THE APPLICATION OF TQM WITHIN SMALL AND MEDIUM SIZED CONSTRUCTION RELATED ORGANISATIONS

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DEDICATION

I hereby dedicate this thesis to my late brothers, MORGAN MWILA CHILESHE, CHARLES MWANGO CHILESHE, and my sister DOREEN MUBANGA CHILESHE. Sadly you are not here to share my success. This dedication also goes to my parents COSMAS NKOLE CHILESHE and CHRISTINE NAOMI CHILESHE. Thanks for being there.

This work would not have been complete without the steadfast support and encouragement of my wife RUTHY over the years and the patience of my daughters ROSEMARY and SUZANNE. As promised, I have finally delivered.

ABSTRACT

In order to probe the application of TQM within Small and Medium Sized UK Construction-Related Organisations, a study was conducted on 63 SMEs; 20 (31.7%) of these reported implementation of TQM on their management system. For this purpose, a monitoring and assessment tool was developed, incorporating within it the TQM implementation quality features or techniques, grouped in 10 sub principles. The rate of TQM commitment and advancement was then measured for each organisation. The study was designed to assess the levels of advancement of implementation constructs in both UK TQM and non-TQM Construction related SMEs. The research was conducted in four stages: exploratory, descriptive, empirical and analytic research.

The exploratory stage involved an extensive literature review for searching TQM models and critical success factors. The Powell (1995) instrument was selected as the criterion for the critical success factors, with the justification provided for the selection, by comparing and evaluating it with other existing and validated instruments such as Saraph et al, 1989; Flynn et al, 1995; Black and Porter, 1996 and Ahire et al, 1996.

The descriptive study involved a questionnaire survey of construction related SMEs in the UK. The research design also included:

1. an empirical investigation to assess the critical success factors and levels of TQM advancement in the UK construction SMEs,
2. identification of the advocated advantages associated with the implementation,
3. measuring the success of TQM and assessment of the business and organisation performance,
4. assessment of the competitive environment. The survey was conducted to investigate the four stated issues and finally,
5. to ascertain the combined effect of TQM practices on the business and organisation performance in the context of organisation size, TQM maturity and union density. The results of the surveys provided the levels of implementation of TQM in both TQM and Non-TQM organisations. The survey results of the study indicated that while TQM deploying organisations were more advanced in the observation of the deployment constructs, non-TQM organisations exhibited marked levels of achievement of implementation constructs.

The empirical and analytical research involved in subjecting the developed Total Quality-Self Monitoring and Assessment Rating Tool (TQ-SMART) Model to a structural analysis based on the computation of the TQM relative advancement indices. The TQ-SMART was developed consisting of 10 TQM constructs with 34 independent variables (items). This resulted in the 10

constructs having high cronbach values. The TQ-SMART model was found to be valid, based on the goodness of fit indices. (Field 2000). It also exhibited strong undimensionality, reliability, convergent, discriminant and criterion-related validities. The structural models demonstrated and built in this study hypothesised and tested the relationship among the ten TQM deployment constructs and their contribution to the UK Construction-related SME's business and organisational performance indicators (BOPI) and competitive advantage.

The explanatory research involved a detailed case study on three organisations. An interpretative approach was used to gain further insights in the implementation of TQM. This included both non-TQM and TQM deploying organisations.

Though various assessment models exist, and literature has examined issues such as organisations needing to identify the unused capabilities, there is a lack of formal methods of working out the unused capabilities or conducting empirical studies. The application of the relative advancement index will prove particularly useful as benchmarks for comparison with other TQM deploying organisations. The Commitment and Advancement indices generated by the TQ-SMART Model serves as an assessment and monitoring mechanism for TQM deployment organisations at the same time as an assessment mechanism for non-TQM deploying organisations wishing to identify their existing levels of quality initiatives. Quality Managers can use this model as well as Senior Management to assess their strengths and weaknesses on the deployment constructs necessary for the effective and efficiency implementation of TQM.

The research concluded that the conceptual model though not generalisable was still indicative of the general trends within the UK Construction Related SMEs.

DECLARATION

I hereby declare that this research has not been submitted in part or in whole in support of an application for another degree or qualification at Sheffield Hallam University or any other institution of learning.

