Akao (1990) is:

"converting the customers' demands into 'quality characteristics' and developing a design quality for the finished product by systematically deploying the relationships between the demands and characteristics, starting with the quality of each functional component and extending the deployment to the quality of each part and process. The overall quality of the product will be formed through this network of relationships" (pp. 5).

QFD is a cross-functional tool that assists the Clients' Representative to understand customer requirements sufficiently to develop priorities for these requirements that are customer-oriented and technically correct. This prioritisation will be used as a guide to focus on what the wants throughout the project definition. Discussing QFD in detail is beyond the scope of this section; more details can be obtained from the Mallon and Mulligan (1993).

In project definition, the project control activities and methods for various project functions should be defined to achieve quality at work. This means that, in the project definition, out of the three objectives - quality; cost; and time - quality should be focused more than the others. Because, if the project is safe, quality job, then it will more than likely on budget and schedule (Burati and Mathews 1991). Heisler (1994) stated that for projects where a formal quality programme is required, preparation of a
project quality plan should also begin at the earliest time. He also added that, this will have the effect of minimising the impact of retrofitting to demonstrate compliance with programme requirements. Thus, the quality programme should also be established in the project definition. The foregoing led to the following definition of 'Developing project definition' task, and best practices for the improvement of the task to be proposed.

**Developing project definition - Task definition**

Defining and developing the Client's requirements through careful planning and forethought. It includes the feasibility study of the project.

**Practices for the improvement of developing project definition**

- Analyse the Client's brief, and highlighting any omissions.
- Establish programme and staffing requirements for producing project definition.
- Apply Quality Function Deployment (QFD) and other TQM tools to develop the Client's requirements, and identify quality characteristics for accomplishing the Client's requirements.
- Involve construction professionals to achieve constructability in project definition.
- Define project specific quality plan to implement TQM.
In the pre-project phase 'procurement' as defined by Hill (1988) is:

"activities associated with supplier pre-qualification, with long lead component supply, transportation, insurance and local material evaluation" (pp. 46).

In the Client's perception the term 'procurement' can be related to activities associated with procuring the contractor, designer, and other participants to the project. Since TQM stresses teamwork and continuous improvement, it needs the careful selection of the right partner to function in a team atmosphere and work for innovative approach. The Construction Industry Institute (CII 1991) provides the following guidelines to Owners/Client for selecting the project partner.

a) **Confirm applicability of partnering to organisation**

   To ascertain that the partnering process will be beneficial to the Owner's organisation.

b) **Establish selection team**

   Consider representation from organisational elements expected to be affected (ie. Marketing, Operations, Engineering, Purchasing, Construction, Legal, etc.).

c) **Develop selection plan**

   The selection plan should address the selection criteria, in which:

   - scope of the services is determined;
   - technical skill needed of the partner are set;
   - desired commercial criteria are mentioned; and
   - conceptual issues to be discussed are determined.
d) Identify potential partners

Shortlisting potential contractors from a long list can be accomplished either through personal interviews or by requesting written responses to an inquiry document.

e) Conduct interviews

At this stage, conceptual issues identified in the selection plan are concentrated.

f) Owner and Contractor both seek management approval of the specific potential partners and the expected scope/nature of the relationship.

g) Develop and issue final inquiry documents

The selection criteria listed in the selection plan is considered, and the sequenced inquiries on the subjects of: scope of services and conceptual issues; technical issues; and commercial issues are considered.

h) Develop final evaluation criteria

i) Evaluate proposals

The proposals are ranked on subjective elements and finally the partner is selected.

j) Management approvals

According to Federle (1993), one of the observations recommended in the third TQM workshop held at Iowa State University (May 1992) was that Owners/Clients should select only those contractors and designers with in-place quality-management processes. This statement is supported by many of the reports such as Latham (1994), CII (1991) and NEDC (1991). Latham insisted that Designers should not be selected on the basis of price, they should also be pre-qualified. Owners should examine previous projects of the designer and contractor, looking for the evidence of the effectiveness of their quality-management processes. To examine the effectiveness of the participants' quality-management processes, Hellard (1993) recommends second party audit on the participants. He also stated that project auditing (second party audit)
should be undertaken by the Client, or on his/her behalf, prior to the appointment of, or signing of a contract with, any of the firms who will make up the project team. In construction, the constructor is usually the first party and Client is the second party. In order to identify the potential Contractors, Hellard also suggested using the British Standards Institution (BS 5750 identical to ISO 9000) registration. Since the registered firms are being required by the British standard to follow appropriate quality procedures, they should already have experienced some kind of quality system in previous projects.

The CII's guidelines indicate that, during the subsequent interviews with the Contractor, the project objectives, range and combination of professional and commercial relationships, and the management policy are exchanged, and finally a co-ordination agreement to act jointly in the project is prepared. NEDC's Working Party (1991) stated that, in full partnering arrangement this agreement forms the main contract.

It is well known, that the standard forms of contract, while not intrinsically adversarial, encourage the development of adversarial attitudes (Client Management Task Force 1992). Such attitudes and claims affect quality by absorbing wasteful amount of management effort within both Contractor and Client organisation. One of the root causes for this situation, as highlighted by Latham (1994), CII (1991) and NEDC (1991), was the contentious contractual terms inherent in the existing contractual agreements. Unless the adversarial terms are removed from the contract, mutual trust and co-operation between the parties will not occur. Therefore, both the Construction Industry Institute and Latham Report recommend use of trusting terms in the contractual agreement between participants.

Another important issue to be addressed in the selection of participants is the Sub-contractor and vendor selection process. If selected Sub-contractors do not have the
required standards to meet the quality plan, then considerable improvement would not be met, and consequently there may not be customer satisfaction. Thus, careful selection of Sub-contractor and supplier is necessary for successful project. Research by Mathews and Burati (1989), indicated that many Owners and Contractors have carefully selected their Sub-contractors, and they required their vendors to implement TQM if they wish to be considered for their projects; those who have not met their requirements have simply been dropped from the selection process. If the Client is not involved in the Sub-contractors selection process, Latham (1994) and Hellard (1993) require the main Contractor to notify the Client of the Sub-contractor selection process.

It may be argued that the above procedures such as interview and audit may attract an additional cost for the project, but Hellard (1993) and Latham (1994) stated that the earlier in the project, the price of quality is paid, the greater will be the ultimate quality and cost benefit on the end product.

The definition of 'procurement' followed by the best practices for the Client's Representatives for improving the procurement task are proposed as follows from the above.

**Procurement - Task definition**

The procurement task involves the selection of suitable contractors, professionals and other participants to the project. The main objective is to ensure that the participants for the project are acquired in the most effective way.
Practises for the improvement of procurement

- Depending on the size of Client's organisation and nature of the project, appoint a selection team to select project participants.
- Ensure that the selection team is represented by all sections of the organisation (i.e. marketing, operations, engineering, purchasing, construction, etc.).
- Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.
- Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards registration.
- Conduct an audit against identified firms, and assess that their equipment and systems satisfy the quality plan.
- Request Tenderers to notify any of the aspects for quality improvement not included in the quality plan.
- Select the Contractor, who meets the pre-determined selection criteria, and seek Client's approval.
- Conduct interviews with the Contractor, share project objectives and management policy, and agree the formation of a Joint Management Team.
- When preparing contract document, minimise unnecessary contract terms which impose more risks and liabilities on contractor.
- Ensure that the co-ordination agreement and safety plans are included in the contract.
- To pre-qualify Designers and Consultants consider the principles used in the Contractor selection process.
- Ensure that the Main Contractor adopts qualitative approaches in the selection process of Sub-contractors and vendors.
- Ensure that the selected Sub-contractors have got enough equipment to satisfy the quality plan.
- Advice the Main Contractor the principles of selection of Sub-contractors and vendors.
6.6.4 Organising a Joint Management Team

Burati (1992) stated that the procedure for organising a joint team at the interface is same as organising teams within the organisation. He also stated that the joint teams should be responsible for establishing joint goals, plans and controls for the project. According to Mathews and Burati (1989), many companies had formed a joint project team early on in the project with members from all phases of the project. The team usually comprises project managers, representatives of the major design engineering disciplines, a construction representative, a quality engineer, a procurement manager, and an operations representative.

Team organisation is the primary responsibility of the Client's Representative before a project starts (Todryk 1990, Tsiotras 1993). As a first step, a pre-construction session should be conducted, and this session should include the Client, Designer, Contractor and if possible Sub-contractors (Deffenbaugh 1993), thus, participants jointly develop a project mission. One method of improving the nature and quality of the team is to have a clear mission statement (Deffenbaugh 1993, Todryk 1990). Todryk stated that the Client's Representatives should keep the mission up-front and visible by action and in writing. He, further required the Client's Representatives to be supportive of team members who are willing to learn new skills, attitudes, methods and procedures so that the team can be more effective and obtain team goals. The team-building is not solely the responsibility of Client's Representatives, Deffenbaugh states that it is a joint operation, in which all participants discuss and negotiate their requirements for the project in order to satisfy everyone involved in the project. He identified the following activities of the team members for organising a joint management team.

- Considering all the requirements for success by all entities, each person composes a mission for the project.
Together the group achieves consensus on a project mission. With achieved mission, the group becomes a team with a common purpose and vision for a successful project.

The team members brainstorm their ideas to agree on the key items that need to happen to accomplish the mission.

As the session closes, the team agrees on a leader and sets a regular meeting time.

Finally, the Quality lead team (Joint Management Team) is formed to monitor all teams on the jobsite so that designer and worker time is effectively used for positive results.

Based on the agreed plan of action, the participants share the responsibilities for controlling the project. However, the leadership of the Joint Management Team is subject to the extent of the involvement of the Client in the project. Research by NEDC's Working Party (1991) indicates that partnerships such as DuPont/Fluor Daniel, Union Carbide/Bechtel, Procter & Gamble/Kellog, Shell Oil/Ralph M Parsons, Anglian Water/Biwater have established some kind of joint team for controlling their project. In their relationships, the NEDC working Party has noted that the team leadership has changed from one to the another. In some cases, it has been taken by the Client and in the others the Contractors have taken the responsibility of leading the team.

The foregoing led to the following definition of 'organising a Joint Management Team' task, and best practices for the improvement of the task to be proposed.
Organising a Joint Management Team - Task definition

A Joint Management Team should be established at the earlier stage of the project. This team should be represented by members of both the Client and Contractor. Plans and objectives specific to the project should be shared between the parties. An action plan for co-ordination, problem solving, performance measurement, communications, etc., should be prepared jointly. The plan should address the involvement of appropriate parties from both organisations. In accordance with the action plan, responsibility and authority are delegated to the respective personnel.

Practices for the improvement of organising a Joint Management Team

- Conduct meetings of top level representatives from all parties, and share project plan and objectives.
- Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications, and corrective actions.
- Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.
- Ensure that the membership of the Joint Management Team is well balanced by the representatives of the Client and Contractor.
- Depending on the nature of project and problem, assist the joint team in appointing quality improvement team and corrective action teams.
- Record the agreed action plans, and communicate it to the entire organisation.
- Delegate the quality champion or quality consultants to train the members of the co-ordination team on quality tools and technology and team building skills.
6.6.5 Design management

According to Ledbetter (1994), the Quality Performance Management System (QPMS) defines the 'design phase' as:

"any work performed on a design product (drawing, diagram, purchase order, specification sheet, data sheet, etc.) prior to "issue for construction" or "issue for fabrication" or "approved for construction" (pp. 36).

In respect to the objectives stated in the brief, outline design followed by detailed design are performed. It is often rare to delegate the overall design process to one mind, it is the output of input from many participants at various stages of design phase. On behalf of the Client, Client's Representatives play a prominent role in restating the Client's brief in the form of detailed objectives (Walker 1989). Depending on the Client's procurement option, the roles of other participants such as external Design Consultant, in-house Designer, and Contractor's Designer in the design phase vary (see Section 2.6).

Research by Burati (1992) revealed that rework costs a significant portion of total costs. The major cause for the rework was found to be design deviations, which averaged 78 per cent of the total number of deviations, and 79 per cent of the total deviation costs. The research identified that one of the factors which caused deviations was the design deviations initiated by the Client. This kind of problem often occurs due to the Client's design input based on inadequate information and advice (Parsloe 1990). The reason for the Client's inadequate design input, according to Parsloe, is no provision for active input to briefing from Client's Representatives, strategic planners, and end users. If the Client is inexperienced, it is the responsibility of Client's Representatives to correctly assess the Client's requirements, and guide him/her through the process (Parsloe 1990, Gameson and Hudson 1993). In the design
process, the role of Client’s Representatives as stated by Parsloe include: extracting information from the Client regarding his/her requirements and expectations; and liaising with other members of the design team in order to co-ordinate design activities and determine the best design solutions. It includes co-operating with the participants for continuous improvement and make the Client aware of the risks of incomplete design (Latham 1994).

Another important factor to be considered during design phase is constructability of the design. This requires the construction professionals to participate earlier in the design phase and provide valuable informations to enhance the constructability of the design. Chase (1993) identified that many companies solicited the input for design improvements from construction employees and suppliers. He stated that this enhanced design to reflect more efficiency, less waste, fewer errors, more ease of construct. Graves (1993) suggested the following action points for improvement in design:

- reduce rework and revisions to plans and specifications;
- keep construction cost in conformance to budget (estimate and bids within budget);
- reduce the cycle time to complete design and documents;
- produce final design documents that meet the Client's expectations and requirements; and
- reduce hours or cost per drawing (productivity and rework).

In order to reduce re-work and revisions in design, BS 5750 Part 1 (Clause 4.4.3 and 4.4.4) requires Client’s Representatives (referred as Design Service Organisation) to take following actions on design input and design output.

**Design input:**

- identify and document design input requirements;
- review their selection for adequacy; and
resolve incomplete, ambiguous or conflicting requirements with those responsible for drawing them up.

Design output:

- meet the design input;
- contain or reference acceptance criteria;
- conform to appropriate regulatory requirements whether or not these have been stated in the input information; and
- identify those characteristics of the design that are crucial to the safe and proper functioning of the product.

In the selection process, Clients should also pre-qualify their designers, allowing only those with effective quality management programmes to be considered for their projects (Chase 1993, Latham 1994). This not only reduces undesirable variability, but it allows the parties to better understand and meet each other's expectations.

The above led to the following definition of the 'design management' task and best practices for Client's Representatives.

Design management - Task definition

Design management for the Client's Representative includes coordinating the design team for continuous improvement and checking that the design confirms and satisfies the Client's requirements.
Practices for the improvement of design management

• If design responsibility is left to the Contractor, during the pre-bid assessment, assess the design capabilities of Contractor's professionals and ensure that they have enough design expertise.

• If separate design professionals are to be appointed, pre-qualify them by auditing their expertise.

• Consult the Contractor and construction professionals for advice during the preliminary design, and achieve constructability in the earlier phase of the design.

• Provide the Designer with necessary design input data as and when required, and without delay.

• Before issuing design inputs, ensure that they are completely checked and reviewed right at the first time.

• Ensure that the detailed design satisfy fire and means of escape regulations, building regulations, health and safety regulations, and traffic and noise control regulations, etc.,

• Assist the design professionals to feel secure from and confident of their creative input.

• Trace the occurrence of design omissions and errors, inform the design team, and ensure that corrective action is taken.

• Avoid unnecessary changes in the project scope during the detailed design.

• During all stages of design, get the Client's feedback on the degree to which expectations are being met.
6.6.6 Safety management

There are considerable similarities between the approaches to health and safety and effective quality management. The principles of good health and safety management and good quality management are, however, the same (HSE 1991, HSC 1992). The Report of Health and Safety Commission (HSC) stated that the monitoring techniques of safety programme are similar to that of the TQM programme. Health and Safety Executive (HSE) describes the key elements of successful health and safety management as set out below.

Policy
The health and safety policy influence all activities and decisions, including those to do with the selection of resources and information, the design and operation of working systems, the design and delivery of products and services, and the control and disposal of waste.

Organising
Organisations are structured and operated so as to put their health and safety policies into effective practice.

Planning
Performance standards and specific actions needed to promote a positive health and safety culture and to eliminate and control risks are planned for a systematic approach to policy implementation.

Measuring performance
Health and safety performance in organisation which manage against pre-determined standards.
Auditing and reviewing performance

Lessons are learned through regular reviews of performance based on data from monitoring activities and from audits of the whole health and safety management system.

The general Contractor has traditionally been responsible for managing the project safety programme, where safety was seen as an activity that the contractor's staff had the responsibility to monitor and enforce (Fisk 1992). However, Mathews and Burati (1989) stated that Clients ultimately pay for losses on jobsites; following good management practice, Client's should oversee Sub-contractor's activities to ensure they too are applying good management and safe working practices. This indicates that on behalf of Client, the Client's Representatives have a duty to achieve an effective safety programme during construction.

In construction, different firms are involved in producing the final product with different ways of working which do not fit together very well. However, the HSC (1992) report suggests a unique procedure for implementing safety programme. It recommended the following procedure for the participants for developing a unique safety procedure.

*Client:* make sure you tell your Contractors what monitoring system is in use, how it works and how they fit in.

*Contractor:* make sure you find these things out and tell the Client about your own system.

*Both Contractor and Client:* Both companies discuss and agree how they will work together within the systems.
The HSC Report requires Client's Representatives to:

- ensure that the design of any structure comprised in the project complies with regulation 10(1)(a) in the circumstances of the project;

  [Regulation 10(1)(a) requires to ensure, so far as reasonably practicable that the design, the Designer prepares is such that, if the structures conforms to the design, persons at work who are building, maintaining (including re-pointing, redecorating or cleaning) or repairing the structure will not be exposed to risks to their health or safety.]

- ensure, before the start of the construction phase, that a health and safety plan exists, which:

  . sets out arrangements for the project which ensures, so far as is reasonably practicable, the health and safety of all persons at work by virtue of the project; and

  . includes the arrangements for the management of the construction work, and monitoring compliance by all persons with the requirements or prohibitions placed on each of them with respect to the project by virtue of the relevant statutory provisions.

- take such measures as it is reasonable for a person in his/her position to take to ensure, so far as is reasonably practicable, in respect of the project that adequate financial provision is made and adequate time is allowed to enable every employer of employees who are, and every person who is, at work by virtue of the project to comply with his/her duties under the relevant statutory provision relating to the contract;

- ensure that a health and safety file is prepared in respect of each structure comprised in the project;

- ensure that, on the completion of construction work on each structure comprised in the project, the health and safety file in respect of that structure is delivered to the Client.
Some of the partnering companies studied by NEDC's Working Party (1991), such as Fluor Daniel/DuPont and Bechtel Constructors/Union Carbide, have implemented their safety programme effectively through the joint workforce. These partners have jointly developed the safety plan. Training on safety was given to all participants jointly by both Client's and Contractor's technical personnel. This indicates that the Client's Representatives should participate in implementing the programme down towards the craft level.

The above discussions led to the formulation of the following definition and practices for the 'safety management' task.

**Safety management - Task definition**

In order to ensure an accident-free environment, a health and safety plan must be developed by the Client's organisation. Performance and corrective actions, according to the safety plan should be measured, discussed, and recorded.

**Practices for the improvement of safety management**

- As part of the quality plan, develop a health and safety plan in accordance with the health and safety regulation, and ensure that it is included in the contract.
- Request tenderers to notify of any hazard or precautions not included in the plan.
- Ensure that the design of any structure complies with the safety plan.
- Ensure that the health and safety file, containing information of the design, and the health and safety of any person carrying out construction, is prepared in respect of each structure.
- Ensure that the health and safety plan is implemented by the Contractors and vendors, during construction.
6.6.7 Measuring and reviewing performance

Measurement is an important part of the TQM process which can be used in many ways to contribute to the continuous improvement of the process. Zairi (1994) stated that the TQM-based performance is based on people productivity, their empowerment and involvement and giving them total ownership in the design, control and measurement of their processes. Thus, he described that performance measurement is about recording human activity and providing a stimulus for action with the view of doing better all the time. As continuous improvement is one of the main principles of TQM, the performance measurement can be used to identify the standards which are inadequate or absent for improvement. Burati and Mathews (1992) describes this process as below.

- Measures established at the planning stage should be carefully monitored and their conformity to the initial plan verified.
- Any deviations from the established plan should be investigated and removed through the P-D-C-A (Plan-Do-Check-Act) problem-solving process.

Continuous undertaking of this process helps determine the root causes of the problem and continuously improves the solution for the problem. In the cycle of never ending improvement, Dale (1990) and Oakland (1994) both suggested two ways for measuring performance:

- comparing performance against internal standards (process control and improvement) includes scrap costs, customer complaints, defect reports etc.
comparing performance against external standards (benchmarking) using published information, visits to companies etc., and will be concerned with advanced quality planning, quality circles, statistical process control, mistake proofing, etc.

BS 7850 (Clause 5.4.2) states that statistical analysis plays a major role in revealing cause, effect, and solution for the problem identified from the measurement. Thus, it suggests that the trends displayed by measurements should be interpreted statistically.

Zairi (1994) states that performance measurement is about the improvement seen by the next customer. He, further describes that it should be aimed at establishing whether expectations have been fulfilled at each stage of the customer-supplier chain. The overall measure should reflect what has been delivered to the end customer and customer satisfaction, the ultimate goal, has been achieved. Thus, it is spectaculative that the Client's Representatives, on behalf of the Client should use the performance measurement for measuring client's satisfaction and conforming requirements. According to Zairi (1994), the European Quality Award (EQA) provides the following measures for measuring customer satisfaction.

- **Product and service quality**
  - capability of meeting specification
  - defect, error, reject rates
  - on-time delivery
  - responsiveness and flexibility
  - support
  - warranty and guarantee provisions

- **Indirect measures of customer satisfaction**
  - complaint levels
customer returns (by value and quality)
re-work levels
accolades and rewards received

In construction, all works are process related, and it is performed through a team approach using cross-functional contributions. This leads the experts (Kearney 1993, Zairi 1994) to argue that there should be only one set of measures of the business and the TQM programme should be used to drive progress against them. Kearney states that, in this way people can see the relevance of their own efforts within the overall programme.

In most partnering arrangements, the participants such as Client's Representatives, Contractor, Designer, etc., establish a joint management team (Section 5.7, Chapter 5). In such cases, measurement should be principally performed by joint teams involved in the partnerships work processes. Deffenbaugh (1993) stated that regular meetings of the Joint Management Team should be held to check upon the quality progress. In these meetings, the team should review measurements most important to the job at that given time and take action to promote improvement where needed. According to NEDC (1991), most of the partnering companies have established performance evaluation teams comprising members from both contractor and Client. Subject to continuous improvement, these joint teams have measured the actual performance of the staff and workforce at all levels. This indicates that the Client's Representatives, on behalf of the Client, participate the Joint Management Team, and through the joint evaluation, they ensure that the Client's requirements are being met. This enables Client's Representatives to verify the conformity of the measures established at the planning stage. Dale (1990), in addition to the other factors such as utility, service ability, and appearance etc., required the Client to measure the performance in terms of value for money, because it enables the Client to evaluate the cost-benefit of the performance.
The above discussion led the following definition and practices for the 'measuring and reviewing performance' task.

**Measuring and reviewing performance - Task definition**

Measures established at the planning stage should be carefully monitored and their conformity to pre-determined standards ensured. Any deviation from the established plan should be investigated and removed through the P-D-C-A (Plan-Do-Check-Act) problem solving process. Performance of quality programme should be measured jointly by the Joint Management Team.

**Practices for the improvement of measuring and reviewing performance**

- Measure the effects of training given to the Client's organisation for example by measuring skills of workforce before and after the training.
- Through the Joint Management Team conduct a regular measurement of performance and progress.
- Identify, problem areas, deficiencies and deviations.
- Use the TQM tools, such as fish-bone diagram and statistical methods to identify the causes of and solutions to various problems.
- Discuss with team members causes of deficiencies and deviations, and suggest corrective action.
- Check, through the JMT, that the corrective action has been implemented.
- Continually review the results of any performance measurement and identify areas where performance standards are absent or inadequate.
- Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.
- Define a system to measure the performance improvements in terms of cost/benefit.
- Assess the Client's satisfaction with performance.
6.6.8 Communications

Total Quality Management will change the way many people operate and do business. In traditional organisation people need to be informed of decisions which affect them, whereas in a TQM business, people need timely, accurate information in order to make decisions which affect the quality of their work (Jeffries and Evans 1992). Oakland (1994) stated that the essence of changing attitudes to quality is to gain acceptance for the need to change, and for this to happen it is essential to provide relevant information, convey good practices, and generate interest, ideas and awareness through excellent communication process. He also identified two essential components for effective TQM communications:

- general information about the TQM process; and
- regular meetings between employees and managers/supervisors.

The first component deals with communicating the company's commitment to TQM, quality policy and information relating to development of TQM process. The second component stresses continuous meetings between all participants. In meetings, all kinds of problems (including quality, safety, dispute) are discussed, and input for process improvement should be sought from participants. The top management should listen to staff and obtain their opinions, very often ideas for improvement will come from staff carrying out a particular action (TQM Task Force of ECI 1993, Jeffries and Evans 1992). In specific, Jeffries and Evans summarise the following to be communicated by the management in a TQM business.

_TQM related information:_

- what TQM is about;
- how it affects them;
- what the vision is; and
- what it will mean for them.
Information relating to the business or organisation

- the direction of the business;
- what decisions are being made at senior levels;
- the reason for those decisions; and
- how they will be affected personally.

Everyone involved in the construction process are responsible for handling and transmitting job-related information from one party to the other. The Client's Representatives have traditionally been the focal point of contact for all participants (Gameson and Hudson 1993). They also have to communicate with everyone to explain what is going on, and obtain their views on possible solutions and determine how it is to be implemented. According to Jeffries and Evans (1992) and Oakland (1994), Client's Representatives should communicate the TQM vision and the project related business to all participants. This includes communicating to both intra and inter-organisations. Hensey (1993) suggested that for construction projects, the following action points for effective communication should be adopted by the Client's Representative:

- regular Client updates on project;
- effective internal project team communications;
- honesty in reporting/discussing issues;
- representing the Client well to regulators; and
- few nasty surprises, quick handling of problem.

Reports by CII (1991) and NEDC (1991) stated that partnering arrangements between participants enhance communications between them. In partnerships, meetings are conducted regularly by the joint team, which provide parties to exchange their ideas on particular problem, and enable them to find an effective solution for that problem. Some surveys (Burati and Mathews 1991, and Lathem 1994) indicate that Client's professionals go to considerable lengths to brief Sub-contractors and their operatives
on-site. This provides staff with a clear picture of the Client's objectives and expectations.

Oakland (1994), from the current practices of many TQM driven organisations, indentified the following ten communication methods for quality improvement.

**Suggestion schemes**

This event should be used sparingly to obtain maximum impact, and must be given lively publicity. If special prizes are to be awarded, presentations to the best suggestions should be made with the appropriate publicity.

**'Departmental' talk-ins**

This method calls for gathering people together for brief but organised periods to discuss quality issues relevant to the department.

**Induction and vocational training**

Induction training in quality alerts people to the requirements, codes of practice, conduct, procedures, and the quality culture. Vocational training for specific jobs should satisfy the employees' interests in quality created during the induction phase.

**Poster campaigns**

Posters and similar devices can form an important part of the quality communication message from the very beginning.

**Point-of-work reminders**

This is used for highlighting special problems and to encourage careful working practices.
**Competitions**

A competition may be at the company/organisation level with, say, a determined attempt to win a national or continental 'quality award' on an inter-departmental basis.

**Prizes and formal presentations**

In the recognition process, some sort of certificate of recognition are awarded to allow people to display their success. Photographs and reports of such award 'ceremonies' provide a colourful method of publicity.

**Demonstrations and exhibitions**

Static exhibitions of certain aspects of quality can be a focal point of interest, and a powerful way of making an impact.

**House magazines or newsletters/posters**

Local or organisation-specific newspapers have a role to play if regular communication is to be achieved on a broad scale.

**Opinion or attitude surveys**

Employee opinion or attitude surveys are conducted by questionnaire as part of TQM. If these are designed carefully, they should measure the employee perception of the programme.

Based on the above, the task definition followed by practices for the improvement of 'communication' task are proposed as follows.

**Communications - Task definition**

Receiving and dispersing information on behalf of the Client. This includes exchanging information by open communications with all participants.
Practices for the improvement of communications.

- Convey management's commitment to TQM to the Client.
- Establish a good communication system that keeps all participants aware of the objectives, progress and successful stories of the programme.
- Communicate the standards, procedures and systems relating to implementation and performance measurement to relevant participants.
- Prompt actions of client to feedback from contractor, supplier, and other professionals.
- Communicate the suggestions and required corrective actions to respective parties.
- Welcome comments and suggestions from participants for process improvement.
- Publish successful results and recognise employees, using newsletters/posters.
- Communicate the Client's views and suggestions on process improvement.
- Adopt 'walk and talk' policy for effective communication.
- Follow 'on the job briefings' to discuss problems and issues relevant to the job.

6.6.9 Motivation

A manager's task is to identify the personal needs of each employee and then to design a job in such a way that they can be met. If the needs are identified accurately, then the appropriate environment can be provided and the employee will be properly motivated (Pilcher 1992).

Maslow (1970) identified a hierarchy of needs consisting of five levels: physiological; safety or security; social, esteem, and self-actualisation. Pilcher stated that the two lower level needs (Physiological and safety or security) can be satisfied by providing satisfactory financial awards such as good wages, supplementary benefits like pensions, health, holiday pay and some protection from dismissal. The three higher
levels tend to be satisfied by job attributes such as independence of action, increased responsibility, recognition and public endorsement of success, a challenging job, creative task demands, a high status job title, and freedom in decision making.

According to Rosenau (1992), Frederick Herzberg argued that many things done to improve motivation are not motivators at all. He called these 'hygiene factors'. The absence of hygiene factors is demotivating, but their presence is not motivating. However, many experts (Kanter 1989, Rosenau 1992, Turner 1993) agree that 'achievement' and 'recognition' are the most powerful motivators. This led to five new factors for effective motivation (1989):

- **Purpose**: people must believe in the importance of their work, and that it contributes to the development of the organisation.
- **Pro-activity**: emphasising the achievement of results, rather than fulfilling roles, and delegating professional integrity through results gives subordinates the opportunity to take responsibility for their own development.
- **Profit sharing**: allowing people to share in the entrepreneurial culture will encourage them to value it.
- **Progression**: as people near the top of Maslow's hierarchy, they become conscious of the need for self-fulfilment. They therefore value the opportunity to increase their learning experiences.
- **Professional recognition**: another measure of achievement is professional recognition. Line Managers must therefore ensure that their subordinates receive due recognition.

Implementing the aforementioned factors for successful motivation needs further investigation in the managerial style of managing people and process. Douglas McGregor (1966) identified two managerial styles: Theory X and Theory Y. Theory X is authoritarian style, in which top management makes decisions and coerces workers to comply. Theory Y is the participative style, built upon the findings that people both
enjoy working and want to work. It assumes useful controls are within individuals and managers can draw upon worker's self-direction. In this style, the people are self-motivated to achieve the business objective. This concept (Theory Y) resembles the basic principle underlies in TQM - management by participation. This makes it important to empower the people who are actually performing the process to take responsibility over that process. Turner (1993) describes 'empowerment' as, the leadership approaches that enable employees to take ownership of their jobs so that they choose to involve themselves in constantly improving the performance. Oakland (1994) from his observation on companies states that:

"where individuals are stimulated to commit themselves to a goal, and where their personal pride and self-esteem are at stake, then the level of motivation is at a peak".

Thus, in TQM, Client's Representatives should empower everyone, as far as possible, for their own performance, and encourage them to committed to attaining quality in a highly motivated fashion.

Deffenbaugh (1993) stated that recognition promote teamwork on the job and pride in one's work. He identified that this can be accomplished by using positive reinforcement in the form of 'crew of the month' or some other similar award. This recognises the workers who do the right things right at first time. Recognition can also be accomplished by rewards in the form of cash or prizes, but research by Sanders (1993) revealed that several people had achieved significant success with recognition as opposed to rewards. To motivate the participants (Contractors, Sub-contractors etc.), research by NEDC (1991) indicated that some Clients used incentive schemes.
The above discussion led the formulation of the task definition and practices for the 'motivation' task as follows.

**Motivation - Task definition**

Establishing a good environment which encourages people to work successfully in the interest of the Client and other participants.

**Practices for the improvement of motivation**

- Encourage the Client to implement TQM in the project.
- Identify the needs of each participant.
- Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.
- Empower people to act for quality improvement.
- Recognize high-performing people.
- If possible introduce incentive schemes to enable parties to work towards a common goal.

6.6.10 Co-ordination

A group (team) approach towards construction projects is vital because a project is never a one-person or one-manager task. Moreover, in TQM-based projects, formation of many cross functional groups such as Quality Improvement Teams, Corrective Action Teams, Quality Awareness Team, Education Action Teams are inevitable (Chrest 1993). In such cases, the typical project organisation is not just a relationship between individuals, but between sets of interlocking and interdependent groups. This interdependence requires co-ordination. The greater the specialisation, the greater the interdependences and, therefore, the greater the need for co-ordination amongst them (March and Simon 1958). Calvert (1986) describes co-ordination as the linking together of the various members to constitute a practical ensemble, and the balancing of
resources and activities to ensure complete harmony at every performance. Thus, in
construction projects one of the main responsibilities of Client's Representatives is to
ensure that the overall co-ordination of Contractors, Suppliers and other organisations
working on site is of a high standard (Austen 1986, Mastrandrea 1986).

Mintzberg (1979) describes five basic co-ordinating mechanisms as follows.

- **Mutual adjustment** (which achieves co-ordination by the process of informal
  communication).

- **Direct supervision** (which achieves co-ordination by creating managerial roles
  arranged in a hierarchy. As and when familiar problems arise which are beyond
  the discretion of the person carrying out the work they are referred upward until a
  level is reached in the hierarchy which has the necessary discretion. The
  exercised discretion travels down to the workforce as an instruction).

- **Standardisation of work processes** (which achieves co-ordination by establishing
  a programmed or specified response in advance of the execution of the relevant
  work. The capacity to perform a particular programme depends upon training:
  employees are taught the appropriate reactions to specific situations that will
  repeatedly confront them at work).

- **Standardisation of outputs** (which achieves co-ordination by setting targets or
  goals, ie. the required results are specified).

- **Standardisation of skills** (which achieves co-ordination by the use of craft or
  professional training of the workforce).

Mastrandrea (1986) stated that the project managers co-ordinate largely by mutual
adjustment. Galbraith (1973) called this process 'the creation of lateral relations'.
Mastrandrea described that within the continuum of increasingly sophisticated roles
varying with the level of uncertainty encountered, beginning with direct contact
between two people who share a problem to matrix design, the integrating role needs to
be considered for better co-ordination. Integration has been defined as 'the quality of
the state of collaboration that exists among departments that are required to achieve units of effort by the demands of the environment (Lawrence and Lorsch 1967).

TQM is a teamwork and involves many groups working together. This amalgamation of groups and individuals may create differences between people, differences of opinion, values, objectives, etc. This differences will lead to discussion, argument, and conflicts. In order to avoid this problems, Mastrandrea requires the Client's Project Manager (Client's Representatives) to play an 'integrator' role. As an integrator if the Client's Representatives are to maintain an effective mixed team comprising all the groups working in the project, they must constructively prevent and overcome this destructive intergroup conflict. Lawrence and Lorsch (1967) identified three methods of handling conflict:

- **confrontation** (choosing, after discussion, a solution from those put forward for consideration);
- **smoothing** (conflict avoidance); and
- **forcing** (the naked use of power).

Lawrence and Lorsch also established that most effective integration was achieved in organisations which used confrontation, that is discussing with participants and arriving at a solution for the problem.

Jeffries (1992) emphasised the following procedures to help the team members work together effectively.

- *Ensuring that all group members are able to participate fully during meetings.* This could involve inviting people to contribute, asking questions, and ensuring that all contributions are valued.
- *Helping members build on each other's ideas - effective groups stay focused on an idea and do not jump to another before discussion of the first idea is complete.*
Helping the group resolve any conflict in a way which is constructive and creative.

Promoting a climate of openness where people do not feel defensive about their own involvement in the problem.

Preventing over-talking or interruptions taking place during discussions.

The above discussions led to propose the definition and practices for the 'co-ordination' task as follows.

Co-ordination - Task definition

Keeping all participants to function together efficiently for a common goal. This includes preventing and resolving conflicts.

Practices for the improvement of co-ordination

- Initiate actions in both the Clients' team and joint team, and keep them focused on the target.
- Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness.
- Identify and resolve differences constructively and positively.
- Solve disputes immediately with the assistance of team members.
- Conduct meeting at regular intervals and ensure that all parties attend the meetings continually.
6.6.11 Documentation

Levy (1987) defines 'documentation' of a construction project as maintaining sufficient records to account for the actions and inactions of all participants to the process. Traditionally, Documentation have been mainly used for the purpose of participant's own defense for the day-to-day events that led up to the problem (Fisk 1992). However, in TQM, Sanders (1993) states that the implementation efforts, the success, and the failures all need to be documented to aid in future implementation efforts. The Documented records are used in TQM for assessing performance for continuous improvement.

Documented procedures are an important part of quality management for the following reasons (CIRIA 1991).

- Their preparations forces attention into how things are being done and onto defining the best way of doing things. This may reveal overlaps, gaps, malpractices, inefficiencies of many sorts, cut corners, re-working and a variety of other undesirables. All of these can detract from the standard of the service and generate unnecessary cost.

- Implementation of the documented procedures ensures that everyone carrying out similar functions does so in the same way - the way that has been agreed to be the best way - rather than perhaps by picking up other people's bad practices, or wasting his/her own and other people's time trying to find out how he is supposed to act.

- The existence of the documented procedures makes it a great deal easier the training of new staff - and therefore avoids waste of time in this area.

- Documentation of procedures renders the activities they cover amenable to management control.
Clause 4.16 of BS 5750, Part 1 requires Client’s Representatives (referred as Design Service Organisations) to establish and maintain procedures for identification, collection, indexing, filing, storage, maintenance and disposition of quality records. Appropriate quality system documentation includes the following (ISO 9004 - 2 1991).

**Quality manual:** This should provide a description of the quality system as a permanent reference.

**Quality plan:** This should describe the specific quality practices, resources and the sequence of activities relevant to a particular service.

**Procedures:** This should define how the activities are to be conducted, controlled and recorded.

**Quality records:** These provide information:

- on the degree of achievement of the quality objectives;
- on the level of customer satisfaction and dissatisfaction with the service;
- about the results of the quality system for review and improvement of the service;
- for analysis to identify trends;
- for corrective action and its effectiveness;
- on appropriate Sub-contractor’s performance;
- on the skills and training of personnel; and
- on competitive comparisons.

The quality documentation also includes maintaining safety file. Client’s Representatives should maintain a safety file in respect of each structure comprised in the project containing any information included with the design and any other information which is reasonably foreseeable will be necessary to ensure the health and
safety of any person performing construction on or in the structure at any time (HSC 1992).

The above points led the formulation of the following definition and practices for the 'documentation' task.

**Documentation - Task definition**

Recording an act, condition, or event which bears an effect on the objective of the relevant process. It includes recording both the success and failure of efforts spent on the process.

**Practices for the improvement of documentation**

- Document the Client's quality plan containing policy, objectives, and structure of organisation.
- Maintain a safety file, containing safety policy, performance standards, rules and procedures.
- Document the quality plan specific to the project.
- Record the degree of achievement of the quality objectives at each stage of the project.
- Record the level of Client satisfaction with the service.
- Record decisions made on corrective actions and effectiveness during performance.
- Record the performance of Contractors and Suppliers against the quality procedures.
- Maintain these documents as readily retrievable and retain for a designated period.
6.6.12 Project post-mortem

Project post-mortem is a session conducted at the end of the project to review, discuss, and check all aspects of the project to uncover opportunities for improvement on future projects (Deffenbaugh 1993). Deffenbaugh states that all of the original jobsite quality planners are reassembled after the completion of the project to review the project, its success and failures. It includes all participants such as Clients, Client's Representatives, Contractors, Sub-contractors, and Suppliers etc.

Turner (1993) stated that data gathered at the post-mortem reviews should include:

- as-built design (final configuration);
- a comparison of final costs and benefits for feeding back to the estimating process, and to the selection of future projects;
- a record of the technical achievement on the project for feeding back to the design and selection of future projects; and
- a review of the successes and failures of the project and the lessons learned, for feeding back to the management of future projects.

In essence, the post-mortem review will answer the following questions.

What went right?
What went wrong?
What will be done differently on the next project?

Reviewing the success and failures of the project can be done by: debriefing meetings; and post-completion audits (Turner 1993).
Debriefing meetings:

All people who attended the project launch workshop are assembled together to review and brainstorm the assumptions made. It allows people to show their grief, or frustration, or pleasure at having been a member of the project.

Post-completion audits

This is a formal review of the project against checklist. It can also be conducted by external Consultants.

During the debriefing meetings all participants should be allowed to consider several items for the next project. For example, Deffenbaugh (1993) insisted inviting workers to discuss constructability issues. With workers input, the Designers can make practical improvements. Other participants can be interviewed in the same manner. Processes are reviewed for replication on other projects. In addition to adopt the above procedures of project post-mortem, Client's Representatives should also answer the following questions (Tsiotras 1993).

Does the product/service meet the original expectation?

Is the product/service cost-effective?

Finally, minutes of the post-mortem meetings are distributed to every participants so that all may learn from every project team's experience (Chrest 1993).

The above points led the formulation of the following definition and practices for the 'project post-mortem' task.

Project post-mortem - Task definition

Project post-mortem is conducted at the end of the project to review, discuss and check all aspects of the project to uncover opportunities for improvement on future projects.
Practices for the improvement of project post-mortem

- Conduct post-mortem meetings involving all jobsite quality planners.
- Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.
- Assess achievement of Clients' requirement.
- Assess Clients' satisfaction on overall performance of the project.
- Widely distribute the minutes of the post-mortem meetings.

6.7 HYPOTHESIS THREE

"The practices identified for all of the twelve tasks (see Section 6.6) are "best practices" for Client's Representatives to achieve total quality in construction projects".

6.8 SUMMARY

This chapter has: analysed the roles of Client's Representatives; identified the important tasks of Client's Representatives in TQM-based construction projects; and established best practices for achieving all of the tasks effectively. The traditional role of Client's Representatives, and its inability in solving various problems such as conflicts, disputes, cost/time overrun etc., were highlighted, and the need for the TQM-approach for solving all these problems effectively and achieving continuous improvement was emphasised. The TQM-approach requires Client's Representatives to adopt a 'teamwork' philosophy in controlling the project. This helps to achieve total quality in construction. The tasks of Client's Representatives identified as important for a TQM-based construction project are as follows:
1. Preparing and organising
2. Developing project definition
3. Procurement
4. Organising a Joint Management Team
5. Design management
6. Safety management
7. Measuring and reviewing performance
8. Communications
9. Motivation
10. Co-ordination
11. Documentation

In order to achieve the second objective of this chapter, various issues and problems involved in each of the twelve identified tasks were reviewed and discussed. These discussions have led to formulate the best practices for each tasks. Section 6.6 has presented discussions followed by the list of best practices for all of the tasks. The identified tasks and best practices for Client's Representatives have formed the basis for further investigations, which can be seen in subsequent chapters.
CHAPTER SEVEN

RESEARCH DESIGN

7.1 INTRODUCTION
7.2 RESEARCH METHOD AND OBJECTIVES
7.3 RESEARCH STRATEGY
7.4 PHASE ONE: LITERATURE REVIEW AND EXPERT OPINION
7.5 PHASE TWO: DATA COLLECTION AND ANALYSIS
7.6 SUMMARY
CHAPTER SEVEN

RESEARCH DESIGN

7.1 INTRODUCTION

Chapter 5 and Chapter 6 stated the three propositions that the author aimed to investigate. This chapter discusses the research methodology, and collectively presents the propositions in the form of three hypotheses. Various research strategies are highlighted, and the strategy adopted for this research is rationalised. Accordingly, the data collection, sampling procedure and the questionnaire design used in this research have also been discussed.

7.2 RESEARCH METHOD AND OBJECTIVES

At a more concrete level, the scientific method of research is said to comprise the following steps (Buckley 1976):

- **knowledge steps from observations which take place through a definable searching process**;
- **the research problem is defined, which means answering why the research is being done and what it is supposed to achieve**;
- **a research plan must be formulated. It comprises the selection of appropriate strategies, domains and techniques**;
inquiry ensues in accordance with the plan and is directed by the need to obtain relevant and sufficient evidence;

the outcome of the inquiry is stated in explicit terms which may result in the support or refutation of an existing hypothesis; and

the conclusions are documented with sufficient support and clarity that they establish what was done, what was found, and what significance the findings may have.

Buckley described these steps as gears to the assurance of quality research. The methodology followed in this research is based on the above steps. Based on the first two steps the problems for the research were identified through the preliminary literature review. The identified problems led to formulate the following objectives (see Section 1.2).

- Identify the appropriate contractual arrangement for implementing TQM in construction projects.
- Determine and define responsibilities of the Client's Representative in construction projects when adopting TQM.
- Establish best practices for Client's Representatives.

7.3 RESEARCH STRATEGY

Having identified the research problem and objectives, the next step was to choose the appropriate strategy (i.e. the way for generating and testing theory) that would help to achieve the research objectives. Buckley suggested the following four possible methods.
**Opinion Research**

If the researcher seeks the views, judgements or appraisals of other persons with respect to a research problem, he/she engaged in opinion research (e.g. questionnaires, opinion polls, and interview).

**Empirical Research**

An empirical strategy requires that the researcher observe and/or experience things for himself/herself rather than through the mediation of others (e.g. case study, field study, laboratory study).

**Archival Research**

This is concerned with the examination of recorded facts (e.g. original documents or official files or records, publication of data gathered by other investigators).

**Analytic Research**

Analytic research relies on the use of internal logic on the part of the researcher. The researcher has the resources required for solving the problem within himself/herself. No explicit reference to external data source is necessary.

As the research aimed to provide initial observations (with respect to the objectives) from the literature, the empirical, archival, and analytic research were deemed inappropriate, because, these strategies are best suited for analysing actual behaviour and fact-finding. They are useful at identifying new variables and possible relationships between variables. Furthermore, testing the initial observations by conducting a few case studies or interviews will not reflect the perception of the whole construction industry. Thus, it was decided to choose a strategy which enhances the data collection from a large number of firms including all sections of the construction industry (such as building, civil, offshore, power, etc.); and allows quantitative analysis in the testing of inferences. To this situation, Buckley (1976)
and Fowler (1988) recommend opinion survey, because it provides a large sample of data and enables the researcher to infer results using statistical analyses. One of the major disadvantages of the survey approach was that the important variables had to be known in advance. However, the amount of literature in the area of construction project management and Total Quality Management was viewed as a good source for the development of variables. This led to the research being conducted in two main phases:

Phase One  - Literature review and expert opinion; and
Phase Two  - Data collection and analysis.

7.4 PHASE ONE: LITERATURE REVIEW AND EXPERT OPINION

A literature review was undertaken by investigating various issues and concepts that underlie contractual relationships between participants, and the role of the Client's Representative with respect to the principles of TQM. Much of the literature was obtained from the Pilkington Library (Loughborough University) and some was obtained through the Library interloan facilities available at Loughborough University of Technology. The literature review and findings have been presented in Chapters Two to Six.

Once the initial findings (relating to the three objectives) had been compiled from the literature, expert opinion was required before the original data collection in order to check the validity of the initial findings. Thus, an informal interview with the Chairman of TQM Task Force of European Construction Institute (Mr.P.G.Harvey) was undertaken. The input from the interview gave a good guidance in the direction of the research. Since the interview was just a sharing of ideas regarding overall findings of the literature review and more a open ended, details of the interview have
not presented in the thesis, however, alterations and modifications were made to the initial findings.

The initial findings from the literature review supplemented by the information from the expert opinion led to formulate the following three proposals into hypotheses.

**Hypothesis I (see Chapter 5)**

Partnering arrangements provide the ideal relationship for the participants to implement TQM in construction projects.

**Hypothesis II (see Chapter 6)**

The important tasks of Client's Representatives in a TQM-based construction project include: preparing and organising; developing project definition; procurement; organising a Joint Management Team; design management; safety management; measuring and reviewing performance; communications; motivation; co-ordination; documentation; and project post-mortem.

**Hypothesis III (see Chapter 6)**

The practices identified for all of the twelve tasks (see Section 6.6) are "best practices" for Client's Representatives to achieve total quality in construction projects.
The data collection mode in opinion survey includes: mail; telephone; personal interview; or group administration (Fowler 1988, Buckley 1976). Fowler stated that the choice of data collection mode has implications for response rates, question form, and survey costs.

**Response rates**

The problem of non-response is central to the use of mail surveys. Fowler stated that, "if mail questionnaires to a general population sample without appropriate follow-up procedures is followed, the rate of return is likely to be less than 30 per cent. Without follow-up procedures only a minority of potential respondents will return a questionnaire. However, he argued that if extensive and appropriate follow-up procedures are utilized and if the project is otherwise well designed and executed, response rates can be obtained for mail surveys similar to rates obtained using other modes.

**Questionnaire form**

Fowler (1988) advised that when self-administered questionnaire is used, it would be better to have closed questions - that is, questions that can be assured by simply checking a box or circling the proper response from a set provided by the researcher. If the questionnaire contains open ended questions, it will usually require an interview.