ACKNOWLEDGEMENT

I would like to take this opportunity to express my thanks to the Supervisory Team for making sure that this thesis is completed. My sincere gratitude to Professor Paul Watson, Dr Paul Stephenson and Professor Alan Griffith for their patience and time.

My family, Wife Ruthy and two daughters Rosemary Mulenga and Suzanne Kapimpa.

CONTENT

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

1	EFQM EM	European Foundation for Quality Management Excellence Model
2	TQM	Total Quality Management
3	CI	Construction Industry
4	SME	Small-and-Medium Sized Enterprise
5	TQ-SMART	Total Quality: Self Monitoring and Assessment Rating Tool
6	RADAR	Results Assessment Deployment and Review
7	AI	Artificial Intelligence
8	UK	United Kingdom
9	MBNQA	Malcolm Baldrige National Quality Award
10	CFA	Confirmatory Factor Analysis
11	ANOVA	Analysis of Variance
12	PDCA	Plan-Do-Check-Act
13	DTI	Department of Trade & Industry
14	NFI	Normed-Fit-Index
15	RMSR	Root Mean Square Residual
16	GFI	Goodness-of-Fit
17	AGFI	Adjusted Goodness of Fit
18	EFA	Exploratory Factor Analysis
19	KMO	Kaiser-Meyer-Olkin
20	QA	Quality Assurance
21	SME	Small and Medium Sized Enterprises
22	SMI	Small and Medium Industries
23	AMOS	Analysis of Moment Structures
24	SEM	Structural Equation Modelling
25	BOPI	Business and Organisational Performance Indicators
26	HRM	Human Resources Management

Chapter One

Introduction

CHAPTER ONE: GENERAL INTRODUCTION

1.1 Background to the research

While on attachment with Scott Wilson Kirkpatrick & Partners, I had the opportunity to work both in the Design and Site Offices. My main responsibilities then as Assistant Designer Representative (ADR) were to liaise with the contractors and clients. This among other things gave me an insight in Quality Assurance procedures. My interest in Construction Management was born and developed through this attachment. Upon completion of the work, I felt it necessary to pursue postgraduate studies. The choice of study was never questionable as I was curious to investigate and find out more about what happens in the field of construction. This prompted me to study the research topic, Investigation into the Application of Total Quality Management (TQM) within UK construction-related organisations and the advocacy of solutions to implementation problems'. However the scope of the MSc Research was too broad as it covered all types of organisations from large to small / medium enterprises (SMEs).

Upon completion of my MSc Studies, I was awarded a studentship to pursue a PhD in Construction Management. The area of research again was never questionable because the issue of Quality Assurance had been tackled at the industrial experience and MSc level; however, the PhD was another ball game. Drawing heavily on an approach by Kekale (2001), "It was easy to decide what to write about; the real problem was rather, how to write"? In short the issue of Quality Management would always form the main focus of my PhD research. The literature review revealed that the majority of firms within the industry were small and medium size organisations. However, the majority of management writing on TQM was focussed on large organisations and mainly from the manufacturing environment. Therefore, the first identifiable gap was a lack of any detailed empirical studies within the SME and on another level the Construction Industry was found wanting in terms of TQM implementation. Again drawing heavily on studies by Kekale (2001), the guiding principles in writing this thesis would be to ensure that it contained a contribution to existing research, showing proof of logic and a mastery of research methodology containing evidence to support the thesis.

The initial area of research was the application of Total Quality Management (TQM) within the Construction Industry. However, after careful examination and an extensive literature review, it was decided that the area was too broad and large. The Construction Industry encompasses large, medium and small organisations such as speculative house builders, civil engineering firms to contractors. It was decided that the aims could be reduced to account for only Small/Medium Enterprises (SME) and the application of BS 7850: Part 2 (ISO 9004-4) *Total Quality Management: Part 2. Guidelines for Quality Improvement.* The rationale behind the shift of research can be found in the following statement:

> "The multitude of small firms that persist in construction and the apparently unchanging methods of work are sometimes viewed as the cause of what is held to be the inferior economic performance and are especially contrasted with the trends in manufacturing industry which has been subject to such pronounced changes in structure and production methods " (Fleming in Johnson and Vitale 1988:216)