**Cost**

Survey costs depend on a multitude of factors. Some of them, as quoted by Fowler are the amount of professional time required to design the questionnaire, the questionnaire length, the geographic dispersion of the sample, the availability and interest of the sample, the call back procedures, the respondent selection rules, and the
availability of trained staff. However, from the experience of colleague researchers, it was understood that in most cases mail surveys cost less than personal interviews. Considering all of these three implications, a self-administered questionnaire survey through mail was deemed as suitable. In particular, since the questionnaire to the respondents had to be of the following characteristics, a mail survey was opted:

- asking questions with long or complex response categories;
- asking batteries of similar questions;
- questions of simply checking a box or circling the proper response; and
- the fact that the respondent does not have to share idea with an interviewee.

The main problem with most postal surveys, is often poor response. According to Siegel (1956), a sample sizes as small as $N = 6$ can be used only through non-parametric statistical analysis unless the nature of the distribution is known exactly. Since the scale of rating used in the questionnaire survey was such that only non-parametric analysis can be applied (see Chapter 8), a sample size of more than 6 is enough for statistical analysis. However, the power efficiency of tests could be improved, if the sample size is increased. Hence, in this type research, it was considered that a sample of more than 30 firms would be enough for statistical analysis to be performed. It was decided to post questionnaires to 110 Client's Representatives. According to Fowler's assumption, the response rate in excess of 30% of 110 (i.e. 33) firms was expected.

7.5.1 Questionnaire administration

The study, partially adopted Dillman's Total Design Method (TDM) for the development and use of a mail questionnaire. Dillman (1978) offered advice on the envelope, cover letter, mailing dates, and some other factors which both the quality and quantity of response. Dillman argued that obtaining a useful response rate requires considerable attention to the details of the questionnaire. Based on his advice
and with the advice of the other experts such as Fowler (1988) and Young (1966), the following procedures were followed in this survey.

- Individual, one page, dated covering letter printed on the Department of Civil and Building Engineering letter headed paper.
- Blue ball point signature added to each covering letter.
- A booklet type questionnaire with an attractive cover (coloured) and no questions on the front cover.
- Questions laid out spaciously in a vertical answer format.
- Self-addressed, first class stamped envelope for returning the completed questionnaire.
- Telephone the respondents, seeking their interest in participating the survey, before sending the questionnaire.

7.5.2 Design of questionnaire

Since the questionnaire was determined to be a self-administered one, it was realised that it should be self-explanatory without sharing of any clarifications regarding the questions. In order to ensure this, a covering letter and a separate page of introduction describing the aim and objectives of the research were attached to the questionnaire. In order to avoid confusing the respondents with new terms, a glossary of terms used in the questionnaire was also enclosed.

The more the questionnaire can be set up so that the respondent has the same kinds of tasks and questions to answer, the less likely it is that respondents will become confused; also, the easier the task will be for the respondents (Fowler 1988). To achieve this, questions of similar characteristics were put in a single section. The 130 questions listed in the questionnaire were placed in four different sections, and the
respondents were requested to answer all questions in a particular section in a similar manner (see Appendix A).

**Section One** comprised: the respondent's company and job related details; respondent's experience on specific types of construction projects (e.g. Building, Civil Engineering, Offshore etc.).

**Section Two** included: the respondent's familiarity on and experience with TQM; and questions related to the application of partnering in TQM. The objective of this section was to measure the suitability of 'partnering arrangement' for implementing TQM.

**Section Three** included: the task definitions and practices for the improvement of each tasks, identified in Chapter 6, were listed in appropriate order. Respondents were requested to assess: to what extent they agreed with the definition of each task; and how important each of the practices are for the improvement of the respective tasks. Against each task and practice, scale ranging from 1 to 5 were provided, and respondents were requested to circle the appropriate number in respect to their opinion.

The scoring for task definition was:

1 - Strongly disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly agree
The scoring for best practices was:

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</tbody>
</table>

*Section Four* included: the twelve tasks listed in a vertical order, with a box provided against each task. The respondents were asked to rank each of the task as to how important those tasks were for implementing TQM. Finally, space was provided for the respondent to make comments about any of the questions included in the questionnaire.

7.5.3 Sample

As already mentioned in Chapter 1, the data collection was centred on the UK construction industry. It was seen in Chapter 2 that, apart from the Client, the UK construction industry is represented by two main groups: Consultants (such as Architects, Engineers, Quantity Surveyors etc.); and Contractors. Thus, the question of who should be included in our population was resolved by deciding to choose the Consultants and the in-house Client’s Representatives. The rational behind this decision was being that the research was mainly aimed at investigating the role of the Client’s Representative. It was also realised that Client's Representatives would have known their roles very well than the others in the construction industry.

In order to obtain the list of Client's Representatives from all disciplines of the construction industry (such as building, civil engineering, offshore etc.), a search was performed in current directories, journals, and magazines related to the respective
disciplines. The Client's Representatives' organisations identified for the research were obtained from the following sources.

- The Consultants File 1994 published along with the journal - Highways and Transportation.
- International Directory of Consulting Engineers (1987).
- CIOB Handbook and list of members.
- British Architects Directory.
- 'Europetroleum' magazine.
- Client list produced by the Chartered Institute of Purchasing and Supply.
- Other journals and magazines.

7.6 SUMMARY

This chapter has described how the research was undertaken, and justified the methodology adopted during this research. In order to achieve its objectives, this research comprised two phases. Phase One was aimed at determining the initial observations, consist of the appropriate contractual arrangement and important tasks and best practices for the Client's Representative, from literature review followed by expert opinion. Phase two was comprised of data collection and analysis. After considering the three main implications of the data collection - response rate, questionnaire form, and cost - self-administered postal questionnaire survey was deemed suitable for this research. Since the primary objective of this research was to investigate the role of the Client's Representative, the sample for the research was decided to choose only from the population of Client's Representatives of the four sectors of the UK construction industry: building; civil engineering; offshore; and power, process and chemical plants. The questionnaire analysis and corresponding results have been reported in the next chapter.
CHAPTER EIGHT

DATA ANALYSIS AND RESULTS

8.1 INTRODUCTION
8.2 QUESTIONNAIRE RESPONSE
8.3 RESPONDENT PERSONNEL
8.4 APPROPRIATE CONTRACTUAL ARRANGEMENT FOR TQM
8.5 IMPORTANT TASKS FOR CLIENT'S REPRESENTATIVES WHEN INVOLVED IN TQM
8.6 BEST PRACTICES FOR CLIENT'S REPRESENTATIVES WHEN INVOLVED IN TQM
8.7 DISCUSSION OF RESULTS
8.8 SUMMARY
CHAPTER EIGHT

DATA ANALYSIS AND RESULTS

8.1 INTRODUCTION

The empirical results of this research have been reported with reference to testing the three hypotheses presented in Chapter Seven. The data obtained from the questionnaire survey have been analysed using appropriate statistical techniques, and accordingly the results have been interpreted and discussed in this chapter.

8.2 QUESTIONNAIRE RESPONSE

The empirical testing of the initial findings observed from the Phase One of the research were mainly based on data collected through the mail questionnaire survey. One hundred and ten Client's Representatives organisations were contacted. Thirty-eight of them responded fully to the questionnaire, a 35 per cent response rate. When compared to Fowler's (1988) statement that 30 per cent response can be normally achieved in a questionnaire survey, and considering its complexity, this research achieved a good response. This provided a good sample enabling a statistical analysis to be performed. Out of 110, twenty respondents returned the questionnaire unanswered. The main reason for not participating in the survey was reported as:

- lack of time to complete the questionnaire;
- lack of knowledge on TQM; and
- company policy.
Among the companies participated in the survey, 47 per cent have agreed to participate in further research, if it would be conducted. Appendix D lists the Client's Representatives who participated in the survey.

8.3 RESPONDENT PERSONNEL

The various types of Client's Representative have been presented in Chapter Three. They can be classified with respect to profession, type of organisation (i.e. Consultancy or Client), type of project involved (i.e. Building, Civil Engineering, Offshore, etc.). In this survey, 37 per cent of the Client's Representatives were in-house, and the respondents comprised Directors, Chief Executives, Quality Managers etc., of the respective Client's organisations. The external Client's Representatives accounted for 63 per cent, and comprised Architects, Quantity Surveyors, Project Managers, Engineers, etc. In order to test the applicability of the research findings to various sections of the construction industry such as Building, Civil Engineering, Offshore etc., the respondents were requested to notify the percentage involvement in each of the sections respectively. Based on the maximum percentage involvement in a particular section, they were grouped into four major sections. Table 8.1 shows the four groupings and the percentage of respondents in each group. It can be seen from this table that the Client's Representatives from Civil Engineering constituted more than the others. Subsequently, the highest participation were from the other sectors of the construction industry, in the descending order: Building, Offshore construction, and others including Power, Process, and Chemical Plants.
Table 8.1: Participation of respondents from four sections of the construction industry

<table>
<thead>
<tr>
<th>Groups</th>
<th>Client's Representatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>26%</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>42%</td>
</tr>
<tr>
<td>Offshore Construction</td>
<td>21%</td>
</tr>
<tr>
<td>Power, Process, and Chemical Plants</td>
<td>11%</td>
</tr>
</tbody>
</table>

The construction related experience of the Client's Representatives participating in this survey ranged from 1 year to 42 years. Table 8.2 shows that 71 per cent of the respondents have been in the construction industry for more than 20 years, and 90 per cent have got more than 10 years experience in construction. Only 10 per cent have experienced less than 10 years.

Table 8.2: Respondents' construction related experience

<table>
<thead>
<tr>
<th>Experience in years</th>
<th>Client's Representatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9 years</td>
<td>10%</td>
</tr>
<tr>
<td>10 to 19 years</td>
<td>19%</td>
</tr>
<tr>
<td>20 to 29 years</td>
<td>34%</td>
</tr>
<tr>
<td>30 years and above</td>
<td>37%</td>
</tr>
</tbody>
</table>

Since the investigation was centered around TQM, the respondents were requested about their familiarity with, and involvement in TQM. Table 8.3 shows that the majority of the Client's Representatives (56 per cent) were very familiar with TQM, and comparatively, a
significant proportion of them (40 per cent) have implemented TQM in construction. The vast experience of the respondents in construction process and their involvement in TQM show that they are adequately experienced and knowledged in TQM to provide reasonable answers to the research investigation.

Table 8.3: Respondents' previous involvement in TQM

<table>
<thead>
<tr>
<th>Familiarity with TQM</th>
<th>Client's Representatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not familiar</td>
<td>18%</td>
</tr>
<tr>
<td>Averagely familiar</td>
<td>26%</td>
</tr>
<tr>
<td>Very familiar</td>
<td>56%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implemented TQM in construction</th>
<th>Client's Representatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not implemented</td>
<td>60%</td>
</tr>
<tr>
<td>Implemented</td>
<td>40%</td>
</tr>
</tbody>
</table>
8.4 APPROPRIATE CONTRACTUAL ARRANGEMENT FOR TQM

Chapter Five proposed the following hypothesis as an answer to the first objective of the research: identification of the appropriate contractual arrangement for TQM.

Hypothesis:

Partnering arrangements provide the ideal relationship for the participants to implement TQM in construction projects.

In order to test this hypothesis, the four of the important characteristics of TQM necessary for a contractual arrangement, as identified in Chapter Five (see Section 5.7), were used in the questionnaire. The characteristics include:

- Teamwork;
- Elimination of administrative barriers such as inspection and protectionism;
- Open communication; and
- Compatibility of objectives.

In relation to these characteristics, the respondents were asked to respond to the following questions based on their previous experience.

(1) Should the contractual arrangement between the Client and Contractor ensure the provision of each of the aforesaid TQM-characteristics?
(2) Does the "partnering arrangement" satisfy each of the aforesaid characteristics?

A scale comprising five categories of ranking were provided against each characteristics. The frequency of rating for each of the characteristics can be seen in Appendix B. Having this data, the following statistical tests were performed to test the hypothesis.
8.4.1 Statistical tests

*Frequency analysis and mean score (central tendency)*

The responses were either tabulated and or presented as percentages for ease of revelation. It can be seen from the questionnaire (Appendix A) that the ordinal scale contained 1 to 5 categories of ranking, denoting 1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree, and 5 for strongly agree. This shows that there exists a continuum of agree and disagree region in the scale. Agree region contains a continuum of scale ranging from agree to strongly agree, similarly, disagree region contains a continuum of scale ranging from disagree to strongly disagree. The central one is discrete, that is, neutral. In order to obtain a probability statement from the responses of the Client's Representatives, the five categories of the scale was grouped into three regions: "agree", "neutral", and "disagree". The percentage frequency in each of these regions were calculated and tabulated. In order to specifically obtain the central tendency of rating (for example agree, strongly agree etc.) the mean score for each one of the variable was calculated by using the command, "custom table", through SPSS-X (Release 3.0) software package.

*Analysis Of Variance (Kruskall-Wallis ANOVA test)*

The Kruskall-Wallis analysis of variance tests the null hypothesis that the K samples come from the same population or from identical populations. The purpose of this test was to assess whether the samples from the four sections of the construction industry (see four groupings in Table 8.1) came from the same population. This will justify the applicability of the findings to the four sections of the construction industry.
8.4.2 Rational of the appropriate statistical tests used in the analysis

Before rationalising the tests which were used in the analysis, it is considered important to highlight some of the basic insights involved in the selection of appropriate statistics for different situations. In statistics, it is evident that the operations and relations employed in obtaining the scores define and limit the manipulations and operations which are permissible in handling the scores. In general, there are four types of scales which can be used to obtain the scores for any type of research: the nominal; ordinal; interval; and ratio scales (Siegel 1956). Nominal scale is a classificatory type. Ordinal one is such that the objects in one category of a scale are not different from the objects in other categories of that scale, but that they stand in some kind of relation to them. For example, *is preferred to*, *is higher than*, etc. Whereas in the interval and ratio scales, the distances between any two numbers on the scale are of known size. However, the scale used in the questionnaire survey was an ordinal scale. The reasons why Siegel (1956) advised only non-parametric tests for the ordinal scale of measurement are listed below.

- The ordinal data are not isomorphic to arithmetic. Thus, the parametric statistical tests, which use means and standard deviations, ought not to be used with data in an ordinal scale.

- Probability statement obtained from most non-parametric statistical test are exact probabilities, regardless of the shape of the population distribution from which the random sample was drawn.

A realisation of this situation led to follow the non-parametric statistical test: Frequency analysis; and Analysis of Variance (Kruskall-Wallis) for testing the hypothesis. The frequency analysis was used to examine the percentage of ratings on different categories of agreements. Based on the maximum percentage of rating on a particular category, the
hypothetical revelations were drawn. In order to strengthen the results of frequency analysis, the mean score analysis was performed each one of the variables. Even though the scale of measurement used in the survey (ordinal scale) was such that which can not be used for arithmatic calculations, the mean score analysis was considered necessary to picture out the overall response in terms of agreement or importance. To test whether the results obtained from the frequency analysis represents the whole sample (Client's Representatives), a test of goodness-of-fit type was required. One such a test available in non-parametric tests is one-sample chisquare test (Siegel 1956). This test tests whether a significant difference exists between the observed number of samples in each category and the expected number specified, based on the null hypothesis. The restriction of this test is that a minimum of five expected frequencies should be provided to each of the categories contained in a scale to obtain the full efficiency of the test. However, the observed data of the research was such that the expected frequencies had to be less than five. Thus, it was deemed not applicable to the research analysis. However, Kruskall-Wallis technique for analysis of variance was adapted to test whether the differences among the samples signify genuine population differences. In other words, as per Siegel, it tests the null hypothesis that the K samples come from the same population or from identical populations. Both the frequency analysis and ANOVA tests were performed by using the SPSS-X (Release 3.0) software package, available at Computer Centre, Loughborough University of Technology.

8.4.3 Contractual characteristics of TQM

As stated in Section 8.4, the respondents were questioned about the presence of the following characteristics of TQM in a contractual arrangement between the Client and Contractor.

- Teamwork.
- Elimination of administrative barriers such as inspection and protectionism.
Open communications.

Compatibility of objectives.

Table 8.4 presents the response of the Client's Representatives expressed as percentages and the mean scores of agreement for each one of the characteristics. It can be seen that 'teamwork' is scored 5 and the other characteristics are scored 4. This indicates that the respondents strongly agree 'teamwork' and just agree the other characteristics. It can also be seen from (Table 8.4) that the proportionate increase of percentage frequency in 'agree' category in each of the characteristics. 'Teamwork' and 'open communication' were agreed by 89.5 per cent of the respondents. 'Compatibility of objectives' was considered next to the teamwork and open communication, it received 84.2 per cent response. Among the four characteristics, 'elimination of administrative barriers' bears less importance. Only 58 per cent of the respondents have agreed as necessary. However, the disagreement for this characteristic is comparatively very low (5.3 per cent) to 58 per cent agreement. Considerable proportion of the respondents (37 per cent) ranked neutral.

Table 8.4: Contractual characteristics for TQM

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Response (%)</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agree</td>
<td>Neutral</td>
</tr>
<tr>
<td>Teamwork</td>
<td>89.5</td>
<td>5.3</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>57.9</td>
<td>36.8</td>
</tr>
<tr>
<td>Open communication</td>
<td>89.5</td>
<td>7.9</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>84.2</td>
<td>13.2</td>
</tr>
</tbody>
</table>
In order to test whether the above results represent the four groups in the research sample, an ANOVA test was performed for each one of the variables. The mean scores of ratings for the four groups of Client's Representatives for each of the variables are displayed in Appendix C. It can be seen from the appendix that there is no considerable difference of mean scores exist between the four groups of respondents. Also, the ANOVA test performed for each of the variables proved that there is no significant difference exists between the groups. Table 8.5 depicts the H value (Kruskall-Wallis statistic) and corresponding significance (the probability associated with the occurrence under null hypothesis as large as an observed H) for each one of the characteristics. The null hypothesis is that there is no difference of scoring among the four groups of Client's Representatives. The significance of H can be tested by measuring the probability of occurrence of any value as large as the observed value of H using the chisquare statistics (Siegel 1956). According to Chisquare statistics, the region of rejection of null hypothesis consists of all values of H which are so large that the probability associated with their occurrence under null hypothesis is equal to or less than the set level of significance (0.05). In a crude sense, it can be said that if the obtained value of significance is greater than 0.05 (set level of significance) then the null hypothesis is accepted. The interpretation is such that there is no difference among the groups, that is, the sample containing the four groups of Client's Representatives has come from the same population. Table 8.6 shows that all of the characteristics have significance greater than 0.05. This indicates that there is no difference among the four groups of Client's Representatives regarding all of the variables. This means that the identified contractual characteristics of TQM are applicable to the four sections of the construction industry: the building; civil engineering; offshore; and power, process, and chemical plants.
Table 8.5: Analysis of variance (ANOVA) of contractual characteristics of TQM by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>7.0</td>
<td>0.07</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>5.5</td>
<td>0.14</td>
</tr>
<tr>
<td>Open communication</td>
<td>5.3</td>
<td>0.15</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>5.3</td>
<td>0.15</td>
</tr>
</tbody>
</table>

8.4.4 Suitability of partnering arrangement for TQM

In response to the question of "Does the partnering arrangement satisfy each of the contractual characteristics of TQM?", the percentage of frequency as presented in Table 8.6 was calculated from the questionnaire response. The degree of agreement for each one of the characteristics is more or less similar to that of the above question. The average score of 4 (i.e. agree) was obtained for all of the characteristics. This ensures that all of the characteristics are agreed as being achieved by partnering arrangement. The results show that partnering achieves all of the four characteristics of TQM. More than 80 per cent of the respondents agreed that partnering achieves 'teamwork' and 'open communication'. Approximately 60 per cent agreed that partnering achieves 'elimination of administrative barriers' and 'compatibility of objectives'. It can be seen that the characteristics which received less agreement on being satisfied by the partnering arrangement have received proportionate increase in neutral (20 per cent to 30 per cent), and less percentage in disagreement categories. This shows that 20 to 30 per cent of the respondents were confused with these characteristics. The ANOVA test (Table 8.7) employed for each of the variables gives the significance of probability of occurrence under null hypothesis of a value as large as the H value greater than the set level of significance, $\alpha = 0.05$. This
proves that the frequency obtained for each one of the variables represents all of the four groups of Client's Representatives.

Table 8.6: Verification of the suitability of partnering arrangement for TQM

Average score: 4 - Agree; 5 - Strongly agree.

<table>
<thead>
<tr>
<th>Characteristics of TQM</th>
<th>Partnering achieves the characteristics of TQM - Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agree</td>
<td>Neutral</td>
</tr>
<tr>
<td>Teamwork</td>
<td>86.8%</td>
<td>7.9%</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>57.9%</td>
<td>28.9%</td>
</tr>
<tr>
<td>Open communication</td>
<td>79%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>63.2%</td>
<td>26.3%</td>
</tr>
</tbody>
</table>

Table 8.7: Analysis of variance of 'suitability of partnering arrangement for the characteristics of TQM' by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>4.9</td>
<td>0.17</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>2.1</td>
<td>0.53</td>
</tr>
<tr>
<td>Open communication</td>
<td>6.7</td>
<td>0.08</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>7.5</td>
<td>0.06</td>
</tr>
</tbody>
</table>

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8.5 IMPORTANT TASKS FOR CLIENT'S REPRESENTATIVES WHEN INVOLVED IN TQM

The important tasks of Client's Representatives when involving in TQM-based construction projects, as identified in phase one of the research include:

- preparing and organising;
- developing project definition;
- procurement;
- organising a joint management;
- design management;
- safety management;
- measuring and reviewing performance;
- communications;
- motivation;
- co-ordination;
- documentation; and
- project post-mortem.

Providing the aforesaid tasks and their relevant definitions, the respondents were asked: how well they agreed with the tasks and its definition for implementing TQM in construction; and to ranking the twelve tasks in order of importance to signify the influence of each of the tasks on the role of Client's Representatives.

Regarding the first question, the data obtained from questionnaire survey were analysed in two stages, namely, frequency analysis and mean score and ANOVA test. Kendall’s Coefficient of concordance was performed to rank each one of the tasks as to how important they are for Client's Representatives.
Table 8.8 shows the frequency expressed in percentage of response and mean score for each of the tasks. It can be seen from this table that more than 80 per cent of the respondents agreed developing project definition, procurement, design management, motivation, and co-ordination. Whereas the remaining tasks received agreement ranging from 60 per cent to 80 per cent. However, the less agreed tasks show some considerable amount of response in 'neutral' category ranging from 5 per cent to 30 per cent. It can also be seen that the proportion of disagreement in each of these tasks is very less when compared to that of the agreement category. This proves that the less agreement in some of the tasks were only because of the proportionate increase in 'neutral' category of the respective tasks. This means that, in such tasks, some considerable proportion of the respondents were either confused or did not understand the definitions. Despite the differences in frequencies, the values of mean scores of all of the tasks (4 for all tasks) indicates that all were uniformly agreed as important for implementing TQM.

The corresponding significance of the ANOVA test for each one of the tasks were shown in Table 8.9. Reference to the set level of significance (α = 0.05) discloses that the probability associated with the occurrence under null hypothesis as large as the H values of all of the tasks are greater than the set level of significance. Thus, it can be concluded that the importance of these tasks find no difference among the four groups of the Client's Representatives.
Table 8.8: The frequency of importance of tasks for Client's Representatives

Average score: 4 - Agree; 5 - Strongly agree.

<table>
<thead>
<tr>
<th>Tasks definition</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agree</td>
<td>Neutral</td>
</tr>
<tr>
<td>Preparing and organising</td>
<td>65.8</td>
<td>26.3</td>
</tr>
<tr>
<td>Developing project definition</td>
<td>89.4</td>
<td>5.3</td>
</tr>
<tr>
<td>Procurement</td>
<td>89.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Organising a Joint Management Team</td>
<td>76.3</td>
<td>23.7</td>
</tr>
<tr>
<td>Design management</td>
<td>86.8</td>
<td>13.2</td>
</tr>
<tr>
<td>Safety management</td>
<td>76.3</td>
<td>23.7</td>
</tr>
<tr>
<td>Measuring and reviewing performance</td>
<td>76.3</td>
<td>23.7</td>
</tr>
<tr>
<td>Communications</td>
<td>78.9</td>
<td>15.8</td>
</tr>
<tr>
<td>Motivation</td>
<td>84.2</td>
<td>13.2</td>
</tr>
<tr>
<td>Co-ordination</td>
<td>81.6</td>
<td>18.4</td>
</tr>
<tr>
<td>Documentation</td>
<td>57.9</td>
<td>31.6</td>
</tr>
<tr>
<td>Project post-mortem</td>
<td>76.3</td>
<td>21.1</td>
</tr>
</tbody>
</table>
**Table 8.9: Analysis of Variance of tasks definition by the four groups of Client's Representatives.**

<table>
<thead>
<tr>
<th>Tasks definition</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparing and organising</td>
<td>6.2</td>
<td>0.10</td>
</tr>
<tr>
<td>Developing project definition</td>
<td>0.2</td>
<td>0.97</td>
</tr>
<tr>
<td>Procurement</td>
<td>7.1</td>
<td>0.07</td>
</tr>
<tr>
<td>Organising a Joint Management Team</td>
<td>3.4</td>
<td>0.34</td>
</tr>
<tr>
<td>Design management</td>
<td>3.3</td>
<td>0.35</td>
</tr>
<tr>
<td>Safety management</td>
<td>0.5</td>
<td>0.91</td>
</tr>
<tr>
<td>Measuring and reviewing performance</td>
<td>0.9</td>
<td>0.83</td>
</tr>
<tr>
<td>Communications</td>
<td>0.8</td>
<td>0.85</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.7</td>
<td>0.88</td>
</tr>
<tr>
<td>Co-ordination</td>
<td>2.6</td>
<td>0.45</td>
</tr>
<tr>
<td>Documentation</td>
<td>2.4</td>
<td>0.50</td>
</tr>
<tr>
<td>Project post-mortem</td>
<td>3.6</td>
<td>0.30</td>
</tr>
</tbody>
</table>

8.5.1 Ranking the importance of the tasks for Client's Representatives

In order rank the tasks in order of importance to Client's Representatives, the respondents were asked to rank each of the twelve tasks using the scale 1 to 12. Out of 38 samples only 22 have responded appropriately as requested. The rest of the Client's Representatives have answered in their own way which are not compatible to take into account for the analysis. Some have used their own scale of ranking, and seven have responded that all of the tasks are important. Thus, those of the 22 respondents who have ranked the tasks using the scale of 1 to 12 were considered for the analysis. Out of the 22, 6 belonged to building construction, 9 belonged to civil engineering, 5 belonged to offshore construction,
and 2 belonged to power, process, and chemical plants. Thus, the results obtained from the analysis can be referred to these four sections of the construction industry. To test the degree to which the Client's Representatives agree in the rankings, the Kendall’s Coefficient of Concordance, W, was calculated as follows (Siegel 1956):

\[
W = \frac{S}{\frac{1}{12} k^2 (N^3 - N)}
\]

Where:

\[
S = \sum (R_j - \frac{\sum R_j}{N})^2
\]

i.e. sum of squares of the observed deviations from the mean of R_j.

\[K = \text{number of sets of ranks, i.e. number of respondent companies.}\]

\[N = \text{number of tasks ranked.}\]

From Table 8.10, \(S = 28702.96, K = 22,\) and \(N = 12.\) When these are substituted in Equation 8.1, \(W = 0.42\) can be obtained. The significance of \(W\) can be tested by measuring the probability of occurrence of any value as large as the observed value of \(W\) using the chi-square statistic. Consequently, the expression \(K(N-1)W\) is approximately distributed as chi-square with degree of freedom \(df = N-1,\) is adopted. Thus, Table 8.10 gives Chi-square as \(22 (12-1) 0.42 = 101.64.\) From statistical tables by Siegel (1956), this value of Chi-square (101.64) has the probability of occurrence under the null hypothesis that the \(K\) rankings are unrelated of \(p < 0.001.\) This enabled to reject the null hypothesis at the 1 per cent level of significance and to conclude that there was a considerable agreement in the ranking among the 22 Client's Representatives and that the degree of agreement among them was higher than would occur by chance.
## Table 8.10: Kendall's coefficient of concordance for ranking the importance of tasks for Client's Representatives

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Respondents</th>
<th>Rj</th>
<th>Rank</th>
<th>Rj - $\sum Rj_N$</th>
<th>$(Rj - \sum Rj)^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparing and organising</td>
<td>1 5 1 1 1 3 1 2 2 2 1 9 2 5 2 3 10 2 6 4 2</td>
<td>66</td>
<td>1</td>
<td>-76.92</td>
<td>5916.69</td>
</tr>
<tr>
<td>Developing project definition</td>
<td>2 1 5 4 8 2 2 4 1 1 1 2 10 3 7 1 1 9 1 1 1 6 11 6</td>
<td>83</td>
<td>2</td>
<td>-59.92</td>
<td>3590.41</td>
</tr>
<tr>
<td>Procurement</td>
<td>9 4 12 10 10 10 10 6 2 3 7 6 10 8 10 10 10 6 8 7 7 10 9</td>
<td>174</td>
<td>10</td>
<td>31.08</td>
<td>965.97</td>
</tr>
<tr>
<td>Organising a Joint Management Team</td>
<td>6 7 3 2 2 9 4 3 8 6 11 3 1 9 3 6 4 7 3 2 8 7</td>
<td>114</td>
<td>3</td>
<td>-28.92</td>
<td>836.37</td>
</tr>
<tr>
<td>Design management</td>
<td>3 2 6 5 6 12 3 8 9 3 5 9 3 7 6 7 5 1 6 8 2 3</td>
<td>119</td>
<td>5</td>
<td>-23.92</td>
<td>572.17</td>
</tr>
<tr>
<td>Safety management</td>
<td>8 10 7 3 3 11 11 9 10 4 3 7 2 1 9 8 2 2 5 9 9</td>
<td>134</td>
<td>6</td>
<td>-8.92</td>
<td>79.57</td>
</tr>
<tr>
<td>Measuring and reviewing performance</td>
<td>7 3 8 6 11 5 10 10 7 9 10 6 4 5 8 9 7 12 4 10 3 8</td>
<td>162</td>
<td>9</td>
<td>19.08</td>
<td>364.05</td>
</tr>
<tr>
<td>Communications</td>
<td>5 6 9 7 4 4 4 5 5 5 5 4 8 6 4 1 4 9 4 9 3 5 5</td>
<td>117</td>
<td>4</td>
<td>-25.92</td>
<td>671.85</td>
</tr>
<tr>
<td>Motivation</td>
<td>11 8 2 8 5 1 9 4 7 4 10 12 4 5 11 2 3 8 6 11 11</td>
<td>143</td>
<td>7</td>
<td>0.08</td>
<td>0.006</td>
</tr>
<tr>
<td>Co-ordination</td>
<td>4 9 4 9 7 6 7 6 6 8 9 5 7 6 3 5 11 13 10 4 6 10</td>
<td>145</td>
<td>8</td>
<td>2.08</td>
<td>4.33</td>
</tr>
<tr>
<td>Documentation</td>
<td>10 11 11 12 9 7 8 11 11 11 8 11 11 8 11 10 5 8 5 7 12</td>
<td>208</td>
<td>11</td>
<td>65.08</td>
<td>4235.41</td>
</tr>
<tr>
<td>Project post-mortem</td>
<td>12 12 10 11 12 8 12 12 12 12 7 12 12 12 12 12 12 12 11</td>
<td>250</td>
<td>12</td>
<td>107.08</td>
<td>11466.13</td>
</tr>
</tbody>
</table>

$s=28702.96$
The true ranking, $R$, of the tasks was given by the "order of various sums of ranks", $R_j$, and is also shown in Table 8.10. It revealed that 'preparing and organising' task was the most important task for the Client's Representatives, with 'developing project definition', 'organising a Joint Management Team', and 'communications' coming second, third, and fourth respectively. As a result of the above analysis, Figure 8.1 lists all of the tasks in the order of importance to Client's Representatives.

Figure 8.1 Importance of tasks for Client's Representatives
The best practices identified in Phase One of the research were forwarded to the Client's Representatives, and were requested to assess how important they are for achieving Total Quality in Construction. A scale containing 5 categories of importance were provided against each one of the practices in order to enable the respondents to check the respective category of importance. Category 1 represents 'not important', 2 stands for 'some what important', 3 stands for 'important', 4 for 'very important', and 5 represents 'essential' (see Appendix A). Since the characteristics of this scale were similar to that of the ones used in the questions of 'tasks definitions' and 'partnering arrangement', the same analysis was performed to test the importance of the practices. However, unlike the previous scale (agree, neutral, and disagree), this one did not constitute the 'neutral' category. Thus, the scale of importance (containing 5 categories) used in this question was broadly divided into two categories for ease of predictions. They include: 'important' and 'not important'. 'Important' category represents 'important', 'very important', and 'essential' categories; and 'not important' category represents 'unimportant' and 'some what important' categories which were originally used in the questionnaire survey. Accordingly, the percentage frequency in each of the two categories were calculated and tabulated. The average score of importance for each one of the practices were also calculated.

Following the frequency test, a non-parametric ANOVA (Kruskall-Wallis Analysis of Variance) test was performed for each one of the practices. The objective of this test was to test the applicability of the best practices to the Client's Representatives of the four sections of the construction industry: building; civil engineering; offshore construction; and power, process and chemical plants.
8.6.1 Preparing and organising

Table 8.11 shows the frequency of responses expressed in percentage for each one of the practices. It can be seen from the table that except two practices all of the practices were regarded as important by 97 per cent of the respondents. The two less important practices included: visiting companies who had successfully implemented TQM; and appointing Quality Consultants for advice. Out of these two practices, 'visiting successful companies' still got majority of response in the important category. Where as the practice, 'appointing Quality Consultants' was considered not important by 58 per cent of the respondents. These results are further ensured by the average scores calculated for all of the practices. The average score of 4 (i.e. very important) was obtained for all of the practices except the above two less important practices. The mean score of the practice 'visiting successful companies' (mean score 3) confirmed the frequency analysis that it is important practice. Similarly, the practice 'appointing Quality Consultants' scores less average score (i.e. 2) than the other practices. It indicated that it is not so important as other practices are for implementing TQM. Table 8.12 shows the H value (Kruskall-Wallis statistics) and the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices. Since the obtained probabilities are greater than the set level of significance (0.05), the decision is to accept the null hypothesis that there is no difference between the ratings of the four groups of Client's Representatives. Thus, it can be concluded that the samples have come from the same population.
### Table 8.11: Importance of practices for preparing and organising

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the focus, concerns and the ability levels of Client’s organisation for planned improvement, by conducting first party audit.</td>
<td>84.2</td>
<td>15.8</td>
</tr>
<tr>
<td>Visit companies who had successfully implemented TQM, and consider their accomplishments before preparing a quality plan.</td>
<td>55.3</td>
<td>44.7</td>
</tr>
<tr>
<td>Appoint Quality Consultants for advice, if necessary.</td>
<td>42.1</td>
<td>57.9</td>
</tr>
<tr>
<td>Prepare a quality policy for the Client’s organisation.</td>
<td>89.4</td>
<td>10.6</td>
</tr>
<tr>
<td>Establish organisational structures and responsibilities.</td>
<td>97.4</td>
<td>2.6</td>
</tr>
<tr>
<td>Prepare education and training requirements for all levels of staff.</td>
<td>89.4</td>
<td>10.6</td>
</tr>
<tr>
<td>Delegate the in-house quality champion or external quality consultant to train the Client’s organisation on professional, quality, technology, and team building skills.</td>
<td>78.9</td>
<td>21.1</td>
</tr>
<tr>
<td>Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.</td>
<td>92.1</td>
<td>7.9</td>
</tr>
</tbody>
</table>
Table 8.12: Analysis of variance of "best practices for preparing and organising" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>PREPARING AND ORGANISING</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the focus, concerns and the ability levels of Client's organisation for planned improvement, by conducting first party audit.</td>
<td>0.9</td>
<td>0.83</td>
</tr>
<tr>
<td>Visit companies who had successfully implemented TQM, and consider their accomplishments before preparing a quality plan.</td>
<td>0.8</td>
<td>0.84</td>
</tr>
<tr>
<td>Appoint Quality Consultants for advice, if necessary.</td>
<td>5.2</td>
<td>0.16</td>
</tr>
<tr>
<td>Prepare a quality policy for the Client's organisation.</td>
<td>2.5</td>
<td>0.48</td>
</tr>
<tr>
<td>Establish organisational structures and responsibilities.</td>
<td>6.1</td>
<td>0.10</td>
</tr>
<tr>
<td>Prepare education and training requirements for all levels of staff.</td>
<td>2.5</td>
<td>0.48</td>
</tr>
<tr>
<td>Delegate the in-house quality champion or external quality consultant to train the Client's organisation on professional, quality, technology, and team building skills.</td>
<td>1.9</td>
<td>0.60</td>
</tr>
<tr>
<td>Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.</td>
<td>3.3</td>
<td>0.34</td>
</tr>
</tbody>
</table>

8.6.2 Developing project definition

Table 8.13 shows that all practices were considered as important for achieving total quality in construction. Out of the five practices, two, namely, 'analyse the Client brief and highlight any omissions', and 'establish programme and staffing requirements for producing project definition' were ranked as important by all of the respondents (100 per cent). 'Involving construction professionals in project definition', and 'defining project specific quality plan' were regarded as next important practices which received important response 94.7 per cent and 89.5 per cent respectively. It can be seen from the same table that considerable agreement exists between the percentage frequencies and the average
scores of importance. The practice, 'application of QFD', is only considered to be just important practice (mean score 3), and the rest of the practices are scored very important (mean score 4). Regarding the results of the ANOVA test performed for each one of the practices, no one practice has shown significant differences across the four groups of Client's Representatives. It can be seen from Table 8.14 that the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices is greater than the set level of significance $\alpha = 0.05$.

Table 8.13: Importance of practices for developing project definition

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse the Client brief, and highlight any omissions</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>Establish programme and staffing requirements for producing project definition.</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>Apply quality Function Deployment (QFD) and other TQM tools to develop Client's requirements, and identify quality characteristics for accomplishing Client's requirements.</td>
<td>73.7</td>
<td>3</td>
</tr>
<tr>
<td>Involving construction professionals to achieve constructability in project definition.</td>
<td>94.7</td>
<td>4</td>
</tr>
<tr>
<td>In project definition, define project specific quality plan to implement TQM.</td>
<td>89.5</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 8.14: Analysis of variance of "best practices for developing project definition" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>DEVELOPING PROJECT DEFINITION</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse the Client brief, and highlight any omissions</td>
<td>0.4</td>
<td>0.93</td>
</tr>
<tr>
<td>Establish programme and staffing requirements for producing project definition.</td>
<td>0.2</td>
<td>0.97</td>
</tr>
<tr>
<td>Apply quality Function Deployment (QFD) and other TQM tools to develop Client's requirements, and identify quality characteristics for accomplishing Client's requirements.</td>
<td>2.4</td>
<td>0.49</td>
</tr>
<tr>
<td>Involve construction professionals to achieve constructability in project definition.</td>
<td>1.2</td>
<td>0.74</td>
</tr>
<tr>
<td>In project definition, define project specific quality plan to implement TQM.</td>
<td>1.7</td>
<td>0.64</td>
</tr>
</tbody>
</table>

8.6.3 Procurement

Table 8.15 summarises the results of importance of best practices for the procurement task. It can be seen that the percentage of important response for all of the practices are high, and range between 66 per cent and 100 per cent. 'Selecting the Contractor, who meets the predetermined selection criteria', and 'ensuring the Main Contractor adapts qualitative approaches in the selection of Sub-contractor' were the two practices ranked highly important (100 per cent). The next important practices were believed to be 'set criteria for the Contractor selection process' (94.8 per cent), 'conduct interviews with the Contractor for sharing objectives' (94.7 per cent), and 'ensuring that the co-ordination agreement and safety plans are included in the contract' (94.7 per cent). The mean scores (4) of these practices prove that they are very important practices. The remaining practices were ranked as important ranging from 66 per cent to 90 per cent. The practices which fall between these two frequencies have the mean scores of either 3 or 4, indicating either important or
very important practices. From Table 8.16, it can be seen that the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices ranges between 0.08 and 0.99 (> 0.05), indicating an agreement among the four groups of Client's Representatives.

Table 8.15: Importance of practices for procurement

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depending on the size of Client's organisation and nature of the project, appoint a selection team to select project participants.</td>
<td>73.7 26.3 3</td>
<td></td>
</tr>
<tr>
<td>Ensure that the selection team represented by all sections of the organisation (i.e. marketing, operations, engineering, purchasing, construction, etc.)</td>
<td>65.8 34.2 3</td>
<td></td>
</tr>
<tr>
<td>Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.</td>
<td>94.8 5.2 4</td>
<td></td>
</tr>
<tr>
<td>Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards registration.</td>
<td>79.4 20.6 3</td>
<td></td>
</tr>
<tr>
<td>Conduct an audit against identified firms, and assess that their equipment and systems satisfy the quality plan.</td>
<td>76.3 23.7 3</td>
<td></td>
</tr>
<tr>
<td>Request Tenderers to notify any of the aspects for quality improvement not included in the quality plan.</td>
<td>73.7 26.3 3</td>
<td></td>
</tr>
<tr>
<td>Select the Contractor, who meets the pre-determined selection criteria, and seek Client's approval.</td>
<td>100 0 4</td>
<td></td>
</tr>
<tr>
<td>Conduct interviews with the Contractor, share project objectives and management policy, and agree the formation of a Joint Management Team.</td>
<td>94.7 5.3 4</td>
<td></td>
</tr>
</tbody>
</table>
When preparing contract document, minimise unnecessary contract terms which impose more risks and liabilities on Contractor. 84.2 15.8 3

Ensure that the co-ordination agreement and safety plans are included in the contract. 94.7 5.3 4

To pre-qualify Designers and Consultants consider the principles used in the Contractor selection process. 89.5 10.5 4

Ensure that the Main contractor adapts qualitative approaches in the selection process of Sub-contractors and Vendors. 100 0 4

Ensure that the selected Sub-contractors have got enough equipment to satisfy the quality plan. 86.8 13.2 4

Advise the Main contractor the principles of selection of Sub-contractors and Vendors. 86.8 13.2 4

Table 8.16: Analysis of variance of "best practices for procurement" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>PROCUREMENT</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depending on the size of the Client's organisation and nature of the project, appoint a selection team to select project participants.</td>
<td>1.7</td>
<td>0.62</td>
</tr>
<tr>
<td>Ensure that the selection team represented by all sections of the organisation (i.e. marketing, operations, engineering, purchasing, construction, etc.)</td>
<td>2.8</td>
<td>0.42</td>
</tr>
<tr>
<td>Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.</td>
<td>0.1</td>
<td>0.99</td>
</tr>
<tr>
<td>Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards registration.</td>
<td>6.6</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Table 8.16 contd.

<table>
<thead>
<tr>
<th>Conduct an audit against identified firms, and assess that their equipment and systems satisfy the quality plan.</th>
<th>3.1</th>
<th>0.36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request Tenderers to notify any of the aspects for quality improvement not included in the quality plan.</td>
<td>1.4</td>
<td>0.70</td>
</tr>
<tr>
<td>Select the Contractor, who meets the pre-determined selection criteria, and seek Client's approval.</td>
<td>0.46</td>
<td>0.93</td>
</tr>
<tr>
<td>Conduct interviews with the Contractor, share project objectives and management policy, and agree the formation of a Joint Management Team.</td>
<td>6.5</td>
<td>0.09</td>
</tr>
<tr>
<td>When preparing contract document, minimise unnecessary contract terms which impose more risks and liabilities on Contractor.</td>
<td>4.5</td>
<td>0.21</td>
</tr>
<tr>
<td>Ensure that the co-ordination agreement and safety plans are included in the contract.</td>
<td>2.0</td>
<td>0.58</td>
</tr>
<tr>
<td>To pre-qualify Designers and Consultants consider the principles used in the Contractor selection process.</td>
<td>3.9</td>
<td>0.27</td>
</tr>
<tr>
<td>Ensure that the Main contractor adapts qualitative approaches in the selection process of Sub-contractors and Vendors.</td>
<td>4.7</td>
<td>0.20</td>
</tr>
<tr>
<td>Ensure that the selected Sub-contractors have got enough equipment to satisfy the quality plan.</td>
<td>1.3</td>
<td>0.73</td>
</tr>
<tr>
<td>Advise the Main contractor the principles of selection of Sub-contractors and Vendors.</td>
<td>2.6</td>
<td>0.46</td>
</tr>
</tbody>
</table>

8.6.4 Organising a Joint Management Team

The practices for 'organising a Joint Management Team' show very high responses as best practices, and range between 81 per cent and 100 per cent (Table 8.17). The practices, 'assisting the members to establish the joint team' and 'recording the agreed action plans, and communicating it to the entire organisation', were highly ranked as important (100 per...
The mean scores showed that, except the practice, 'assist the joint team in appointing quality improvement team and corrective action teams', all of them were very important practices for Client's Representatives. It can be seen from the Table 8.18 that the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices is greater than the set level of significance $\alpha = 0.05$. This result led to interpret that there is no difference between the rankings of the four groups of Client's Representatives.

Table 8.17: Importance of practices for organising a Joint Management Team

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct meetings of top level representatives from all parties, and share project plan and objectives.</td>
<td>97.4 2.6</td>
<td>4</td>
</tr>
<tr>
<td>Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications, and corrective actions.</td>
<td>89.8 10.2</td>
<td>4</td>
</tr>
<tr>
<td>Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.</td>
<td>100 0</td>
<td>4</td>
</tr>
<tr>
<td>Ensure that the membership of the joint team is well balanced by the representatives of the Client and Contractor.</td>
<td>94.7 5.3</td>
<td>4</td>
</tr>
<tr>
<td>Depending on the nature of the project and problem, assist the joint team in appointing quality improvement team and corrective action teams.</td>
<td>81.5 18.5</td>
<td>3</td>
</tr>
<tr>
<td>Record the agreed action plans, and communicate it to the entire organisation.</td>
<td>100 0</td>
<td>4</td>
</tr>
<tr>
<td>Delegate the quality champion or quality consultants to train the members of the co-ordination team on quality tools and technology and team building skills.</td>
<td>84.2 15.8</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 8.18: Analysis of variance of "best practices for organising a Joint Management Team" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>ORGANISING A JOINT MANAGEMENT TEAM</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct meetings of top level representatives from all parties, and share project plan and objectives.</td>
<td>2.5</td>
<td>0.48</td>
</tr>
<tr>
<td>Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications, and corrective actions.</td>
<td>1.7</td>
<td>0.64</td>
</tr>
<tr>
<td>Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.</td>
<td>1.1</td>
<td>0.78</td>
</tr>
<tr>
<td>Ensure that the membership of the joint team is well balanced by the representatives of the Client and Contractor.</td>
<td>0.5</td>
<td>0.92</td>
</tr>
<tr>
<td>Depending on the nature of the project and problem, assist the joint team in appointing quality improvement team and corrective action teams.</td>
<td>1.1</td>
<td>0.77</td>
</tr>
<tr>
<td>Record the agreed action plans, and communicate it to the entire organisation.</td>
<td>1.0</td>
<td>0.79</td>
</tr>
<tr>
<td>Delegate the quality champion or quality consultants to train the members of the co-ordination team on quality tools and technology and team building skills.</td>
<td>2.2</td>
<td>0.53</td>
</tr>
</tbody>
</table>

8.6.5 Design management

Table 8.19 summarises the importance of practices expressed in percentage. The results showed an absolute majority of response in favour of 'important' for each one of the practices. Except the practice, 'assist the design professionals to feel secure from and confident of their creative input', all of the practices received more than 95 per cent response as important. It can be seen from the mean score analysis that the two practices, 'provide the Designer with necessary design input data as and when required, and without
delay' and 'ensuring the detailed design satisfies fire and means of escape regulations, building regulations, health and safety regulations etc.' were essential (mean score 5). The rest of the practices have been almost scored as very important practices (mean score 4). Table 8.20 shows the results of ANOVA test performed for each one of the practices. It can be seen from the table that no one practice has shown significant differences across the four groups of Client's Representatives. The significance of each one of the practices (> 0.05) shows that these practices are applicable to the four sections of the construction industry.

Table 8.19: Importance of practices for design management

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Important</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If design responsibility is left to the Contractor, during the pre-bid assessment, assess the design capabilities of Contractor's professionals and ensure that they have enough design expertise.</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>If separate design professionals are to be appointed, pre-qualify them by auditing their expertise.</td>
<td>94.7</td>
<td>5.3</td>
</tr>
<tr>
<td>Consult the Contractor and construction professionals for advice during the preliminary design, and achieve constructability in the earlier phase of the design.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Provide the designer with necessary design input data as and when required, and without delay.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Before issuing design inputs, ensure that they are completely checked and reviewed right at the first time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure that the detailed design satisfy fire and means of escape regulations, building regulations, health and safety regulations, and traffic and noise control regulations, etc.</td>
<td>97.4</td>
<td>2.6</td>
</tr>
</tbody>
</table>
Table 8.19 contd.