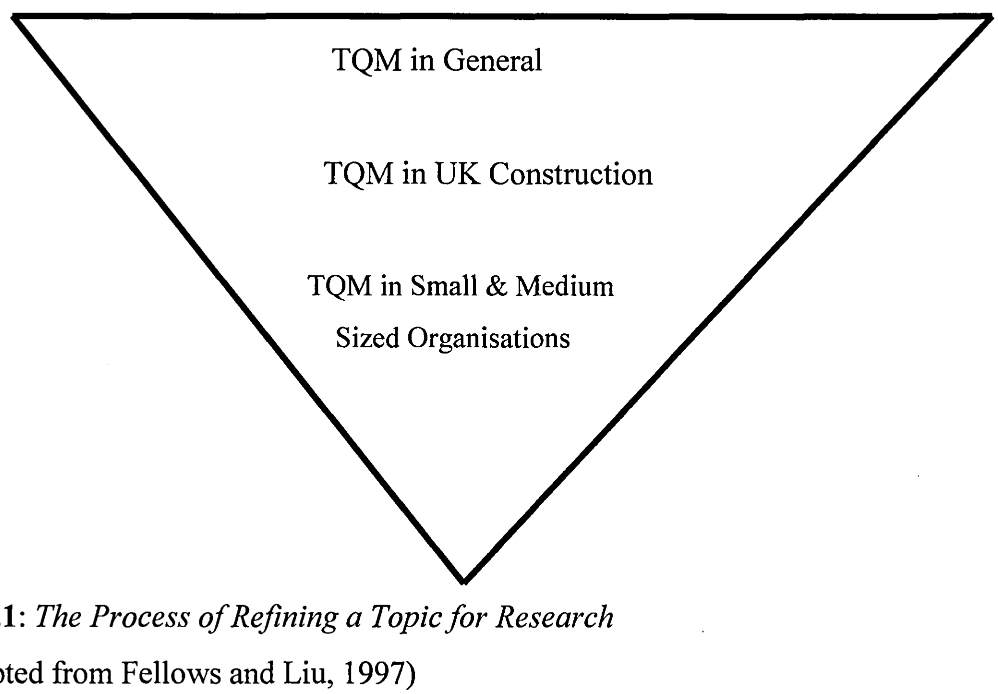

Fig 1.1: *The Process of Refining a Topic for Research*

(Adapted from Fellows and Liu, 1997)

The triangle depicted in Fig 1.1 shows how the narrow focus of the research problem was achieved. Its starts with the first level, namely the broad field, in this instance and that of TQM in general. This was then further narrowed by the Industry Sector. Many studies generally focussed on the Manufacturing Environment (McCabe, 1996; Hasan and Kerr, 2003; Gustaffsson et al, 2003) with Construction identified as being the gap in the research area. Three levels were concerned with identifying which group within the particular industry was to be studied. The choice and justification of the SME's is provided in the next sub-section.

1.2 Rationale of Study

The TQM literature is inundated with articles related to identification of the critical factors of TQM (Saraph et al, 1989; Flynn et al, 1994; Black and Porter, 1996; Huq and Stolen, 1998; Yusof and Aspinwall, 2000a; 2000b; 2000c; and 2001) and more recently Sohal and Terziovski, (2000), the few authors cited are Quality Management specific. Other areas as identified by Sousa and Voss (2002), and a comprehensive study by Sila and Ebrahimpour (2002) found the following as the generally accepted areas of TQM;

- research as related to issues in the implementation of TQM (Porter and Parker, 1993; Sommerville and Sulaiman, 1997; Maritnez-Lorente et al, 1998; Samson and Terziovski, 1999a, 1999b; Al-Khalifa and Aspinwall, 2000; and Zhang et al, 2000),

- Identification of the links between TQM factors and performance, notably among the various authors are Benson et al, 1991; Adam, 1994; Mann and Kehoe, 1994; Larson and Sinha, 1995; Youssef and Zairi, 1995; Flynn et al, 1995; Powell, 1995; Hendricks and Singhal, 1996, 2001; Anderson and Sohal, 1999; Motwani et al, 1997; Lemak and Reed, 1997; Easton and Jarrell, 1998; Dow et al, 1999; Zhang et al, 2000; Terziovski and Samson, 1999, 2000; Wilson and Collier, 2000; Robson et al, 2002, and more recently Lee, 2004;Martinez-Lorente and Martinez-Costa, 2004.