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assist the design professionals to feel secure from</td>
<td>84.2</td>
<td>15.8</td>
</tr>
<tr>
<td>and confident of their creative input.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trace the occurrence of design omissions and errors,</td>
<td>97.4</td>
<td>2.6</td>
</tr>
<tr>
<td>inform the design team, and ensure that corrective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>action is taken.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoid unnecessary changes in the project scope during</td>
<td>94.7</td>
<td>5.3</td>
</tr>
<tr>
<td>the detailed design.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During all stages of design, get the Client's feedback</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>on the degree to which expectations are being met.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.20: Analysis of variance of "best practices for design management" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>DESIGN MANAGEMENT</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>If design responsibility is left to the Contractor, during the pre-bid assessment,</td>
<td>4.9</td>
<td>0.58</td>
</tr>
<tr>
<td>assess the design capabilities of Contractor's professionals and ensure that they</td>
<td></td>
<td></td>
</tr>
<tr>
<td>have enough design expertise.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If separate design professionals are to be appointed, pre-qualify them by auditing</td>
<td>1.4</td>
<td>0.70</td>
</tr>
<tr>
<td>their expertise.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consult the Contractor and construction professionals for advice during the</td>
<td>6.1</td>
<td>0.10</td>
</tr>
<tr>
<td>preliminary design, and achieve constructability in the earlier phase of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>design.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide the designer with necessary design input data as and when required, and</td>
<td>0.8</td>
<td>0.84</td>
</tr>
<tr>
<td>without delay.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before issuing design inputs, ensure that they are completely checked and reviewed</td>
<td>5.1</td>
<td>0.16</td>
</tr>
<tr>
<td>right at the first time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure that the detailed design satisfy fire and means of escape regulations,</td>
<td>2.2</td>
<td>0.54</td>
</tr>
<tr>
<td>building regulations, health and safety regulations, and traffic and noise control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>regulations, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8.20 contd.

<table>
<thead>
<tr>
<th>Description</th>
<th>Score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assist the design professionals to feel secure from and confident of their creative input.</td>
<td>2.9</td>
<td>0.40</td>
</tr>
<tr>
<td>Trace the occurrence of design omissions and errors, inform the design team, and ensure that corrective action is taken.</td>
<td>1.8</td>
<td>0.62</td>
</tr>
<tr>
<td>Avoid unnecessary changes in the project scope during the detailed design.</td>
<td>3.8</td>
<td>0.28</td>
</tr>
<tr>
<td>During all stages of design, get the Client's feedback on the degree to which expectations are being met.</td>
<td>2.1</td>
<td>0.56</td>
</tr>
</tbody>
</table>

8.6.6 Safety management

Out of seven, four of the practices in 'safety management' receive 100 per cent response as important practices (Table 8.21). The top four included: request Tenderers to notify of any hazard or precautions not included in the plan; ensure that the design of any structure complies with the safety plan; ensure that the health and safety plan is implemented by Contractors and Vendors during construction; and assist Contractors in providing training on health and safety to workers, including to those who are actually carrying out construction work. The remaining practices were equally ranked as important ranging between 82 per cent and 97 per cent. The mean scores (4) showed that all of the practices are very important. The significances of all of the practices, range between 0.64 and 1.0 (Table 8.22), prove that there exists a high agreement among the four groups of Client's Representatives on the practices.
Table 8.21: Importance of practices for safety management

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>As part of the quality plan, develop a health and safety plan in accordance with the health and safety regulation, and ensure that it is included in the contract.</td>
<td>81.6</td>
<td>18.4</td>
</tr>
<tr>
<td>Request Tenderers to notify of any hazard or precautions not included in the plan.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Ensure that the design of any structure complies with the safety plan.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Ensure that the health and safety file, containing information of the design, and the health and safety of any person carrying out construction, in prepared in respect of each structure.</td>
<td>97.4</td>
<td>2.6</td>
</tr>
<tr>
<td>Conduct regular meetings at all levels to discuss health and safety issue.</td>
<td>92.1</td>
<td>7.9</td>
</tr>
</tbody>
</table>

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Table 8.22: Analysis of variance of "best practices for safety management" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>SAFETY MANAGEMENT</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>As part of the quality plan, develop a health and safety plan in accordance with 0.9</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>the health and safety regulation, and ensure that it is included in the contract.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request Tenderers to notify of any hazard or precautions not included in the plan.</td>
<td>0.9</td>
<td>0.83</td>
</tr>
<tr>
<td>Ensure that the design of any structure complies with the safety plan.</td>
<td>1.1</td>
<td>0.77</td>
</tr>
<tr>
<td>Ensure that the health and safety file, containing information of the design, and 1.2</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>the health and safety of any person carrying out construction, in prepared in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>respect of each structure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure that the health and safety plan is implemented by the Contractors and Vendors 0.1</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>during construction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assist Contractors in providing training on health and safety to workers, including 1.2</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>those who are actually carrying out construction work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct regular meetings at all levels to discuss health and safety issue.</td>
<td>1.7</td>
<td>0.64</td>
</tr>
</tbody>
</table>

8.6.7 Measuring and reviewing performance

Table 8.23 shows that all of the practices have been considered as important, and the response range between 66 per cent and 100 per cent. Three of the practices have been scored 100 per cent response as important. These included: discuss with team members causes of deficiencies and deviations, and suggest corrective actions; check, through the Joint Team, that the corrective action has been implemented; and assess Client's satisfaction with performance. 'Measuring the effects of training given to the Client's organisation' received least score (65.8 per cent). The rest of the practices ranged between 71 per cent and 97 per cent important rate. Proportionately, the practices having high frequencies
showed the mean value 4 (very important), and those having less frequencies acquired the mean value 3 (important). Table 8.24 shows that the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices is greater than the set level of significance (0.05). This led to conclude that the four groups of the Client's Representatives does not differ with the practices.

Table 8.23: Importance of practices for measuring and reviewing performance

Score: 2 - some what important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure the effects of training given to the Client's organisation by measuring skills of workforce before and after the training.</td>
<td>65.8 34.2 3</td>
<td></td>
</tr>
<tr>
<td>Through the joint team conduct a regular measurement of performance and progress.</td>
<td>94.7 5.3 4</td>
<td></td>
</tr>
<tr>
<td>Identify, problem areas, deficiencies and deviations.</td>
<td>92.1 7.9 4</td>
<td></td>
</tr>
<tr>
<td>Use the TQM tools, such as fish-bone diagram and statistical methods to identify the causes of and solutions to various problems.</td>
<td>71.1 28.9 3</td>
<td></td>
</tr>
<tr>
<td>Discuss with team members causes of deficiencies and deviations, and suggest corrective action.</td>
<td>100 0 4</td>
<td></td>
</tr>
<tr>
<td>Check, through the joint team, that the corrective action has been implemented.</td>
<td>100 0 4</td>
<td></td>
</tr>
<tr>
<td>Continuously review the results of any performance measurement and identify areas where performance standards are absent or inadequate.</td>
<td>97.4 2.6 4</td>
<td></td>
</tr>
<tr>
<td>Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.</td>
<td>92.1 7.9 4</td>
<td></td>
</tr>
</tbody>
</table>
Table 8.23 contd.

<table>
<thead>
<tr>
<th>Define a system to measure the performance improvements in terms of cost/benefit.</th>
<th>89.5</th>
<th>10.5</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess Client's satisfaction with performance.</td>
<td>100</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 8.24: Analysis of variance of "best practices for measuring and reviewing performance" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>MEASURING AND REVIEWING PERFORMANCE</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure the effects of training given to the Client's organisation by measuring skills of workforce before and after the training.</td>
<td>3.1</td>
<td>0.38</td>
</tr>
<tr>
<td>Through the joint team conduct a regular measurement of performance and progress.</td>
<td>4.0</td>
<td>0.26</td>
</tr>
<tr>
<td>Identify, problem areas, deficiencies and deviations.</td>
<td>0.5</td>
<td>0.91</td>
</tr>
<tr>
<td>Use the TQM tools, such as fish-bone diagram and statistical methods to identify the causes of and solutions to various problems.</td>
<td>2.3</td>
<td>0.51</td>
</tr>
<tr>
<td>Discuss with team members causes of deficiencies and deviations, and suggest corrective action.</td>
<td>0.6</td>
<td>0.90</td>
</tr>
<tr>
<td>Check, through the joint team, that the corrective action has been implemented.</td>
<td>1.6</td>
<td>0.66</td>
</tr>
<tr>
<td>Continuously review the results of any performance measurement and identify areas where performance standards are absent or inadequate.</td>
<td>0.4</td>
<td>0.95</td>
</tr>
<tr>
<td>Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.</td>
<td>3.7</td>
<td>0.30</td>
</tr>
<tr>
<td>Define a system to measure the performance improvements in terms of cost/benefit.</td>
<td>3.1</td>
<td>0.38</td>
</tr>
<tr>
<td>Assess Client's satisfaction with performance.</td>
<td>6.0</td>
<td>0.11</td>
</tr>
</tbody>
</table>
8.6.8 Communications

Table 8.25 demonstrates that all of the practices are important. All were ranked as important by more than 80 per cent of the respondents. The mean values of all of the practices (equal to 4) indicated that all of them are very important practices. The top four of the practices which received 100 per cent important rate included: convey management commitment to TQM to the Client's organisation; establish a good communication system that keeps all participants aware of the objectives, progress, and successful stories of the programme; prompt actions of Client to feedback from Contractor, Supplier, and other professionals; and communicate suggestions and required corrective actions to respective parties. Table 8.26 proves that these results did not differ across the four groups of Client's Representatives. It can be seen that the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices is greater than the set level of significance $\alpha = 0.05$. 
Table 8.25: Importance of practices for communication.

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convey management commitment to TQM to the Client’s organisation.</td>
<td>100 0</td>
<td>4</td>
</tr>
<tr>
<td>Establish a good communication system that keeps all participants aware of the objectives, progress and successful stories of the programme.</td>
<td>100 0</td>
<td>4</td>
</tr>
<tr>
<td>Communicate the standards, procedures and systems relating to implementation and performance measurement to relevant participants.</td>
<td>97.4 2.6</td>
<td>4</td>
</tr>
<tr>
<td>Prompt actions of Client to feedback from Contractor, Supplier, and other professionals.</td>
<td>100 0</td>
<td>4</td>
</tr>
<tr>
<td>Communicate suggestions and required corrective actions to respective parties.</td>
<td>100 0</td>
<td>4</td>
</tr>
<tr>
<td>Welcome comments and suggestions from participants for process improvement.</td>
<td>92.1 7.9</td>
<td>4</td>
</tr>
<tr>
<td>Publish successful results and recognize employees, using newsletters/posters.</td>
<td>78.9 21.1</td>
<td>4</td>
</tr>
<tr>
<td>Communicate the Client’s views and suggestions on process improvement.</td>
<td>97.4 2.6</td>
<td>4</td>
</tr>
<tr>
<td>Adapt ‘walk and talk’ policy for effective communication.</td>
<td>84.2 15.8</td>
<td>4</td>
</tr>
<tr>
<td>Follow ‘on the job briefings’ to discuss problems and issues relevant to the job.</td>
<td>92.1 7.9</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 8.26: Analysis of variance of "best practices for communications" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>COMMUNICATIONS</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convey management commitment to TQM to the Client's organisation.</td>
<td>2.3</td>
<td>0.51</td>
</tr>
<tr>
<td>Establish a good communication system that keeps all participants aware of the objectives, progress and successful stories of the programme.</td>
<td>2.5</td>
<td>0.47</td>
</tr>
<tr>
<td>Communicate the standards, procedures and systems relating to implementation and performance measurement to relevant participants.</td>
<td>1.4</td>
<td>0.70</td>
</tr>
<tr>
<td>Prompt actions of Client to feedback from Contractor, Supplier, and other professionals.</td>
<td>1.2</td>
<td>0.75</td>
</tr>
<tr>
<td>Communicate suggestions and required corrective actions to respective parties.</td>
<td>2.7</td>
<td>0.44</td>
</tr>
<tr>
<td>Welcome comments and suggestions from participants for process improvement.</td>
<td>2.8</td>
<td>0.41</td>
</tr>
<tr>
<td>Publish successful results and recognize employees, using newsletters/posters.</td>
<td>1.1</td>
<td>0.77</td>
</tr>
<tr>
<td>Communicate the Client's views and suggestions on process improvement.</td>
<td>2.1</td>
<td>0.55</td>
</tr>
<tr>
<td>Adapt 'walk and talk' policy for effective communication.</td>
<td>2.0</td>
<td>0.56</td>
</tr>
<tr>
<td>Follow 'on the job briefings' to discuss problems and issues relevant to the job.</td>
<td>1.5</td>
<td>0.68</td>
</tr>
</tbody>
</table>

8.6.9 Motivation

Table 8.27 summarises the results of importance of best practices for 'motivation' task. It can be seen that the importance rate for all of the practices range between 68.4 per cent and 100 per cent. 'Empower people to act for quality improvement' scores highest rankings (100 per cent). 'Introducing incentive schemes to enable parties to work towards a
common goal' scores the least important rate (68.4 per cent). The average score (3) for this practice also proved that it is less important than the other practices. The rest of the practices ranged between 80 per cent and 100 per cent, and scored the mean value 4, indicating very important practices. Table 8.28 shows that the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices is greater than the set level of significance (0.05). Thus, it can be concluded that there is no significant difference of rating between the four groups of Client's Representatives.

Table 8.27: Importance of practices for motivation.

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage the Client to implement TQM in the project.</td>
<td>76.3</td>
<td>4</td>
</tr>
<tr>
<td>Identify the needs of all participants.</td>
<td>97.4</td>
<td>4</td>
</tr>
<tr>
<td>Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.</td>
<td>97.4</td>
<td>4</td>
</tr>
<tr>
<td>Empower people to act for quality improvement.</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>Recognize high-performing people.</td>
<td>94.7</td>
<td>4</td>
</tr>
<tr>
<td>If possible introduce incentive schemes to enable parties to work towards a common goal.</td>
<td>68.4</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 8.28: Analysis of variance of "best practices for motivation" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>MOTIVATION</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage the Client to implement TQM in the project.</td>
<td>0.4</td>
<td>0.95</td>
</tr>
<tr>
<td>Identify the needs of all participants.</td>
<td>0.01</td>
<td>1.0</td>
</tr>
<tr>
<td>Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.</td>
<td>6.2</td>
<td>0.10</td>
</tr>
<tr>
<td>Empower people to act for quality improvement.</td>
<td>3.7</td>
<td>0.30</td>
</tr>
<tr>
<td>Recognize high-performing people.</td>
<td>1.7</td>
<td>0.65</td>
</tr>
<tr>
<td>If possible introduce incentive schemes to enable parties to work towards a common goal.</td>
<td>4.9</td>
<td>0.17</td>
</tr>
</tbody>
</table>

8.6.10 Co-ordination

The practices of 'co-ordination' task received very high frequencies as important practices (Table 8.29). Each of the practices was believed as important by more than 95 per cent of the respondents. In addition, the mean scores (4) indicated that all of the practices are very important. Since the probability associated with occurrence under null hypothesis of a value as large as H value for each one of the practices were greater than the set level of significance (Table 8.30), it could be said that the four groups of Client's Representatives belong to the same population with respect to their rankings.
**Table 8.29: Importance of practices for co-ordination**

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiate actions in both the Client's team and joint team, and keep them focused on the target.</td>
<td>100 0 4</td>
<td></td>
</tr>
<tr>
<td>Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness.</td>
<td>100 0 4</td>
<td></td>
</tr>
<tr>
<td>Identify and resolve differences constructively and positively.</td>
<td>97.4 2.6 4</td>
<td></td>
</tr>
<tr>
<td>Solve disputes immediately with the assistance of team members.</td>
<td>97.4 2.6 4</td>
<td></td>
</tr>
<tr>
<td>Conduct meetings at regular intervals and ensure that all parties attend the meetings continuously.</td>
<td>94.7 5.3 4</td>
<td></td>
</tr>
</tbody>
</table>

**Table 8.30: Analysis of variance of "best practices for co-ordination" by the four groups of Client's Representatives.**

<table>
<thead>
<tr>
<th>CO-ORDINATION</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiate actions in both the Client's team and joint team, and keep them focused on the target.</td>
<td>5.2</td>
<td>0.16</td>
</tr>
<tr>
<td>Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness.</td>
<td>1.1</td>
<td>0.77</td>
</tr>
<tr>
<td>Identify and resolve differences constructively and positively.</td>
<td>1.3</td>
<td>0.73</td>
</tr>
<tr>
<td>Solve disputes immediately with the assistance of team members.</td>
<td>3.3</td>
<td>0.34</td>
</tr>
<tr>
<td>Conduct meetings at regular intervals and ensure that all parties attend the meetings continuously.</td>
<td>2.4</td>
<td>0.50</td>
</tr>
</tbody>
</table>
The results shown in Table 8.31 indicated a majority of response in favour of 'important' for each one of the practices. The top two practices which received 100 per cent important rate included: document the quality plan specific to the project; and record the level of Client satisfaction with the service. The other practices were ranked by more than 90 per cent important response. However, the uniform values of the mean scores (4) implied that all of the practices are equally very important. It can also be seen from the Table 8.32 that the probability associated with occurrence under null hypothesis of a value as large as the H value for each one of the practices is greater than the set level of significance. This led to conclude that the practices do not differ in response by four groups of Client's Representatives.

Table 8.31: Importance of practices for documentation.

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document the Client's quality plan containing policy, objectives, and structure of organisation.</td>
<td>97.4</td>
<td>2.6</td>
</tr>
<tr>
<td>Maintain a safety file, contain safety policy, performance standards, rules and procedures.</td>
<td>97.4</td>
<td>2.6</td>
</tr>
<tr>
<td>Document the quality plan specific to the project.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Record the degree of achievement of the quality objectives at each stage of the project.</td>
<td>94.7</td>
<td>5.3</td>
</tr>
<tr>
<td>Record the level of Client satisfaction with the service.</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 8.31 contd.

| Record decisions made on corrective actions and effectiveness during performance. | 92.1 | 7.9 | 4 |
| From the results of measurement, record the performance of Contractors and Suppliers against the quality procedures. | 97.4 | 2.6 | 4 |
| Maintain these documents as readily retrievable and retain for a designated period. | 89.5 | 10.5 | 4 |

Table 8.32: Analysis of variance of "best practices for documentation" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>DOCUMENTATION</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document the Client's quality plan containing policy, objectives, and structure of organisation.</td>
<td>4.0</td>
<td>0.26</td>
</tr>
<tr>
<td>Maintain a safety file, contain safety policy, performance standards, rules and procedures.</td>
<td>0.9</td>
<td>0.83</td>
</tr>
<tr>
<td>Document the quality plan specific to the project.</td>
<td>1.4</td>
<td>0.70</td>
</tr>
<tr>
<td>Record the degree of achievement of the quality objectives at each stage of the project.</td>
<td>3.7</td>
<td>0.30</td>
</tr>
<tr>
<td>Record the level of Client satisfaction with the service.</td>
<td>3.5</td>
<td>0.32</td>
</tr>
<tr>
<td>Record decisions made on corrective actions and effectiveness during performance.</td>
<td>4.5</td>
<td>0.21</td>
</tr>
<tr>
<td>From the results of measurement, record the performance of Contractors and Suppliers against the quality procedures.</td>
<td>1.3</td>
<td>0.73</td>
</tr>
<tr>
<td>Maintain these documents as readily retrievable and retain for a designated period.</td>
<td>2.1</td>
<td>0.55</td>
</tr>
</tbody>
</table>
8.6.12 Project post-mortem

Table 8.33 shows that all of the practices are important, and the rate of important ranged between 87 per cent and 100 per cent. 'Assess achievement of Client's requirement' was ranked high (100 per cent). The average scores of all of the practices have been 4, this indicated that all of them are very important practices. It can be seen from the Table 8.34 that no one practice has shown significant difference in rating across the four groups of Client's Representatives. The significances (> 0.05) of each of the practices ensured that these practices are applicable to the four sections of the construction industry.

Table 8.33: Importance of practices for project post-mortem

Score: 2 - somewhat important, 3 - important, 4 - very important, 5 - essential

<table>
<thead>
<tr>
<th>Best practices</th>
<th>Response in %</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduction post-mortem meetings involving all jobsite quality planners.</td>
<td>86.9</td>
<td>13.1</td>
</tr>
<tr>
<td>Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.</td>
<td>86.8</td>
<td>13.2</td>
</tr>
<tr>
<td>Assess achievement of Client's requirement.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Assess Client's satisfaction on overall performance of the project.</td>
<td>97.4</td>
<td>2.6</td>
</tr>
<tr>
<td>Widely distribute the minutes of the post-mortem meetings.</td>
<td>89.5</td>
<td>10.5</td>
</tr>
</tbody>
</table>
Table 8.34: Analysis of variance of "best practices for project post-mortem" by the four groups of Client's Representatives.

<table>
<thead>
<tr>
<th>PROJECT POST-MORTEM</th>
<th>H value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct post-mortem meetings involving all jobsite quality planners.</td>
<td>3.2</td>
<td>0.36</td>
</tr>
<tr>
<td>Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.</td>
<td>0.5</td>
<td>0.91</td>
</tr>
<tr>
<td>Assess achievement of Client's requirement.</td>
<td>1.3</td>
<td>0.72</td>
</tr>
<tr>
<td>Assess Client's satisfaction on overall performance of the project.</td>
<td>0.5</td>
<td>0.92</td>
</tr>
<tr>
<td>Widely distribute the minutes of the post-mortem meetings.</td>
<td>1.9</td>
<td>0.59</td>
</tr>
</tbody>
</table>
8.7 DISCUSSION OF RESULTS

The empirical results relating to the three objectives and the associated hypothesis will be discussed in this section.

Hypothesis One: partnering arrangements provide the ideal relationship for the participants to implement TQM in construction projects.

Chapter Five shows that a wealth of literature supports this hypothesis. Both the findings of CII (1991) and NEDC's Working Party (1991) concluded that partnering arrangements achieve the main goals of TQM: customer satisfaction; and continuous improvement. In order to further explore the suitability of partnering arrangements to implement TQM, an in-depth analysis of the characteristics of both TQM and partnering was performed. The important characteristics of TQM that define the relationships between participants, namely, teamwork, elimination of administrative barriers such as inspection and protectionism, open communication, and compatibility of objectives were chosen to test the suitability of partnering to TQM. The generation of these four characteristics can be seen in Chapter 5 (Section 5.7). The results obtained in this chapter (Section 8.4.3) confirm that these characteristics are very important for the contractual relationship between participants involved in TQM. Of these characteristics, 'teamwork', 'open communication' and 'compatibility of objectives' were treated as highly important. Table 8.4 shows that 'elimination of administrative barriers such as inspection and protectionism' has been slightly less agreed than the other characteristics. However, Deming 1986, Juran 1988, Strange 1993, all strongly emphasised this characteristic for the effective implementation of TQM. Table 8.4 shows that 37 per cent of the respondents were neutral about this characteristic, and only 5.3 per cent have disagreed. This indicates that 37 per cent of the respondents were either confused or did not understand the characteristic. Despite the vast
differences in percentage frequencies between the characteristic, 'elimination of administrative barriers' and the rest of the other characteristics, the average scores of all of them have been almost equal (i.e. 'teamwork' 5, and the others 4). Thus, it can be revealed that all of the four characteristics are equally important for implementing TQM in construction.

Regarding the question of 'does the partnering arrangement satisfy each of the four characteristics of TQM, the results from Table 8.5 reveal that partnering achieves all of the four characteristics of TQM. These results support the hypothesis and prove that partnering provide the suitable environment for implementing TQM in construction projects. Furthermore, the results of ANOVA test indicate that the revelation, "partnering arrangement for TQM", is applicable to all of the four sections of the construction industry: building; civil engineering; offshore construction ; and power, process, and chemical plants.

**Hypothesis two:** The important tasks of Client's Representatives in a TQM-based construction project include: preparing and organising; developing project definition; procurement; organising a Joint Management Team; design management; safety management; measuring and reviewing performance; communications; motivation; co-ordination; documentation; and project post-mortem.

The results of statistical analysis presented in this chapter prove that the twelve tasks are important for implementing TQM in construction. The mean scores combined together with the frequency analysis indicate that all of the tasks are equally important for implementing TQM in construction projects. Furthermore, the ANOVA test performed for each one of the tasks indicate that these are important for Client's Representatives
belonging to the four sections of the construction industry: building; civil engineering; offshore; and power, process, and chemical plants.

The Kendall's Coefficient of Concordance test applied to test the degree of agreement of ranking of the tasks among the Client's Representatives prove that the agreement among the Client's Representatives is higher than would be by chance. Figure 8.1 shows the following rankings of the twelve tasks in order of importance for Client's Representatives.