The final area of identified research was that of the relationship between TQM and BSEN ISO 9000:2000, and Human Resources Management within a TQM context. Sousa and Voss (2002) organised and reviewed Quality Management research in the following five key areas as:-

1) the definition of quality management,
2) the definition of product quality,
3) the impact of quality management on firm performance,
4) quality management in the context of management theory and
5) implementation of quality management.

All the above cited articles differ in terms of specific firm size; they could be large or SMEs. Industry-wise they could be manufacturing or service and country factors could be affected by the cultural impact. The major weakness identified from the review was that other studies conducted have largely been in bigger firms (McCabe, 1996) and focussing on manufacturing and service firms (Gustafsson et al, 2003). This view is shared by Ashford (1989) who noted earlier on that the early work on quality management took place in a manufacturing environment and therefore most literature on the subject was written in the vernacular of the factory setting. As Powell (1995) opined, TQM's impact on strategic management research, remains unclear and under-examined. The existing empirical studies of TQM performance intended to help managers implement TQM more effectively lack rigor and theoretical support. The empirical results of Powell (1995) suggested that TQM can produce a competitive advantage. However, there are limitations to the research conducted in that a small sample size was employed (n = 54), of which 24 were non-TQM and 39 TQM, and of the TQM sample, 24 were manufacturing and 15 service organisations. Furthermore the research did not study non-survivors.

The proliferation of articles within manufacturing and service literature has left a void within construction-related research. Most arguments put forward are that the quality management concepts used in manufacturing can be utilised within the service sector. On examination of articles which have conducted quality-related studies within the service organisations, there is an obvious omission that construction does not feature in most of those studied. This leads to the question of whether construction can be regarded as a service industry or not. For example the recent findings by Tsang and Antony (2001) attributed to TQM. Within the UK seven major areas of service industry that featured mostly power or water supply companies. The limitation of this study was its low sample size (25 out of 300). Another study by Robson et al (2002) collected data from 450 service organisations from the North East of England. Though the study was regional, none of the sample employed specifically mentioned Construction. Instead the majority of the respondents came from professional organisations (23%), public sector (22%), and industrial service (16%) with the remainder from consultancies, finance, banking, law and utilities. The premise presented across this study is that Construction is obviously omitted from studies conducted within the service sector and yet it is the largest contributor to the GDP in terms of employment and market share. Furthermore Sila and Ebrahimpour (2002) found hospitality and tourism to be the most important service sectors. The omission of the construction industry from the service management studies has been the motivation for this research. The classification of research areas fall into the following:

- Critical Factors
- Implementation Issues
- TQM around the World
- ISO 9000:2000 and TQM

Source: Sousa and Voss (2002)

Various instruments developed and validated for the measurement of TQM constructs were compared, a summary of which is provided in Chapter Two. The following is the justification for the selection of Powell (1995) to be used in this study and other instruments such as by Ahire et al (1996) and Saraph et al (1989). Whereas Powell (1995) used 12 constructs, this research used 10 constructs, by excluding Flexible Manufacturing and Process Improvement from those used by Powell (1995), because these were more manufacturing oriented. It also renamed the "closer to customers" construct as "customer focus" and "closer to suppliers" as "supplier focus". In terms of a standardised TQM research, Grandzol and Greshon (1998) proposed the seven constructs used by Anderson et al (1994) as adequate for the definition of TQM. The seven being:

- leadership,
- process management,
- employee fulfilment,
- customer focus,
- learning,
- Continuous improvement and co-operation.

Grandzol and Greshon (1998) further argue that the seven constructs either explicitly or implicitly summarise the appropriate operational constructs that best define TQM. However it can be argued that the constructs used in this study as suggested by Powell (1995) adequately cover all the seven constructs. The rationale for not using the Saraph et al (1989) instrument in this study is that it omits the most important constructs in TQM, mainly customer focus and usage of Statistical Process Control (SPC). Flynn et al (1994) was equally considered but on close examination, this instrument excludes employee empowerment and benchmarking scales, which are both considered to be crucial in the TQM Implementation. On the other hand Powell (1995) includes the omissions of Saraph et al (1989) and Flynn et al (1994). As Motwani (2001) observed, Powell's Instrument is very comprehensive and possesses higher validity than the non-empirical TQM studies. Furthermore the construct used in this study spans the entire range of activities deemed critical by TQM authors. Ahire et al (1996) was only tested and validated in the manufacturing industry. Apart from the above mentioned studies, I am aware of other studies that have published empirically validated scales for TQM such as Black and Porter, 1996; Zeitz et al, 1997; Tammim, 1998; Joseph et al, 1999a; 1999b; Agus and Abdullah, 2000 and Zhang et al, 2000.

To date no studies have been undertaken to investigate whether the developed and validated instruments used within the manufacturing and service industries for the identification of critical success factors have specifically been applied within the UK construction-related SMEs. This has not facilitated the SMEs in achieving a sustainable competitive advantage. Existing studies identified are Hoxley (2000) who developed an instrument for measuring UK construction professional service quality. However the limitation of that study was its main focus on Chartered Surveyors and Architects, no SMEs or construction organisations involved in the production aspect of the construction process were included. Too often many small and medium sized organisations decide not to adopt the quality management principles while inherently exhibiting some of the quality initiatives. This proposed model is designed as a monitoring tool for organisations that currently implement TQM. It is also designed as an assessment mechanism of non-TQM organisations wishing to identify the levels of quality initiatives prior to making a decision on whether to formally adopt TQM Implementation.

The rationale for investigating SMEs is that over 95% of construction companies employ fewer than 10 people, and over 50% of the labour force is self-employed. Small and Medium-sized (SMEs) organisations account for 96% of the number of all organisations in the construction industry by employment. It is evident that excluding such a group from any research would be wrong, because of the important role they have to perform in the economy. Though the figure quoted in this research relates only to the construction industry, on a national scale SMEs account for approximately 99.9% of total UK business and support approximately 87.2% share of UK employment and 75.2 % share of turnover. (DTI, 2002). The significance of the contribution made by the SMEs cannot therefore be overlooked.

1.3 Scope of Research

It is against this background that the scope of this thesis is limited to the UK Construction Industry. The main areas of interest for this research are the aspects of opportunities and benefits of TQM deployment. This is particular to SMEs with regards to attaining a sustainable competitive advantage via the utilisation of an assessment and monitoring model. This is achievable by assessing the potential for the transferability and applicability of the measuring instrument to a specific area of construction. One of the major omissions in previous TQM research has been the lack of inclusion of Non-TQM firms. This research redresses that imbalance by drawing on a random sample of organisations whether implementing TQM or not. This not only increases the chance of generalising the findings, but an opportunity to assess the current levels of TQM initiatives in both types of organisations.

1.3.1 Chronological Scope of Research

The data used in this study was mainly collected through a postal questionnaire. It was supplemented by three unstructured interviews via case studies; therefore, triangulation was used in this research. As such, the scope of the study can be described as a "snap shot" of the industry at a point in time, representing more of a picture, albeit far from complete than what is available in the literature. The framework illustrated in Figure 1.2 covers attitudes and perceptions of TQM. It also sums up the entire survey document used for the quantitative analysis and seeks to measure and assess the TQM activities and outcomes. In order to achieve this, there is the need to understand the purpose of TQM and the advocated benefits of TQM which are dealt with in depth in Chapters 4 and 5. These attitudes and perceptions are directly linked to the implementation practices through espoused theories that lead to the implementation outcomes such as the perception of TQM success and the organisational and business performance that are described in Chapters 4 and 5, and the statistical analysis using SPSS and AMOS software presented in Chapters 6 and 7.