1. Preparing and organising
2. Developing project definition
3. Organising a Joint Management Team
4. Communications
5. Design management
6. Safety management
7. Motivation
8. Co-ordination
9. Measuring and reviewing performance
10. Procurement
11. Documentation
12. Project post-mortem

'Preparing and organising' task ranks first. It supports the argument forwarded in Chapter Six that the Client should first commit to TQM, and train the Client's organisation before implementing in an individual project. This indicates that the role of Client's Representatives becomes an essential ingredient to prepare the Client's organisation be sophisticated in TQM. It can be seen that 'documentation' has been ranked eleventh important tasks. This reflects the literature that documentation is not as important as other tasks for achieving total quality (Strange 1993). However, both Sanders (1993) and
Strange (1993) agree that it is important to aid in future implementation efforts. It can be noticed from the ranking that 'organising a Joint Management Team', 'co-ordination', 'motivation', and 'communications', which were seen as important tasks in partnering arrangement (see Section 6.4), have been considered as important than the other tasks such as 'project post-mortem', 'documentation', 'procurement', and 'measuring and reviewing performance'. This indicates that Client's Representatives play important role in implementing 'teamwork' in partnering arrangement.

Hypothesis three: The practices identified for all of the twelve tasks (see Section 6.6) are "best practices" for Client's Representatives to achieve Total Quality in construction projects.

The results indicate that almost all of the practices of Client's Representatives are very important for achieving total quality in construction. However, Table 8.12 indicates that the practice, 'appointing Quality Consultants for advise', is considered not important for preparing the Client's organisation for TQM. It seems that appointing Consultants for guiding the Client's staff to enhance the TQM-implementation programme within the Client's organisation, is not at all important. This indicates that the Client's Representatives should be well trained enough to undertake the innovative approaches involved in implementing TQM down through the Client's organisation. In contradiction to this conclusion, literature emphasises the appointment of Consultants from outside of Client's organisation, because, every initiative at the beginning will need experts for advise (Sanders 1993). In addition to this, research by Burati (1993) and Jennings Group (1993) identified that most of the companies implemented TQM have used outside Consultants for advise.
Except the practice discussed above, the high important rates obtained for all of the other practices justifies that all of them are 'very important' for achieving total quality. This supports the hypothesis that these practices are "best" for Client's Representatives to achieve total quality in construction project. Further analysis, by performing ANOVA test for each of the practices, proves that all of the practices are applicable to the four sections of the construction industry: building; civil engineering; offshore; and power, process, and chemical plants.

8.8 SUMMARY

The chapter has described the procedure for statistically analysing data obtained from the questionnaire survey, and accordingly analysed the data with the aim to test the three hypotheses already made in Chapter Five and Chapter Six of this thesis. The results of the analysis revealed that: a demonstrable coincidence exists between the findings of the literature review and their practical applications to the construction industry; and a considerable agreement on the proposals exists among the four groups of Client's Representatives: Building; Civil Engineering; Offshore Construction; and Power, Process and Chemical Plants. The results of the analysis were also discussed against the three hypotheses previously set out in the Chapter Five and Chapter Six. It was found that all of the three hypotheses were accepted. The overall results of the frequency analysis are summarised below in the graphical form for ease of understanding.
FIGURE 8.2a: CONTRACTUAL CHARACTERISTICS FOR TQM

Legend

**Categories**
1. strongly disagree
2. disagree
3. neutral
4. agree
5. strongly agree

**Characteristics**
- Teamwork
- Elimination of administrative barriers such as inspection and protectionism
- Open communication
- Compatibility of objectives
FIGURE 8.2b: SUITABILITY OF PARTNERING ARRANGEMENT FOR TQM

Legend

Categories
1 - strongly disagree
2 - disagree
3 - neutral
4 - agree
5 - strongly agree

Characteristics
- Teamwork
- Elimination of administrative barriers such as inspection and protectionism
- Open communication
- Compatibility of objectives

Percentage frequency

Categories
FIGURE 8.3: THE IMPORTANT TASKS OF THE CLIENT'S REPRESENTATIVE

Legend

Categories
1 - strongly disagree
2 - disagree
3 - neutral
4 - agree
5 - strongly agree

Tasks
- Preparing and organising
- Developing project definition
- Procurement
- Organising a joint management team
- Design management
- Safety management
FIGURE 8.3: THE IMPORTANT TASKS OF THE CLIENT'S REPRESENTATIVE (Contd.)

Legend

Categories
1 - strongly disagree
2 - disagree
3 - neutral
4 - agree
5 - strongly agree

Tasks
- Measuring and reviewing performance
- Communications
- Motivation
- Co-ordination
- Documentation
- Project post-mortem
FIGURE 8.4: BEST PRACTICES FOR PREPARING AND ORGANISING

Legend

**Categories**
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

**Practices**

- Determine the focus, concerns and the ability levels of Client’s organisation for planned improvement, by conducting first party audit.
- Visit companies who had successfully implemented TQM, and consider their accomplishments before preparing a quality plan.
- Appoint Quality Consultants for advice, if necessary.
- Prepare a quality policy for the Client’s organisation.
- Establish organisational structures and responsibilities.
- Prepare education and training requirements for all levels of staff.
- Delegate the in-house quality champion or external quality consultant to train the Client’s organisation on professional, quality, technology, and team building skills.
- Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.
FIGURE 8.5: BEST PRACTICES FOR DEVELOPING PROJECT DEFINITION

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices

- Analyse the Client brief, and highlight any omissions
- Establish programme and staffing requirements for producing project definition.
- Apply quality Function Deployment (QFD) and other TQM tools to develop Client’s requirements, and identify quality characteristics for accomplishing Client’s requirements.
- Involve construction professionals to achieve constructability in project definition.
- In project definition, define project specific quality plan to implement TQM.
FIGURE 8.6: BEST PRACTICES FOR PROCUREMENT

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
- Depending on the size of Client's organisation and nature of the project, appoint a selection team to select project participants.
- Ensure that the selection team represented by all sections of the organisation (i.e. marketing, operations, engineering, purchasing, construction, etc.)
- Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.
- Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards registration.
- Conduct an audit against identified firms, and assess that their equipment and systems satisfy the quality plan.
- Request Tenderers to notify any of the aspects for quality improvement not included in the quality plan.
- Select the Contractor, who meets the pre-determined selection criteria, and seek Client's approval.
FIGURE 8.6: BEST PRACTICES FOR PROCUREMENT (Contd.)

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
☐ Conduct interviews with the Contractor, share project objectives and management policy, and agree the formation of a Joint Management Team.
☐ When preparing contract document, minimise unnecessary contract terms which impose more risks and liabilities on Contractor.
☐ Ensure that the co-ordination agreement and safety plans are included in the contract.
☐ To pre-qualify Designers and Consultants consider the principles used in the Contractor selection process.
☐ Ensure that the Main contractor adapts qualitative approaches in the selection process of Sub-contractors and Vendors.
☐ Ensure that the selected Sub-contractors have got enough equipment to satisfy the quality plan.
☐ Advise the Main contractor the principles of selection of Sub-contractors and Vendors.
FIGURE 8.7: BEST PRACTICES FOR ORGANISING A JOINT MANAGEMENT TEAM

Legend

<table>
<thead>
<tr>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct meetings of top level representatives from all parties, and share project plan and objectives.</td>
</tr>
<tr>
<td>Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications, and corrective actions.</td>
</tr>
<tr>
<td>Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.</td>
</tr>
<tr>
<td>Ensure that the membership of the joint team is well balanced by the representatives of the Client and Contractor.</td>
</tr>
<tr>
<td>Depending on the nature of the project and problem, assist the joint team in appointing quality improvement team and corrective action teams.</td>
</tr>
<tr>
<td>Record the agreed action plans, and communicate it to the entire organisation.</td>
</tr>
<tr>
<td>Delegate the quality champion or quality consultants to train the members of the co-ordination team on quality tools and technology and team building skills.</td>
</tr>
</tbody>
</table>
FIGURE 8.8: BEST PRACTICES FOR DESIGN MANAGEMENT

Legend
Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
■ If design responsibility is left to the Contractor, during the pre-bid assessment, assess the design capabilities of Contractor's professionals and ensure that they have enough design expertise.
■ If separate design professionals are to be appointed, pre-qualify them by auditing their expertise.
■ Consult the Contractor and construction professionals for advice during the preliminary design, and achieve constructability in the earlier phase of the design.
■ Provide the designer with necessary design input data as and when required, and without delay.
■ Before issuing design inputs, ensure that they are completely checked and reviewed right at the first time.
FIGURE 8.8: BEST PRACTICES FOR DESIGN MANAGEMENT (Contd.)

Legend

**Categories**
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

**Practices**

- Ensure that the detailed design satisfy fire and means of escape regulations, building regulations, health and safety regulations, and traffic and noise control regulations, etc.
- Assist the design professionals to feel secure from and confident of their creative input.
- Trace the occurrence of design omissions and errors, inform the design team, and ensure that corrective action is taken.
- Avoid unnecessary changes in the project scope during the detailed design.
- During all stages of design, get the Client's feedback on the degree to which expectations are being met.
FIGURE 8.9: BEST PRACTICES FOR SAFETY MANAGEMENT

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
- As part of the quality plan, develop a health and safety plan in accordance with the health
  and safety regulation, and ensure that it is included in the contract.
- Request Tenderers to notify of any hazard or precautions not included in the plan.
- Ensure that the design of any structure complies with the safety plan.
- Ensure that the health and safety file, containing information of the design, and the health
  and safety of any person carrying out construction, is prepared in respect of each structure.
- Ensure that the health and safety plan is implemented by the Contractors and Vendors
during construction.
- Assist Contractors in providing training on health and safety to workers, including those
  who are actually carrying out construction work.
- Conduct regular meetings at all levels to discuss health and safety issue.
FIGURE 8.10: BEST PRACTICES FOR MEASURING AND REVIEWING PERFORMANCE

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices

Measure the effects of training given to the Client's organisation by measuring skills of workforce before and after the training.
Through the joint team conduct a regular measurement of performance and progress.
Identify, problem areas, deficiencies and deviations.
Use the TQM tools, such as fish-bone diagram and statistical methods to identify the causes of and solutions to various problems.
Discuss with team members causes of deficiencies and deviations, and suggest corrective action.
FIGURE 8.10: BEST PRACTICES FOR MEASURING AND REVIEWING PERFORMANCE (Contd.)

Legend

**Categories**
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

**Practices**
- Check, through the joint team, that the corrective action has been implemented.
- Continuously review the results of any performance measurement and identify areas where performance standards are absent or inadequate.
- Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.
- Define a system to measure the performance improvements in terms of cost/benefit.
- Assess Client’s satisfaction with performance.
FIGURE 8.11: BEST PRACTICES FOR COMMUNICATIONS

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
1. Convey management commitment to TQM to the Client's organisation.
2. Establish a good communication system that keeps all participants aware of the objectives, progress and successful stories of the programme.
3. Communicate the standards, procedures and systems relating to implementation and performance measurement to relevant participants.
4. Prompt actions of Client to feedback from Contractor, Supplier, and other professionals.
5. Communicate suggestions and required corrective actions to respective parties.
Legend

**Categories**
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

**Practices**
- Welcome comments and suggestions from participants for process improvement.
- Publish successful results and recognize employees, using newsletters/posters.
- Communicate the Client's views and suggestions on process improvement.
- Adapt 'walk and talk' policy for effective communication.
- Follow 'on the job briefings' to discuss problems and issues relevant to the job.
FIGURE 8.12: BEST PRACTICES FOR MOTIVATION

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
- Encourage the Client to implement TQM in the project.
- Identify the needs of all participants.
- Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.
- Empower people to act for quality improvement.
- Recognize high-performing people.
- If possible introduce incentive schemes to enable parties to work towards a common goal.
FIGURE 8.13: BEST PRACTICES FOR CO-ORDINATION

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
- Initiate actions in both the Client's team and joint team, and keep them focused on the target.
- Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness.
- Identify and resolve differences constructively and positively.
- Solve disputes immediately with the assistance of team members.
- Conduct meetings at regular intervals and ensure that all parties attend the meetings continuously.
FIGURE 8.14: BEST PRACTICES FOR DOCUMENTATION

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
- Document the Client's quality plan containing policy, objectives, and structure of organisation.
- Maintain a safety file, contain safety policy, performance standards, rules and procedures.
- Document the quality plan specific to the project.
- Record the degree of achievement of the quality objectives at each stage of the project.
- Record the level of Client satisfaction with the service.
- Record decisions made on corrective actions and effectiveness during performance.
- From the results of measurement, record the performance of Contractors and Suppliers against the quality procedures.
- Maintain these documents as readily retrievable and retain for a designated period.
FIGURE 8.15: BEST PRACTICES FOR PROJECT POST-MORTEM

Legend

Categories
1 - unimportant; 2 - somewhat important; 3 - important; 4 - very important; 5 - essential

Practices
- Conduct post-mortem meetings involving all jobsite quality planners.
- Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.
- Assess achievement of Client’s requirement.
- Assess Client’s satisfaction on overall performance of the project.
- Widely distribute the minutes of the post-mortem meetings.
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1</td>
<td>INTRODUCTION</td>
</tr>
<tr>
<td>9.2</td>
<td>CONCLUSIONS</td>
</tr>
<tr>
<td>9.3</td>
<td>RECOMMENDATIONS</td>
</tr>
<tr>
<td>9.4</td>
<td>FURTHER RESEARCH</td>
</tr>
</tbody>
</table>

CHAPTER NINE

CONCLUSIONS, RECOMMENDATIONS AND FURTHER RESEARCH
CHAPTER NINE

CONCLUSIONS, RECOMMENDATIONS AND FURTHER RESEARCH

9.1 INTRODUCTION

This research has been devoted to the study of Total Quality Management and its influence on the role of the Client's Representative and the contractual relationships between various participants in a construction project. Relating to the objectives of this study as presented in Chapter 1 some theoretical developments have been proposed and tested. A summary of the issues covered by the research and conclusions of the research findings has been briefly presented. Finally, the recommendations followed by the future research directions has been suggested.

9.2 CONCLUSIONS

The construction industry faces a number of problems such as poor design, constructability issues, and cost/schedule over run as a result of the poor management practice. There have been recently a widespread awareness in the construction industry that these problems could be solved if the participants involved in the process followed the appropriate management practice that enhance teamwork, sharing of plans and business objectives, and interdependance for achieving the common objective between the participants. Without this approach achieving quality in construction is difficult. To uncover the major problems associated with quality in construction, several issues
related to the conceptual arguments on quality problems were explored. The major impediments that hinder the achievement of quality at construction were found to be the following:

- poor communications;
- lack of teamwork;
- inefficient conflict resolution; and
- lack of understanding of team members' expectations.

Since TQM encourages teamwork, enhances communications, and provides an environment for the participants to understand each other's expectations (see Chapter 4), it can be adopted to solve the above problems and promote efficiency in all activities and at all interfaces. The examination of these problems within the TQM framework led to identify the two major attributes: the problem of contractual arrangements that impede teamwork; and the reactive approaches of the Client's and or Client's Representative's involvement in the process. The conclusions from the review have shown that conceptual and methodological confusion over these two attributes exist. The issues and the associated problems inherent in these two attributes are briefly described as follows.

**Contractual arrangements**

This referred to ineffectiveness of the conventional contractual arrangements in enhancing communications, teamwork, and conflict resolutions between participants. This problem was mainly because of the lack of contractual terms emphasising teamwork and contentious contractual terms used in the contract between the entities involved in construction projects.
Client's and or Client's Representative's involvement

In construction, the participants are involved in defining the Client's needs and wants, translating the needs into accurate plans and specifications, and then performing construction in such a manner that the Client's expectations are met. To achieve efficiency in all of these activities and for achieving quality of the service and or product at all stages of the construction process the Client's/Client's Representative's involvement exerts greater importance. It can be efficiently used for: avoiding and or solving disputes; enhancing communications; providing an atmosphere for all of the participants to continuously improve the process, etc. It can be seen in Chapter Three and Chapter Six that most of the conventional management systems fail to involve the Client and or Client's Representatives to address all of these problems.

In order to overcome from these problems and achieve quality, the study identified both the appropriate contractual arrangement and the TQM measures of the Client/Client's Representative. The findings comprised of the contractual arrangement, important tasks and best practices for the Client's Representative have been tested for their importance by conducting questionniare survey with Client's Representatives. The findings of both the literature review and questionnaire survey resulted in the following conclusion.

1. The contractual arrangement between the participants should be characterised by teamwork, elimination of administrative barriers such as inspection and protectionism, open communications, and compatibility of objectives.

2. The partnering arrangement is the most appropriate contractual arrangement for implementing TQM since it achieves all of the aforesaid contractual characteristics. It would enhance the relationships between participants in such a way that all parties will share the business objectives and strive to achieve continuous improvement and customer satisfaction in the process.
The tasks and relevant best practices for the Client's Representatives (see Chapter Six) are found to be very important when TQM is adopted in construction projects. The tasks and their respective definitions are presented as below.

**Preparing and organising**

The development of the Client's quality programme and organising the Client's organisation for TQM. This includes: forecasting the future; setting objectives; establishing policies to meet objectives; developing organisation structure; and delegating authority and responsibility.

**Developing project definition**

Defining and developing the Client's requirements through careful planning and forethought. It includes the feasibility study of the project.

**Procurement**

The procurement task involves the selection of suitable contractors, professionals and other participants to the project. The main objective is to ensure that the participants for the project are acquired in the most effective way.

**Organising a Joint Management Team**

A Joint Management Team should be established at the earlier stage of the project. This team should be represented by members of both the Client and Contractor. Plans and objectives specific to the project should be shared between the parties. An action plan for co-ordination, problem solving, performance measurement, communications, etc., should be prepared jointly. The plan should address the involvement of appropriate parties from both organisations. In accordance with the action plan, responsibility and authority are delegated to the respective personnel.
Design management

Design management for the Client's Representative includes co-ordinating the design team for continuous improvement and checking that the design confirms and satisfies the Client's requirements.

Safety management

In order to ensure an accident-free environment, a health and safety plan must be developed by the Client's organisation. Performance and corrective actions, according to the safety plan should be measured, discussed, and recorded.

Measuring and reviewing performance

Measures established at the planning stage should be carefully monitored and their conformity to pre-determined standards ensured. Any deviation from the established plan should be investigated and removed through the P-D-C-A (Plan-Do-Check-Act) problem solving process. Performance of quality programme should be measured jointly by the Joint Management Team.

Communications

Receiving and dispersing information on behalf of the Client. This includes exchanging information by open communications with all participants.

Motivation

Establishing a good environment which encourages people to work successfully in the interest of the Client and other participants.

Co-ordination

Keeping all participants to function together efficiently for a common goal. This includes preventing and resolving conflicts.
Documentation

Recording any act, condition, or event which bears an effect on the objective of the relevant process. It includes recording both the successes and failures of efforts spent on the process.

Project post-mortem

Project post-mortem is conducted at the end of the project to review, discuss and check all aspects of the project to uncover opportunities for improvement on future projects.

The results of the ANOVA test performed for all of the initial findings comprised of contractual arrangement, tasks, and best practices proved that they are applicable to all of the four categories of the construction projects: building; civil engineering; offshore construction; and power, process, and chemical plants.

9.3 RECOMMENDATIONS

The results of the theoretical and empirical investigations obtained in this research led to suggest the following recommendations for achieving total quality in construction.

9.3.1 Appropriate contractual arrangement for TQM

In TQM, achievement of customer satisfaction and continuous improvement is more likely to be found in the way the parties working together. Therefore, in the contractual arrangement between the participants, the contract structure and terms should be designed include the following characteristics:

- teamwork;
- elimination of administrative barriers such as inspection and protectionism;
open communications; and  
- compatibility of objectives.

Partnering arrangements were found to provide the participants with the right environment to achieve all of these characteristics successfully (Section 8.4). Therefore, in order to achieve total quality, the participants involved in construction projects need to establish partnering arrangements that satisfy each of the above characteristics.

9.3.2 Best practices for Client's Representatives

The following best practices are recommended to improve the effectiveness and performance of the tasks of Client's Representatives to achieve total quality in construction. Based on the results of the questionnaire survey, each of the practices are recommended as essential or very important or important practices respectively.

Recommendations of best practices for the improvement of preparing and organising

Very important practices

- Determine the focus, concerns and the ability levels of Client's organisation for planned improvement, by conducting first party audit.
- Prepare a Quality policy for the Client's organisation.
- Establish organisational structures and responsibilities.
- Prepare education and training requirements for all levels of staff.
- Delegate the in-house quality champion or external quality consultant to train the Client's organisation on professional, quality, technology, and team building skills.
- Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.
Important practice

- Visit companies who had successfully implemented TQM, and consider their accomplishments before preparing a quality plan.

Recommendations of best practices for the improvement of developing project definition

Very important practices

- Analyse the Client's brief, and highlight any omissions.
- Establish programme and staffing requirements for producing project definition.
- Involve construction professionals to achieve constructability in project definition.
- In project definition, define project specific quality plan to implement TQM.

Important practice

- Apply Quality Function Deployment (QFD) and other TQM tools to develop Clients' requirements, and identify quality characteristics for accomplishing Clients' requirements.

Recommendations of best practices for the improvement of procurement

Very important practices

- Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.
- Select the Contractor, who meets the pre-determined selection criteria, and seek Client's approval.
- Conduct interviews with the Contractor, share project objectives and management policy, and agree the formation of a Joint Management Team.
- Ensure that the co-ordination agreement and safety plans are included in the contract.
To pre-qualify Designers and Consultants consider the principles used in the Contractor selection process.

Ensure that the Main Contractor adopts qualitative approaches in the selection process of Sub-contractors and vendors.

Ensure that the selected Sub-contractors have got enough equipment to satisfy the quality plan.

Advice the Main Contractor the principles of selection of Sub-contractors and vendors.

**Important practices**

- Depending on the size of Client's organisation and nature of the project, appoint a selection team to select project participants.
- Ensure that the selection team is represented by all sections of the organisation (i.e. marketing, operations, engineering, purchasing, construction, etc.).
- Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards (BS 5750 or ISO 9000) registration.
- Conduct an audit against identified firms, and assess that their equipment and systems satisfy the quality plan.
- Request Tenderers to notify any of the aspects for quality improvement not included in the quality plan.
- When preparing contract document, minimise unnecessary contract terms which impose more risks and liabilities on contractor.

**Recommendations of best practices for the improvement of organising a Joint Management Team**

**Very important practices**

- Conduct meetings of top level representatives from all parties, and share project plan and objectives.
Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications, and corrective actions.

Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.

Ensure that the membership of the joint team is well balanced by the representatives of the Client and Contractor.

Record the agreed action plans, and communicate it to the entire organisation.

Delegate the quality champion or quality consultants to train the members of the co-ordination team on quality tools and technology and team building skills.

**Important practice**

Depending on the nature of project and problem, assist the joint team in appointing quality improvement team and corrective action teams.

**Recommendations of best practices for the improvement of design management**

**Essential practices**

Provide the Designer with necessary design input data as and when required, and without delay.

Ensure that the detailed design satisfy fire and means of escape regulations, building regulations, health and safety regulations, and traffic and noise control regulations, etc.

**Very important practices**

If design responsibility is left to the Contractor, during the pre-bid assessment, assess the design capabilities of Contractor's professionals and ensure that they have enough design expertise.

If separate design professionals are to be appointed, pre-qualify them by auditing their expertise.
Consult the Contractor and construction professionals for advice during the preliminary design, and achieve constructability in the earlier phase of the design.

Before issuing design inputs, ensure that they are completely checked and reviewed right at the first time.

Trace the occurrence of design omissions and errors, inform the design team, and ensure that corrective action is taken.

Avoid unnecessary changes in the project scope during the detailed design.

During all stages of design, get the Client's feedback on the degree to which expectations are being met.

**Important practice**

- Assist the design professionals to feel secure from and confident of their creative input.

**Recommendations of best practices for the improvement of safety management**

**Very important practices**

- As part of the quality plan, develop a health and safety plan in accordance with the health and safety regulation, and ensure that it is included in the contract.

- Request Tenderers to notify of any hazard or precautions not included in the plan.

- Ensure that the design of any structure complies with the safety plan.

- Ensure that the health and safety file, containing information of the design, and the health and safety of any person carrying out construction, is prepared in respect of each structure.

- Ensure that the health and safety plan is implemented by the Contractors and vendors, during construction.

- Assist Contractors in providing training on health and safety to workers, including those who are actually carrying out construction work.
Conduct regular meetings at all levels to discuss health and safety issues.

**Recommendations of best practices for the improvement of measuring and reviewing performance**

**Very important practices**

- Through the joint team conduct a regular measurement of performance and progress.
- Identify, problem areas, deficiencies and deviations.
- Discuss with team members causes of deficiencies and deviations, and suggest corrective action.
- Check, through the joint team, that the corrective action has been implemented.
- Continuously review the results of any performance measurement and identify areas where performance standards are absent or inadequate.
- Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.
- Assess Client's satisfaction with performance.

**Important practices**

- Measure the effects of training given to the Client's organisation for example by measuring skills of workforce before and after the training.
- Use the TQM tools, such as fish-bone diagram and statistical methods to identify the causes of and solutions to various problems.
- Define a system to measure the performance improvements in terms of cost/benefit.