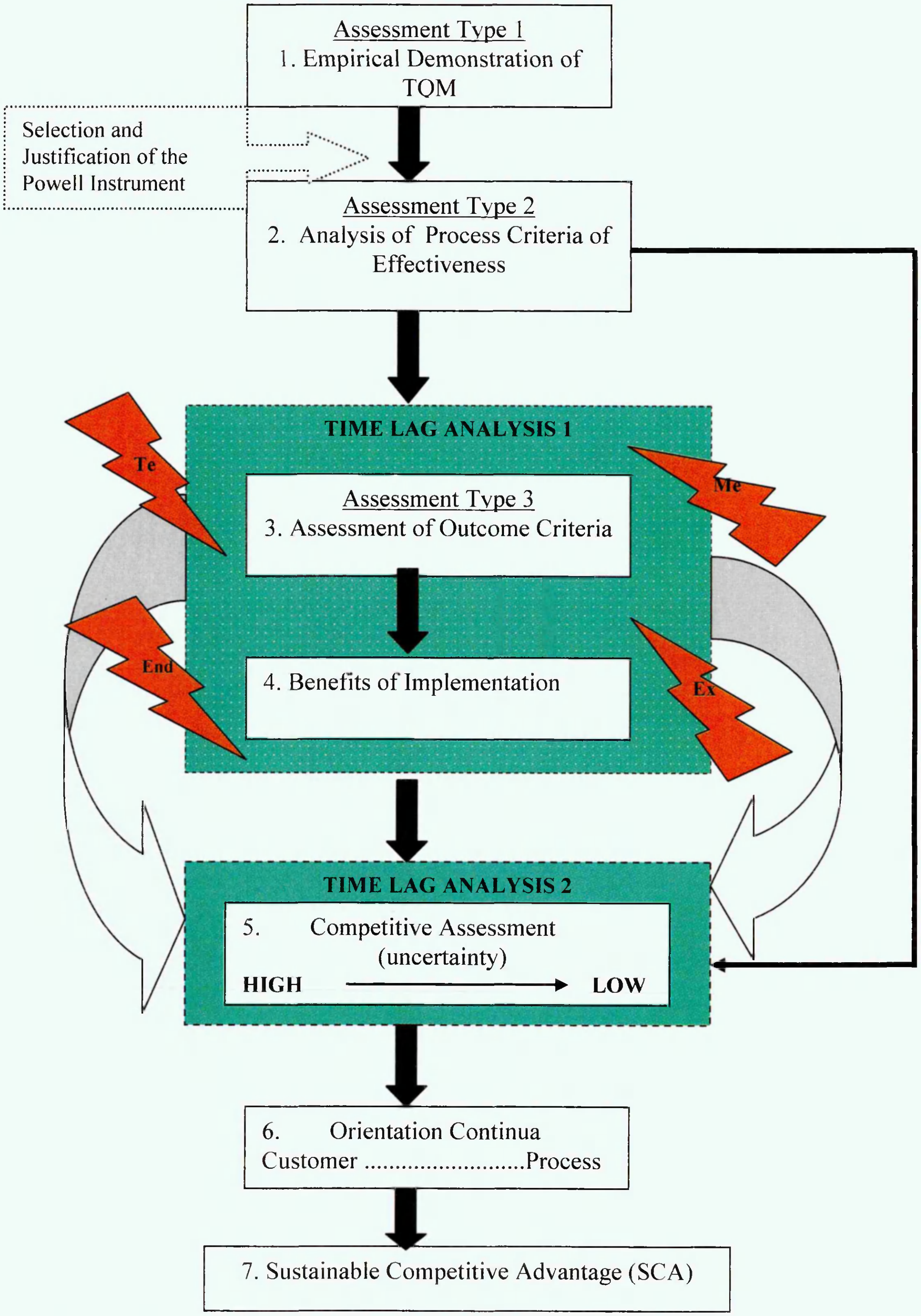

Fig 1.2: *Conceptual Framework for the Survey Study*

Based on Hackman and Wageman (1995), they suggest that in order to effectively measure and assess the TQM activities and outcomes, a fully-fledged evaluation of a TQM program should include the three distinct types of assessment. These are shown in boxes 1 to 3 of Figure 1.2 and are as follows; 1). Empirical demonstration of TQM has in fact been implemented, and confirmation that it is TQM that is being assessed, 2) Analysis of Process Criteria of Effectiveness 3). Assessment of Outcome Criteria.

These have the following purposes respectively;

1. To confirm that it is TQM that is being assessed rather than, for example some subject of the integrated TQM package.
2. To determine whether TQM alters how people work together to meet customer requirements
3. The degree to which improvements in bottom line organisational effectiveness are found.

The whole research hinges upon conducting the three types of assessment and the survey document is designed towards achieving the stated assessments. However as noted by Hackman and Wageman (1995), in order to conduct the three distinct types of assessment entails the usage of different methods and analytical strategies. Furthermore there are problems encountered in ascertaining the assessment of the outcome criteria. This leads to the time lag analysis indicated in the second box and for illustrative purposes; these problems are indicated in form of the symbol for "flashes" or "interference". These are: 1) Measurement (Me) problems associated with even standard indices of firm performance, 2) Exogenous (ex) disturbances 3). Temporal (te) issues. The second type of time lag analysis relates to the impact of the competitive assessment which borders on the orientation and uncertainty (Reed et al, 1996). The following subsection now presents the aim and objectives designed to achieve the assessments set out in the research conceptual framework. A full description linking the conceptual framework to achieving the aim and objectives is explained in full detail in Chapter Two.