**Recommendations of best practices for the improvement of communications.**

**Very important practices**

- Convey management's commitment to TQM to the Client's organisation.
. Establish a good communication system that keeps all participants aware of the objectives, progress and successful stories of the programme.

. Communicate the standards, procedures and systems relating to implementation and performance measurement to relevant participants.

. Prompt actions of client to feedback from contractor, supplier, and other professionals.

. Communicate the suggestions and required corrective actions to respective parties.

. Welcome comments and suggestions from participants for process improvement.

. Publish successful results and recognise employees, using newsletters/posters.

. Communicate the Client's views and suggestions on process improvement.

. Adopt 'walk and talk' policy for effective communication.

. Follow 'on the job briefings' to discuss problems and issues relevant to the job.

Recommendations of best practices for the improvement of motivation

Very important practices

. Encourage the Client to implement TQM in the project.

. Identify the needs of each participant.

. Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.

. Empower people to act for quality improvement.

. Recognize high-performing people.

Important practice

. If possible introduce incentive schemes to enable parties to work towards a common goal.
Recommendations of best practices practices for the improvement of coordination

Very important practices

- Initiate actions in both the Clients' team and joint team, and keep them focused on the target.
- Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness.
- Identify and resolve differences constructively and positively.
- Solve disputes immediately with the assistance of team members.
- Conduct meeting at regular intervals and ensure that all parties attend the meetings continually.

Recommendations of best practices for the improvement of documentation

Very important practices

- Document the Client's quality plan containing policy, objectives, and structure of organisation.
- Maintain a safety file, containing safety policy, performance standards, rules and procedures.
- Document the quality plan specific to the project.
- Record the degree of achievement of the quality objectives at each stage of the project.
- Record the level of Client satisfaction with the service.
- Record decisions made on corrective actions and effectiveness during performance.
- From the results of measurement, record the performance of Contractors and suppliers against the quality procedures.
Recommendations of best practices for the improvement of project post-mortem

Very important practices

. Conduct post-mortem meetings involving all jobsite quality planners.
. Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.
. Assess achievement of Clients' requirement.
. Assess Clients' satisfaction on overall performance of the project.
. Widely distribute the minutes of the post-mortem meetings.

9.4 FURTHER RESEARCH

The research findings, and the various implications of the applicability of TQM and partnering to construction projects, discussed throughout the thesis have created directions for future investigations. They are summarised below.

As discussed in Chapter Seven, the research tested only the applicability and importance of the best practices to the construction industry. It did not further investigate as to how to practically perform the best practices in construction projects. For example, one of the best practices identified by the research was, "through the joint team conduct a regular measurement of performance and progress". It can be seen that, the questions of how to measure the performance and progress and by what means were unanswered. This ensures that the research gives only the appropriate directions for the Client's Representatives to achieve total quality in construction. However, the empirical applications need further investigations. Therefore, the means of performing the best practices, the benefits of applications of the best practices to construction
projects, the linkages of the best practices of Client's Representatives and productivity are some of the area that may be investigated.

The research addressed the principles and characteristics of partnering arrangement and compared with that of the TQM, and finally recommended the partnering arrangement for improving relationships between participants. These investigations were mainly centred around the Client/Main Contractor relationships. However, to achieve the optimum benefit from the use of both partnering and TQM approach, the Client-Sub-contractor relationships should also be bound through some kind of partnering arrangements. Since such partnerships would improve communications and teamwork between the Client and Sub-contractors, it would also enhance the quality of the service or product offered by the operatives of Sub-contractors, Specialists Contractors, Vendors, etc. Thus, investigations are recommended into Client, Sub-contractor, and Specialist Contractor relationships.
BIBLIOGRAPHY AND REFERENCES


CII (Construction Industry Intitute)., 1991. *In search of partnering excellence.* Special publication 17-1, July, Austin.


PARSLOE, C. J., 1990. *A design briefing manual.* BSRIA (Building Services Research and Information Association), Berkshire.


REFERENCES


BS (British Standard) 4778., 1987. Quality vocabulary (part 1 and part 2). British Standards Institution, UK.


BURATI, J. L, Jr., 1990. Total quality management: the competitiveedge. CII publication 10-4, The construction industry institute, Austin, USA.


CII (Construction Industry Institute), 1991. *In search of partnering*. Special publication 17-1, July, Texas, USA.


JCT WITH CD (81) (Joint Contracts Tribunal with Contractor's Design)., 1981. Article 3, Clauses 30, 18, and 27, Joint Contracts Tribunal, London.

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JOINER, B. L, and SCHOLTES, P. R., 1986. The quality manager’s new job. *Quality progress*, 19 (10), UK.


McKenna, J., 1987. Management contracting-defining the system. Building technology and management, August/September, UK.


Mintzberg, H., 1982. A note on that dirty word efficiency. Interfaces, Vol. 12, USA.


PERISCO, J. Jr., 1989. Team up for quality improvement. *Quality progress*, 22(1), UK.


APPENDIX A

SAMPLE QUESTIONNAIRE
TOTAL QUALITY MANAGEMENT IN CONSTRUCTION PROJECTS: ROLE OF CLIENTS' REPRESENTATIVES

QUESTIONNAIRE SURVEY

INTRODUCTION

TQM is an integrated approach. Open communication and effective co-ordination between the participants are essential if total quality is to be achieved in construction. Clients' Representatives are the focal point of communication between the client and all other participants, and are responsible for co-ordinating a number of teams within the project organisation.

In recognition of the importance of the role of clients' representatives in TQM, the present research aims to produce best practices for client's representative when implementing TQM in construction process.

As part of this research, twelve important responsibilities of client's representatives have been identified. To successfully accomplish these responsibilities, the best practices to be followed by the client's representative have also been suggested. This questionnaire has been developed in order to assess industry's opinion towards the relevant practices, and determine the changing role of the Client's Representatives.

Please return the completed survey using self addressed envelope enclosed to:

L. Jawahar Nesan
c/o Dr. A.D.F. Price (Senior Lecturer)
Department of Civil Engineering
Loughborough University of Technology
Loughborough
Leics. LE11 3TU
UK.
GLOSSARY OF TERMS

CLIENTS' REPRESENTATIVES
A professional body (an individual or a firm, and in-house or outside to Client's organisation), whom has been delegated by the Client to advice and act on his or her behalf as a distinct member of the project team within the limit provided by the Client, in making decision, solving disputes and co-ordinating various parties of the project to achieve Client's requirements successfully.

PARTNERING
Partnering is a relationship between Client and contractor, based upon trust, dedication to common goals and an understanding of each others' individual expectations and values. Where a joint management team is established to co-operate in avoiding problems, solving disputes and measuring performance. The services are not inspected.

QUALITY FUNCTION DEPLOYMENT (QFD)
QFD is a process used to convert the customers demands into "quality characteristics" and develop a design quality for the finished product by systematically deploying the relationships between the demands and the characteristics. It relies on matrices, a rectangular arrangement of data into rows and columns, for the organisation, analysis, and development of information relating to a product. It integrates these matrices and charts into a system to realize customer requirements, functions, quality requirements and construction methods.

FIRST PARTY AUDIT
It is an audit performed by the company itself, as a periodic check on effectiveness of the company quality system, quality performance etc.,
SECTION ONE

This section aims to determine company characteristics.

Company:

Please specify Company name and address:

-----------------------------------------------------------------------

-----------------------------------------------------------------------

-----------------------------------------------------------------------

Client's Representatives such as Project Manager, Architect, Consultant, Quantity Surveyor etc., may be in-house or external to Client's organisation. In the following question, those who are in-house can circle No.1, and those who are external to the Client's organisation can respond to other types accordingly.

Type of company:

<table>
<thead>
<tr>
<th>In-house:</th>
<th>External:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client/Owner: 1</td>
<td>Project management 2</td>
</tr>
<tr>
<td>Architect/Engineer 3</td>
<td>Consultant: 4</td>
</tr>
<tr>
<td>Others: 5</td>
<td></td>
</tr>
</tbody>
</table>

If other, please specify ________________________________

Types of project experienced by the company: please indicate in percentage (number of projects).

<table>
<thead>
<tr>
<th>Civil engineering</th>
<th>Building construction</th>
<th>Off-shore construction</th>
<th>Others (specify)</th>
</tr>
</thead>
<tbody>
<tr>
<td>:----- %</td>
<td>:----- %</td>
<td>:----- %</td>
<td>:----- %</td>
</tr>
</tbody>
</table>

Individual data:

Please indicate your title and position in your company: ________________________________

Respondents' construction related experience: ________ years.

Do you want the questionnaire results?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

Would you like to participate further in this research?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>
SECTION TWO

The objective of this section is to obtain the respondent’s perception of and involvement in TQM, and assess how best the “partnering arrangement” is advantageous for implementing TQM in construction.

How familiar are you with the TQM concept? Circle appropriately.

<table>
<thead>
<tr>
<th>Not at all</th>
<th>average</th>
<th>Very familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Have you been involved in TQM construction projects? Please tick.

[ ] yes

[ ] no

If yes, please indicate the type of the project in which you personally have involved: indicate in percentage.

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td></td>
</tr>
<tr>
<td>Building construction</td>
<td></td>
</tr>
<tr>
<td>Off-shore construction</td>
<td></td>
</tr>
<tr>
<td>Others, specify</td>
<td></td>
</tr>
</tbody>
</table>

Should the contractual arrangement between the Client and Contractor ensure the provision of each of the following TQM characteristics?

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

Teamwork

Elimination of administrative barriers such as inspection and protectionism

Open communication

Compatibility of objectives

Does the "Partnering arrangement" (see glossary) satisfy each of the following characteristics?

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

Teamwork

Elimination of administrative barriers such as inspection and protectionism

Open communication

Compatibility of objectives

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Responsibilities of Client's Representatives when implementing TQM in construction include: preparing and organising, developing project definition, procurement, organising a joint co-ordination team, design management, safety management, measuring and reviewing performance, communication, motivation and co-ordination, documentation and Project post-mortem. Practices for the improvement of each responsibility are specified separately in this section. Respondents are requested to assess: a) how well they agree with issues explained for each responsibility; and b) how important each of the practices are for achieving each responsibility. Please circle the appropriate number.

### PREPARING AND ORGANISING

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

The development of Client's quality programme and organising the Client's organisation for TQM. This includes: forecasting the future; setting objectives; establishing policies to meet objectives; developing organisational structure; and delegating authority and responsibility. 1 2 3 4 5

**Scale:** 1 unimportant, 2 some what important, 3 important, 4 very important, 5 essential

**Practices for preparing and organising**

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the focus, concerns and the ability levels of Client's organisation for planned improvement, by conducting first party audit.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Visit companies who had successfully implemented TQM, and consider their accomplishments before preparing a quality plan.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Appoint Quality Consultants for advise, if necessary.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Prepare a Quality policy for Client's organisation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Establish organisational structures and responsibilities.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Prepare education and training requirements for all levels of staff.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Delegate the in-house Quality champion or external Quality Consultants to train the Client's organisation on professional, quality, technology, and team building skills.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**comments:**
Developing Project Definition

Defining and developing the Client's requirements through careful planning and forethought. It includes the feasibility study of the project.

<table>
<thead>
<tr>
<th>Practices for developing project definition</th>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse the Client brief, and highlight any omissions.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Establish programme and staffing requirements for producing project definition.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Apply Quality Function Deployment (QFD) and other TQM tools to develop Client's requirements, and identify quality characteristics for accomplishing Client's requirements.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Involve construction professionals to achieve constructability in project definition.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>In project definition, define project specific quality plan to implement TQM.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1 unimportant, 2 somewhat important, 3 important, 4 very important, 5 essential
The procurement task involves the selection of suitable Contractors, professionals and other participants to the project. The main objective is to ensure that the participants for the project are acquired in the most effective way.

Scale: 1 unimportant, 2 some what important, 3 important, 4 very important, 5 essential

**Practices for procurement**

- Depending on the size of Client's organisation and nature of the project, appoint a selection team to select project participants.
  
- Ensure that the selection team is represented by all sections of the organisation (i.e. marketing, operations, engineering, purchasing, construction etc).
  
- Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.
  
- Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards registration.
  
- Conduct an audit against identified firms and assess that their equipment and systems satisfy the quality plan.
  
- Request Tenderers to notify any of aspects for quality improvement not included in the quality plan.
  
- Select the Contractor, who meets the pre-determined selection criteria, and seek Clients' approval.
  
- Conduct interviews with the contractor, share project objectives and management policy, and agree the formation of a joint management team.
  
- When preparing contract document, minimise unnecessary contract terms which impose more risks and liabilities on Contractor.
  
- Ensure that the co-ordination agreement and safety plans are included in the contract.
  
- To pre-qualify Designers and Consultants consider the principles used in the Contractor selection process.
  
- Ensure that the Main Contractor adopts qualitative approaches in the selection process of Sub-contractors and vendors.
  
- Ensure that the selected Sub-contractors have got enough equipment to satisfy the quality plan.
  
- Advise the Main Contractor the principles of selection of Sub-contractors and vendors.

**strongly disagree** **strongly agree**

1 2 3 4 5

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ORGANISING A JOINT MANAGEMENT TEAM

A joint management team should be established at the earlier stage of the project. This team is represented by members of both the Client and Contractor. Plans and objectives specific to the project should be shared between the parties. An action plan for co-ordinating, problem solving, performance measurement, communication etc., are prepared jointly. In accordance with the action plan, responsibility and authority are delegated to the respective personnel.

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td>1</td>
</tr>
</tbody>
</table>

Scale: 1 unimportant, 2 some what important, 3 important, 4 very important, 5 essential

Practices for organising management team

<table>
<thead>
<tr>
<th>Conduct meetings of top level representatives from all parties, and share the project plan and objectives.</th>
<th>1 2 3 4 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications and corrective actions.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Ensure that the membership of the joint team is well balanced by the representatives of the Client and Contractor.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Depending on the nature of project and problem, assist the joint team in appointing quality improvement teams and corrective action teams.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Record the agreed action plans, and communicate it to the entire organisation.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Delegate the Quality champion or Quality Consultants to train the members of the joint management team on quality tools and technology and team building skills.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

comments:
DESIGN MANAGEMENT

Design management for Client's Representatives includes coordinating the design team for continuous improvement and checking that the design conforms and satisfies the Client's requirements.

Scale: 1 unimportant, 2 somewhat important, 3 important, 4 very important, 5 essential

strongly disagree strongly agree
1 2 3 4 5

Practices for design management

If design responsibility is left to the Contractor, during the pre-bid assessment, assess the design capabilities of Contractor's professionals, and ensure that they have enough design expertise.

If separate design professionals are to be appointed, pre-qualify them by auditing their expertise.

Consult the Contractor and construction professionals for advice during the preliminary design, and achieve constructability in the earlier phase of the design.

Provide the Designer with necessary design input data as and when required, and without delay.

Before issuing design inputs, ensure that they are completely checked and reviewed right at the first time.

Ensure that the detailed design satisfy fire and means of escape regulations, building regulations, health and safety regulations, and traffic and noise control regulations etc.,

Assist the design professionals to feel secure from and confident of their creative input.

Trace the occurrence of design omissions and errors, inform the design team, and ensure that corrective action is taken.

Avoid unnecessary changes in the project scope during the detailed design.

During all stages of design, get the Client's feedback on the degree to which expectations are being met.

Comments:
In order to ensure an accident-free environment, a health and safety plan must be developed by the Client's organisation. Performance and corrective actions, according to the safety plan are measured, discussed, and recorded.

<table>
<thead>
<tr>
<th>Practices for safety management</th>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>As a part of the quality plan, develop a health and safety plan in accordance with the health and safety regulation, and ensure that it is included in the contract.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Request the tenderers to notify of any hazard or precautions not included in the plan.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Ensure that the design of any structure complies with the safety plan.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Ensure that the health and safety file, containing information of the design, and the health and safety of any person carrying out construction, is prepared in respect of each structure.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Ensure that the health and safety plan is implemented by the Contractors and vendors, during construction.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Assist Contractors in providing training on health and safety to workers, including those who are actually carrying out construction work.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Conduct regular meetings of all levels to discuss health and safety issue.</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1 unimportant, 2 somewhat important, 3 important, 4 very important, 5 essential

comments:

333
MEASURING AND REVIEWING PERFORMANCE

Measures established at the planning stage are carefully monitored and their conformity to the pre-determined standards ensured. Any deviation from the established plan should be investigated and removed through the P-D-C-A (Plan-Do-Check-Act) problem solving process. Performance of quality programme should be measured jointly by the co-ordination team.

Scale: 1 unimportant, 2 somewhat important, 3 important, 4 very important, 5 essential

Practices for measuring and reviewing performance

Measure the effects of quality training given to the Client's organisation by measuring quality skills of workforce before and after the training.

Through the joint team conduct a regular measurement of performance and progress.

Identify, problem areas, deficiencies, and deviations.

Use the TQM tools such as fish-bone diagram and statistical methods, etc., to identify the causes of and solutions to various problems.

Discuss with team members causes of deficiencies and deviations, and suggest corrective action.

Check, through the joint team, that the corrective action has been implemented.

Continuously review the results of measurement and identify areas where performance standards are absent or inadequate.

Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.

Define a system to measure the performance improvements in terms of cost/benefit.

Assess Client's satisfaction with performance.

comments:

334
COMMUNICATIONS

Receiving and dispersing information on behalf of Clients' organisation. This includes exchanging information by open communication with all participants.

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>strongly agree</th>
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<tbody>
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<td>1</td>
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<td>3</td>
<td>4</td>
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<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1 unimportant, 2 some what important, 3 important, 4 very important, 5 essential

Practices for communications

Convey management's commitment to TQM to the Client's organisation 1 2 3 4 5

Establish a good communication system that keeps all participants aware of the objectives, progress and successful stories of the programme. 1 2 3 4 5

Communicate the standards, procedures and systems relating to implementation and performance measurement to relevant participants. 1 2 3 4 5

Prompt actions of Client to feedback from Contractor, supplier, and other professionals. 1 2 3 4 5

Communicate the suggestions and required corrective actions to respective parties. 1 2 3 4 5

Welcome comments and suggestions from the participants for process improvement. 1 2 3 4 5

Publish successful results and recognize employees, using newsletters/posters. 1 2 3 4 5

Communicate the Client's views and suggestions on process improvement. 1 2 3 4 5

Adopt 'walk and talk' policy for effective communication. 1 2 3 4 5

Follow 'on the job briefings' to discuss problems and issues relevant to the job. 1 2 3 4 5

comments:

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335
## MOTIVATION

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishing a good environment which encourages people to work successfully in the interest of the Client and other participants.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

Scale: 1 unimportant, 2 somewhat important, 3 important, 4 very important, 5 essential

### Practices for motivation

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage the Client to implement TQM in the project.</td>
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<tr>
<td>Identify needs of each participant.</td>
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</tr>
<tr>
<td>Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.</td>
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</tr>
<tr>
<td>Empower people to act for quality improvement.</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Recognize high-performing people.</td>
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<tr>
<td>If possible introduce incentive schemes to enable parties to work towards a common goal.</td>
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</tr>
</tbody>
</table>

comments:

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336
**CO-ORDINATION**

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

Keeping all participants to function together efficiently for a common goal. It includes working for preventing and resolving conflicts.

**Scale:** 1 unimportant, 2 somewhat important, 3 important, 4 very important, 5 essential

**Practices for co-ordination**

| Initiate actions in both the Clients' team and joint management team, and keep them focused on the target. | 1 2 3 4 5 |
|                                                                                                           |
| Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness. | 1 2 3 4 5 |
| Identify and resolve differences constructively and positively.                                          | 1 2 3 4 5 |
| Solve disputes immediately with the assistance of team members.                                         | 1 2 3 4 5 |
| Conduct meeting at regular intervals and ensure that all parties attend the meetings continuously.        | 1 2 3 4 5 |

comments:

---------------------------------------------------------------------
Recording an act, condition, or event which bears an effect on the objective of the relevant process. It includes recording both the success and failure of efforts spent on the process.

Scale: 1 unimportant, 2 somewhat important, 3 important, 4 very important, 5 essential

Practices for documentation

Document the client’s quality plan containing policy, objectives, and structure of organisation. 1 2 3 4 5

Maintain a safety file, containing safety policy, performance standards, rules and procedures. 1 2 3 4 5

Document the quality plan specific to the project. 1 2 3 4 5

Record the degree of achievement of the quality objectives at each stage of the project. 1 2 3 4 5

Record the level of client’s satisfaction with the service. 1 2 3 4 5

Record decisions made on corrective actions and effectiveness during performance. 1 2 3 4 5

From the results of measurement, record the performance of contractors and suppliers against the quality procedures. 1 2 3 4 5

Maintain these documents as readily retrievable and retain for a designated period. 1 2 3 4 5

comments:
PROJECT POST-MORTEM

Project post-mortem is conducted at the end of the project to review, discuss, and check all aspects of the project to uncover opportunities for improvement on future projects.

scale:  1 unimportant,  2 somewhat important  
       3 important,  4 very important,  5 essential

Practices for project post-mortem

Conduct post-mortem meetings involving all jobsite quality planners.  1 2 3 4 5
Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.  1 2 3 4 5
Assess achievement of Client’s requirements.  1 2 3 4 5
Assess Client’s satisfaction on overall performance of the project.  1 2 3 4 5
Widely distribute the minutes of the post-mortem meetings.  1 2 3 4 5
SECTION FOUR

The objective of this section is to identify the significant influence of the twelve tasks on the role of the Client's Representative in implementing TQM. Please rank them relatively in terms of how important these tasks are to the client representative.

Preparing and organising
Developing project definition
Procurement
Organising a joint co-ordination team
Design management
Safety management
Measuring and reviewing performance
Communications
Motivation
Co-ordination
Documentation
Project post-mortem

Please write below any comments you would like to make about any of the practices.

------------------------------------------------------------------------

Thank you very much for your co-operation.
APPENDIX B

FREQUENCY OF RESPONSES FROM CLIENT'S REPRESENTATIVES
### FREQUENCY OF RESPONSES FROM CLIENTS' REPRESENTATIVES

**Table B1: Contractual characteristics for TQM**

Should the contractual arrangement between the Client and Contractor ensure the provision of each of the following TQM characteristics?

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>0</td>
<td>2</td>
<td>14</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Open communication</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>9</td>
<td>23</td>
</tr>
</tbody>
</table>

**Table B2: Suitability of partnering arrangement for TQM**

Does the "Partnering arrangement" (see glossary) satisfy each of the following characteristics?

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Open communication</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Task definition</td>
<td>strongly disagree</td>
<td>disagree</td>
<td>neutral</td>
<td>agree</td>
<td>strongly agree</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>---------</td>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td>Preparing and organising</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Developing project definition</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Procurement</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>Organising a Joint Management Team</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Design management</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>13</td>
<td>20</td>
</tr>
<tr>
<td>Safety management</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>6</td>
<td>23</td>
</tr>
<tr>
<td>Measuring and reviewing performance</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Communications</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Motivation</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Co-ordination</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Documentation</td>
<td>0</td>
<td>4</td>
<td>12</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Project post-mortem</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>15</td>
<td>14</td>
</tr>
</tbody>
</table>
Table B4: Best practices

### Preparing and organising

<table>
<thead>
<tr>
<th>Preparing and organising</th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the focus, concerns and the ability levels of Client’s organisation for planned improvement, by conducting first party audit.</td>
<td>1</td>
<td>5</td>
<td>12</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Visit companies who had successfully deployed TQM, and consider their accomplishments before preparing a quality plan.</td>
<td>6</td>
<td>11</td>
<td>11</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Appoint Quality Consultants for advise, if necessary.</td>
<td>12</td>
<td>10</td>
<td>9</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Prepare Quality policy for Client’s organisation</td>
<td>2</td>
<td>2</td>
<td>11</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Establish organisational structures and responsibilities.</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Prepare education and training requirements for all levels of staff.</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Delegate the in-house Quality champion or external Quality Consultants to train the Client’s organisation on professional, quality, technology, and team building skills.</td>
<td>3</td>
<td>5</td>
<td>11</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>19</td>
</tr>
</tbody>
</table>

### Developing project definition

<table>
<thead>
<tr>
<th>Developing project definition</th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse the Client brief, and highlight any omissions.</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>Establish programme and staffing requirements for producing project definition.</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>9</td>
<td>19</td>
</tr>
</tbody>
</table>
Apply Quality Function Deployment (QFD) and other TQM tools to develop Client's requirements, and identify quality characteristics for accomplishing Client's requirements.

<table>
<thead>
<tr>
<th>Procurement</th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depending on the size of Client's organisation and nature of the project, appoint a selection team to select project participants.</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Ensure that the selection team is represented by all sections of the organisation (ie.marketing, operations, engineering, purchasing, construction etc).</td>
<td>4</td>
<td>9</td>
<td>13</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards registration.</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Conduct an audit against identified firms and assess that their equipment and systems satisfy the quality plan.</td>
<td>2</td>
<td>7</td>
<td>14</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Request tenderers to notify any of aspects for quality improvement not included in the quality plan.</td>
<td>1</td>
<td>9</td>
<td>16</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

Involve construction professionals to achieve constructability in project definition.

In project definition, define project specific quality plan to implement TQM.
<table>
<thead>
<tr>
<th>Activity</th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select the Contractor, who meets the pre-determined selection criteria</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>and seek Clients' approval.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct interviews with the contractor, share project objectives and</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>management policy, and agree the formation of a joint co-ordination</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>team.</td>
<td></td>
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</tr>
<tr>
<td>When preparing contract document, minimise unnecessary contract</td>
<td>0</td>
<td>6</td>
<td>18</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>terms which impose more risks and liabilities on Contractor.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ensure that the co-ordination agreement and safety plans are included</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>in the contract.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>To pre-qualify Designers and Consultants consider the principles used</td>
<td>0</td>
<td>4</td>
<td>15</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>in the Contractor selection process.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure that the Prime Contractor adopts qualitative approaches in the</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>selection process of Sub-contractors and vendors.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure that the selected Sub-contractors have got enough equipment</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>to satisfy the quality plan.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advise the Prime contractor the principles of selection of Sub-</td>
<td>0</td>
<td>5</td>
<td>13</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>contractors and vendors.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Organising Joint Management Team</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct meetings of top level representatives from all parties, and</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>share the project plan and objectives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications and corrective actions.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>1</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
</table>

Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0</th>
<th>11</th>
<th>14</th>
<th>13</th>
</tr>
</thead>
</table>

Ensure that the membership of the joint team is well balanced by the representatives of the Client and Contractor.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>2</th>
<th>10</th>
<th>14</th>
<th>12</th>
</tr>
</thead>
</table>

Depending on the nature of project and problem, assist the joint team in appointing quality improvement teams and corrective action teams.

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>5</th>
<th>17</th>
<th>10</th>
<th>4</th>
</tr>
</thead>
</table>

Record the agreed action plans, and assist the team to communicate it to the entire organisation.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0</th>
<th>8</th>
<th>16</th>
<th>14</th>
</tr>
</thead>
</table>

Assist the Quality champion or Quality Consultants to train the members of the co-ordination team on quality tools and technology and team building skills.

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>4</th>
<th>14</th>
<th>13</th>
<th>5</th>
</tr>
</thead>
</table>

**Design management**

<table>
<thead>
<tr>
<th></th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>If design responsibility is left to the Contractor, during the pre-bid assessment, assess the design capabilities of Contractor's professionals, and ensure that they have enough design expertise.</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>If separate design professionals are to be appointed, pre-qualify them by auditing their expertise.</td>
<td>0</td>
<td>2</td>
<td>10</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Consult the Contractor and construction professionals for advice during the preliminary design, and achieve constructability in the earlier phase of the design.</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>21</td>
<td>10</td>
</tr>
</tbody>
</table>
Provide the Designer with necessary design input data as and when required, and without delay.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Unimportant</th>
<th>Somewhat Important</th>
<th>Important</th>
<th>Very Important</th>
<th>Essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before issuing design inputs, ensure that they are completely checked and reviewed right at the first time.</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Ensure that the detailed design satisfy fire and means of escape regulations, building regulations, health and safety regulations, and traffic and noise control regulations etc.</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>Assist the design professionals to feel secure from and confident of their creative input.</td>
<td>2</td>
<td>6</td>
<td>14</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Trace the occurrence of design omissions and errors, inform the design team, and ensure that corrective action is taken.</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Avoid unnecessary changes in the project scope during the detailed design.</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>During all stages of design, get the Client's feedback on the degree to which expectations are being met.</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Safety management</td>
<td>Unimportant</td>
<td>Somewhat Important</td>
<td>Important</td>
<td>Very Important</td>
<td>Essential</td>
</tr>
<tr>
<td>As a part of the quality plan, develop a health and safety plan in accordance with the health and safety regulation, and ensure that it is included in the contract.</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Request the tenderers to notify of any hazard or precautions not included in the plan.</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Ensure that the design of any structure complies with the safety plan.</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>24</td>
</tr>
</tbody>
</table>
Ensure that the health and safety file, containing information of the design, and the health and safety of any person carrying out construction, is prepared in respect of each structure.

Ensure that the health and safety plan is implemented by the Contractors and vendors, during construction.

Ensure that training on health and safety at work is given by the Contractors to the workers, including those who are actually carrying out construction work.

Conduct regular meetings of all levels to discuss health and safety issue.

<table>
<thead>
<tr>
<th>Measuring and reviewing performance</th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure the effects of quality training given to the Client’s organisation by measuring quality skills of workforce before and after the training.</td>
<td>1</td>
<td>12</td>
<td>15</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Through the joint team conduct a regular measurement of performance and progress.</td>
<td>0</td>
<td>2</td>
<td>14</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Identify, from the measurement problem areas, deficiencies, and deviations.</td>
<td>0</td>
<td>3</td>
<td>8</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>Use the TQM tools such as fish-bone diagram and statistical methods, etc., to identify the causes of and solutions to various problems.</td>
<td>4</td>
<td>7</td>
<td>16</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Discuss with team members causes of deficiencies and deviations, and suggest corrective action.</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>20</td>
<td>11</td>
</tr>
</tbody>
</table>
Check through the joint team, that the corrective action has been implemented.  
Continuously review the results of measurement and identify areas where performance standards are absent or inadequate.  
Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.  
Define a system to measure the performance improvements in terms of cost/benefit.  
Assess Client’s satisfaction over the performance.

<table>
<thead>
<tr>
<th>Communications</th>
<th>unimportant</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convey the management's commitment to TQM to the entire organisation</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>Establish a good communication system that keeps all participants aware of the objectives, progress and successful stories of the programme.</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Communicate the standards, procedures and systems relating to implementation and performance measurement to relevant participants.</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Prompt actions of Client to feedback from Contractor, supplier, and other professionals.</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Communicate the suggestions and required corrective actions to respective parties.</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>13</td>
<td>14</td>
</tr>
</tbody>
</table>
Welcome comments and suggestions from the participants for process improvement.

To publish successful results and recognize employees, use newsletters/posters.

Communicate the Client's views and suggestions on process improvement.

Adopt 'walk and talk' policy for effective communication.

Follow 'on the job briefings' to discuss problems and issues relevant to the job.

<table>
<thead>
<tr>
<th>Motivation</th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage the Client to implement TQM in the project.</td>
<td>1</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Identify needs of each participant.</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Empower people to act for quality improvement.</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Recognize high-performing people.</td>
<td>0</td>
<td>2</td>
<td>11</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>If possible introduce incentive schemes to enable parties to work towards a common goal.</td>
<td>5</td>
<td>7</td>
<td>11</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Co-ordination</th>
<th>un-important</th>
<th>somewhat important</th>
<th>important</th>
<th>very important</th>
<th>essential</th>
</tr>
</thead>
</table>

If possible introduce incentive schemes to enable parties to work towards a common goal.
<p>| Initiate actions in both the Clients' team and co-ordination team, and keep them focused on the target. | 0 | 0 | 12 | 13 | 13 |
| Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness. | 0 | 0 | 13 | 13 | 12 |
| Identify and resolve differences constructively and positively. | 0 | 1 | 8 | 15 | 14 |
| Solve disputes immediately with the assistance of team members. | 0 | 1 | 11 | 16 | 10 |
| Conduct meetings at regular intervals and ensure that all parties attend the meetings continuously. | 0 | 2 | 18 | 7 | 11 |
| <strong>Documentation</strong> | <strong>un-important</strong> | <strong>somewhat important</strong> | <strong>important</strong> | <strong>very important</strong> | <strong>essential</strong> |
| Document the client's quality plan containing policy, objectives, and structure of organisation. | 0 | 1 | 14 | 13 | 10 |
| Maintain a safety file, containing safety policy, performance standards, rules and procedures. | 0 | 1 | 7 | 10 | 20 |
| Document the quality plan specific to the project. | 0 | 0 | 14 | 9 | 15 |
| Record the degree of achievement of the quality objectives at each stage of the project. | 0 | 2 | 16 | 13 | 7 |
| Record the level of client's satisfaction with the service. | 0 | 0 | 17 | 9 | 12 |
| Record decisions made on corrective actions and effectiveness during performance. | 0 | 3 | 14 | 11 | 10 |</p>
<table>
<thead>
<tr>
<th>Task</th>
<th>Unimportant</th>
<th>Somewhat Important</th>
<th>Important</th>
<th>Very Important</th>
<th>Essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the results of measurement record the performance of contractors and suppliers against the quality procedures.</td>
<td>0</td>
<td>1</td>
<td>18</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Maintain these documents as readily retrievable and retain for a designated period.</td>
<td>1</td>
<td>3</td>
<td>14</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Conduct post-mortem meetings involving all jobsite quality planners.</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.</td>
<td>0</td>
<td>5</td>
<td>15</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Assess achievement of Client's requirements.</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Assess Client's satisfaction on overall performance of the project.</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Distribute the minutes of the post-mortem meeting to participants.</td>
<td>0</td>
<td>4</td>
<td>9</td>
<td>13</td>
<td>12</td>
</tr>
</tbody>
</table>
APPENDIX C

MEAN SCORE OF RESPONSES FOR FOUR GROUPS OF CLIENT'S REPRESENTATIVES
**MEAN SCORES OF FREQUENCIES FOR FOUR GROUPS OF CLIENT'S REPRESENTATIVES**

Table C1: Contractual characteristics

Should the contractual arrangement between the Client and Contractor ensure the provision of each of the following TQM characteristics?

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Open communication</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Table C2: Suitability of partnering for TQM

Does the "Partnering arrangement" (see glossary) satisfy each of the following characteristics?

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Elimination of administrative barriers such as inspection and protectionism</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Open communications</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Compatibility of objectives</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Task definition</td>
<td>Building</td>
<td>Civil</td>
<td>Offshore</td>
<td>Process</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------</td>
<td>-------</td>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td>Preparing and organising</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Developing project definition</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Procurement</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Organising a Joint Management Team</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Design management</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Safety management</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Measuring and reviewing performance</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Communications</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Motivation</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Co-ordination</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Documentation</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Project post-mortem</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
Table C4: Best practices

<table>
<thead>
<tr>
<th>preparing and organising</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the focus, concerns and the ability levels of Client's organisation for planned improvement, by conducting first party audit.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Visit companies who had successfully deployed TQM, and consider their accomplishments before preparing a quality plan.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Appoint Quality Consultants for advise, if necessary.</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Prepare Quality policy for Client's organisation</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Establish organisational structures and responsibilities.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Prepare education and training requirements for all levels of staff.</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Delegate the in-house Quality champion or external Quality Consultants to train the Client's organisation on professional, quality, technology, and team building skills.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Delegate appropriate responsibilities and authority to the respective personnel, for conducting quality programme.</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Developing project definition</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse the Client brief, and highlight any omissions.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Establish programme and staffing requirements for producing project definition.</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
Apply Quality Function Deployment (QFD) and other TQM tools to develop Client's requirements, and identify quality characteristics for accomplishing Client's requirements.

In project definition, define project specific quality plan to implement TQM.

<table>
<thead>
<tr>
<th>Procurement</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depending on the size of Client's organisation and nature of the project, appoint a selection team to select project participants.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure that the selection team is represented by all sections of the organisation (ie. marketing, operations, engineering, purchasing, construction etc).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set criteria for the Contractor selection process and ensure that this include technical skills, quality and safety systems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify the potential Contractors through questionnaire requests or preliminary interviews or by checking British Standards registration.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct an audit against identified firms and assess that their equipment and systems satisfy the quality plan.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request tenderers to notify any of aspects for quality improvement not included in the quality plan.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select the Contractor, who meets the pre-determined selection criteria and seek Clients' approval.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conduct interviews with the contractor, share project objectives and management policy, and agree the formation of a joint co-ordination team.

<table>
<thead>
<tr>
<th>Organising a joint co-ordination team</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct meetings of top level representatives from all parties, and share the project plan and objectives.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Assist the members to jointly develop action plans for problem solving, resolving disputes, performance measurement, communications and corrective actions.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Assist the members to establish the joint team and delegate responsibilities and authority to the appropriate personnel.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Ensure that the membership of the joint team is well balanced by the representatives of the Client and Contractor.

<table>
<thead>
<tr>
<th>Design management</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>If design responsibility is left to the Contractor, during the pre-bid assessment, assess the design capabilities of Contractor's professionals, and ensure that they have enough design expertise.</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>If separate design professionals are to be appointed, pre-qualify them by auditing their expertise.</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Consult the Contractor and construction professionals for advice during the preliminary design, and achieve constructability in the earlier phase of the design.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Provide the Designer with necessary design input data as and when required, and without delay.</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Before issuing design inputs, ensure that they are completely checked and reviewed right at the first time.</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
Ensure that the detailed design satisfy fire and means of escape regulations, building regulations, health and safety regulations, and traffic and noise control regulations etc.,

<table>
<thead>
<tr>
<th>Task</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assist the design professionals to feel secure from and confident of their creative input.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Trace the occurrence of design omissions and errors, inform the design team, and ensure that corrective action is taken.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Avoid unnecessary changes in the project scope during the detailed design.</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>During all stages of design, get the Client's feedback on the degree to which expectations are being met.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Safety management

As a part of the quality plan, develop a health and safety plan in accordance with the health and safety regulation, and ensure that it is included in the contract.

<table>
<thead>
<tr>
<th>Task</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request the tenderers to notify of any hazard or precautions not included in the plan.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Ensure that the design of any structure complies with the safety plan.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Ensure that the health and safety file, containing information of the design, and the health and safety of any person carrying out construction, is prepared in respect of each structure.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Ensure that the health and safety plan is implemented by the Contractors and vendors, during construction.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
Ensure that training on health and safety at work is given by the Contractors to the workers, including those who are actually carrying out construction work.

<table>
<thead>
<tr>
<th>Conduct regular meetings of all levels to discuss health and safety issue.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring and reviewing performance</td>
</tr>
<tr>
<td>Building</td>
</tr>
<tr>
<td>Measure the effects of quality training given to the Client's organisation by measuring quality skills of workforce before and after the training.</td>
</tr>
<tr>
<td>Through the joint team conduct a regular measurement of performance and progress.</td>
</tr>
<tr>
<td>Identify, from the measurement problem areas, deficiencies, and deviations.</td>
</tr>
<tr>
<td>Use the TQM tools such as fish-bone diagram and statistical methods, etc., to identify the causes of and solutions to various problems.</td>
</tr>
<tr>
<td>Discuss with team members causes of deficiencies and deviations, and suggest corrective action.</td>
</tr>
<tr>
<td>Check through the joint team, that the corrective action has been implemented.</td>
</tr>
<tr>
<td>Continously review the results of measurement and identify areas where performance standards are absent or inadequate.</td>
</tr>
<tr>
<td>Ensure that the measurement results comply with the pre-determined health and safety plan and quality plan where appropriate.</td>
</tr>
<tr>
<td>Task</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Define a system to measure the performance improvements in terms of</td>
</tr>
<tr>
<td>cost/benefit.</td>
</tr>
<tr>
<td>Assess Client's satisfaction over the performance.</td>
</tr>
<tr>
<td>Convey the management's commitment to TQM to the entire organisation</td>
</tr>
<tr>
<td>Establish a good communication system that keeps all participants</td>
</tr>
<tr>
<td>aware of the objectives, progress and successful stories of the</td>
</tr>
<tr>
<td>programme.</td>
</tr>
<tr>
<td>Communicate the standards, procedures and systems relating to</td>
</tr>
<tr>
<td>implementation and performance measurement to relevant participants.</td>
</tr>
<tr>
<td>Prompt actions of Client to feedback from Contractor, supplier, and</td>
</tr>
<tr>
<td>other professionals.</td>
</tr>
<tr>
<td>Communicate the suggestions and required corrective actions to</td>
</tr>
<tr>
<td>respective parties.</td>
</tr>
<tr>
<td>Welcome comments and suggestions from the participants for process</td>
</tr>
<tr>
<td>improvement.</td>
</tr>
<tr>
<td>To publish successful results and recognize employees, use</td>
</tr>
<tr>
<td>newsletters/posters.</td>
</tr>
<tr>
<td>Communicate the Client's views and suggestions on process</td>
</tr>
<tr>
<td>improvement.</td>
</tr>
<tr>
<td>Motivation</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Adopt 'walk and talk' policy for effective communication.</td>
</tr>
<tr>
<td>Follow 'on the job briefings' to discuss problems and issues relevant to the job.</td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
</tr>
<tr>
<td>Encourage the Client to implement TQM in the project.</td>
</tr>
<tr>
<td>Identify needs of each participant.</td>
</tr>
<tr>
<td>Encourage co-ordination team members to aim for continuous improvement, and assist them to maintain a positive climate.</td>
</tr>
<tr>
<td>Empower people to act for quality improvement.</td>
</tr>
<tr>
<td>Recognize high-performing people.</td>
</tr>
<tr>
<td>If possible introduce incentive schemes to enable parties to work towards a common goal.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Co-ordination</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiate actions in both the Clients' team and co-ordination team, and keep them focused on the target.</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Provide a common ground for both the Client and Contractor by maintaining openness and avoiding defensiveness.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Identify and resolve differences constructively and positively.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Solve disputes immediately with the assistance of team members.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Conduct meetings at regular intervals and ensure that all parties attend the meetings continuously.

<table>
<thead>
<tr>
<th>Documentation</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document the client's quality plan containing policy, objectives, and structure of organisation.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Maintain a safety file, containing safety policy, performance standards, rules and procedures.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Document the quality plan specific to the project.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Record the degree of achievement of the quality objectives at each stage of the project.</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Record the level of client's satisfaction with the service.</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Record decisions made on corrective actions and effectiveness during performance.</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>From the results of measurement record the performance of contractors and suppliers against the quality procedures.</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Maintain these documents as readily retrievable and retain for a designated period.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Project post-mortem**

<table>
<thead>
<tr>
<th>Project post-mortem</th>
<th>Building</th>
<th>Civil</th>
<th>Offshore</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct post-mortem meetings involving all jobsite quality planners.</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Use brainstorming and other TQM tools to review the success and failures of the project and the lessons learned.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Task</td>
<td>1</td>
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<td>3</td>
<td>4</td>
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<tr>
<td>----------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
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</tr>
<tr>
<td>Assess achievement of Client's requirements.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Assess Client's satisfaction on overall performance of the project.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Distribute the minutes of the post-mortem meeting to participants.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
APPENDIX D

TABLE OF CLIENT'S ORGANISATION PARTICIPATED IN THE RESEARCH
<table>
<thead>
<tr>
<th>No.</th>
<th>Title of Respondents</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Director of Engineering</td>
<td>Acer Consultants Ltd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ACER House</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medawar Road</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surrey Research Park</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guildford</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surrey - GU2 5AR</td>
</tr>
<tr>
<td>2</td>
<td>Director of Development</td>
<td>Aldwyck Housing Association</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wellington House</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leyton Green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Harpende</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herts - AL5 2TG</td>
</tr>
<tr>
<td>3</td>
<td>Group Quality Director</td>
<td>Babtie Shaw &amp; Morten International Ltd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>95 Bothwell Street</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glasgow - G2 7HX</td>
</tr>
<tr>
<td>4</td>
<td>Quality Manager</td>
<td>Balfour Beatty Civil Engineering Ltd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 May day Road</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thornton Heath</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surrey CR7 7XA</td>
</tr>
<tr>
<td>5</td>
<td>Manager Manufacturing Performance</td>
<td>BP Chemicals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Finsbury Circus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>London - EC2M 7BA</td>
</tr>
<tr>
<td>6</td>
<td>Construction Manager</td>
<td>British Airways</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Property Branch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trident House (S583)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Po Box 10 Heathrow Airport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Middlesex - TW6 2JA</td>
</tr>
<tr>
<td>7</td>
<td>Commercial Manager (Construction)</td>
<td>British Gas Plc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bishop House</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 High Holborn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>London - WC1V 6DE</td>
</tr>
<tr>
<td>8</td>
<td>Chief Civil Engineer</td>
<td>British Waterways Technical Services</td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Leeds - LS1 4DD</td>
</tr>
<tr>
<td>9</td>
<td>Chief Executive</td>
<td>Cardiff Bay Development Corporation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Baltic House</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mount Stuart Square</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cardiff - CF1 H</td>
</tr>
<tr>
<td>10</td>
<td>Quality Assurance Manager</td>
<td>Civil Aviation Authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45-49 Kingsway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>London - WC2B 6TE</td>
</tr>
<tr>
<td>11</td>
<td>Engineer</td>
<td>Commission for the New Towns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>502 Avebury Boulevard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Central Milton Keynes - MK9 3HS</td>
</tr>
<tr>
<td>12</td>
<td>Manager Purchasing &amp; Facilities</td>
<td>Conoco Ltd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conoco Centre Technology Park</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Warwick - CV3 46 DA</td>
</tr>
<tr>
<td>13</td>
<td>Quality Representative</td>
<td>Consafe Engineering UK Ltd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greenwell Road East Tullos Industrial Estate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aberdeen - AB1 4AX</td>
</tr>
<tr>
<td>No.</td>
<td>Position</td>
<td>Company/Location</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>14</td>
<td>Director</td>
<td>Corderoy International Ltd 25-28 Buckingham Gate London - SW1E 6LD</td>
</tr>
<tr>
<td>15</td>
<td>Assistant Director (Engineering Project)</td>
<td>Department of Planning and Transportation Norfolk County Council</td>
</tr>
<tr>
<td>16</td>
<td>Director</td>
<td>Dry Bucklin Bicknell St Johns Studios Church Road Richmond Surrey - TW9 2QA</td>
</tr>
<tr>
<td>17</td>
<td>Senior Structural Engineer</td>
<td>EPD Consultants Ltd Pynes Hill Rydon Lane Exeter Devon - EX2 5AZ</td>
</tr>
<tr>
<td>18</td>
<td>Partner</td>
<td>Faulkner Browns Architects and urban Designers Dobson House Northambrianway Killingworth New castle upon Tyne</td>
</tr>
<tr>
<td>19</td>
<td>Senior Personnel Officer</td>
<td>Fluor Danial Ltd Riverside way Cumberley GU15 3AQ</td>
</tr>
<tr>
<td>20</td>
<td>Manager (Construction contracts and Quantity Survey)</td>
<td>Foster Weeler Energy Ltd Station Road Reading - RG1 1LX</td>
</tr>
<tr>
<td>21</td>
<td>Chairman</td>
<td>Haswell and Partners Ltd 99 Great Russell Street London - WC1B 3LA</td>
</tr>
<tr>
<td>22</td>
<td>Project Manager</td>
<td>Kerr McGee Oil (UK) Plc 75 Davies Street London - W1Y 1FA</td>
</tr>
<tr>
<td>23</td>
<td>Quality Assurance Manager</td>
<td>Kvaener Oil &amp; Gas Services Ltd Regent Centre Regent Road Aberdeen - AB1 2NS</td>
</tr>
<tr>
<td>24</td>
<td>Senior Project Engineer</td>
<td>Marathon Oil Capital House 25 Chapel Street London - NW1 5DQ</td>
</tr>
<tr>
<td>25</td>
<td>Senior Engineer</td>
<td>Maunsell &amp; Partners Newlands House The Newlands Withern Essex - CNX 20W</td>
</tr>
<tr>
<td>26</td>
<td>Quality systems Manager</td>
<td>Mc Dowels Ltd Victory House Manor Royal Crowley West Sussex - RH10 2PN</td>
</tr>
<tr>
<td>No.</td>
<td>Position</td>
<td>Company/Contact Information</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 27  | Managing Director              | MRA International  
The Clock House  
Grove Street  
Wantage  
Oxon - OX12 7A |
| 28  | Quality Manager                | Noble Denton  
131 Aldersgate Street  
London - EC1A 4EB |
| 29  | Quality Manager                | Northcroft International  
1 Horse Guards Avenue  
London - SW1A 2HU |
| 30  | Director                       | Powell Maya Partnership  
21 Upper Cheyne Row  
London - SW3 5JW |
| 31  | Quality Executive              | Sir Alexander Gibb and Partners Ltd  
Earley House  
London Road  
Reading - RG6 1BL |
| 32  | Quality Manager                | Sir William Halcrow & Partners Ltd  
Burderop Park  
Swindon - SN4 0QD |
| 33  | Director of Construction       | Stone & Webstor  
500 Eldergate  
Milton Keynes - MK9 1BA |
| 34  | Quality Assurance Manager      | The Fairhursts Design Group  
Faulkner Street  
Manchester - M1 4EH |
| 35  | Partner                        | The Noble Lewis Partnership  
12 Short Road  
Chiswick  
London - W42 QU |
| 36  | Director                       | TQM International Ltd  
The Stables  
Tarvin Road  
Frodsham  
Cheshire - WA6 6XN |
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