1.3.2 Aims and Objectives of Research

1.3.2.1 Overall Aim

The main aim of this thesis is to improve on the existing scale development, notably the Powell (1995) instrument by re-analysing its existing scales and modifying it to suit the UK Construction Industry. This would be achieved by empirically testing the re-analysed or improved scales by calculating the levels of TQM initiatives with UK construction related SMEs.

The revised model would enable quality managers or senior management to identify areas requiring improvement.

1.3.2.2 Overall Objectives

In order to achieve the above stated aims, the following objectives were set for the study.

- Identify the major constructs of Total Quality Management (TQM) and refine the scales for measuring the constructs.

- Review and evaluate validated Instruments used to measure Quality Management within the Manufacturing and Services Industries.

- Determine if there are any differences in quality management implementation and quality outcomes across UK Construction related SMEs and if so, how and why they differ?

- Investigate the relationships among TQM practices and identify the direct and indirect effects of TQM practices on the various dimensions of performance within the context of organisation size, age, union density and competitive environmental factors.

- Identify the linkages between attainment of a sustainable competitive advantage and implementation of TQM.

- Develop an operational framework of Total Quality-Self Monitoring Assessment Rating Tool (TQ-SMART) that is theoretically grounded. Draw conclusions and empirically validate the model developed.

1.4 Research Findings

The findings of the research can be categorised into six groups, namely:

1. the confirmation in the Construction Industry of results previously obtained in other industries such as Manufacturing and Service Industries,

2. application of the revised good scale previously utilised within the manufacturing and service environment within a construction specific setting.

3. verification of the constructs being more applicable through case studies.

The findings within the first group relate to the classification of organisations based on the extent to which they embrace the TQM philosophy; the high levels of TQM implementation against non-TQM organisations and the confirmation of a positive relationship between implementation of TQM and organisation performance (Flynn et al, 1994; Powell, 1995; Rao et al, 1997; Ahire et al, 1996; Quazi and Padibjo, 1998; and Ahire and O'Shaughnessy 1998)

4. The study contributes to the TQM literature by validating the direct and indirect relations among TQM practices and the effects of these practices on organisation and business performance, as argued by Lemak et al (1997). Academics need to take a leading role in the empirical investigation of the value of TQM.

5. This research validates the proposals of Sousa and Voss (2002) who call for the integration of the content and process elements of the QM practices. The commitment and advancement indices generated by the TQ-SMART Model serves as an assessment and monitoring mechanism for TQM deployment organisations and at the same time as an assessment mechanism for non-TQM deploying organisations wishing to identify their existing levels of quality initiatives.

6. Provide support for the time lag analysis by extending the seminal work of Reed et al (1996), and contributing to the knowledge of the organisation size impact on TQM implementation.

The significant findings within the second, third, fourth and fifth groups are;

1. The revised scale and generation of the TQ- SMART;

- Establishing that empirical differences in weights should be applied to the implementation constructs when assessing the levels of TQM in particular for SMEs. This calls for an adjustment factor to be applied, hence confirming with empirical evidence what has been deduced from theory but not empirically tested, as advocated by Flynn and Saladin (2001)

- The concept of entering the European Foundation for Quality Management Excellence Model (EFQM.EM) award is clearly less favourable among the SMEs but the literature supports that it is the process of deployment that is important.

2. Modelling

Redeveloping on the existing scales and validation of the TQM advancement radial chart (TQ- SMART Model) that can be used by quality and senior managers within the construction SMEs at both the industry and organisation level. The industry level application would serve as a benchmark with competitors and other organisations whereas the organisation level would be to assess the levels of TQM and identify the areas requiring improvement. The direct and indirect contributory effects are obtained from the structural analysis results of the SEM. These coefficients are used to determine the **Unit Contributions** of the ten deployment constructs towards Market, Financial and Organisational Performance. (Customer and Employee Satisfaction). Though the results show indication of a relationship between the process and outcome, difficulties in detecting the direct effects of TQM on organisational performance are taken on board.

3. Testing of Instruments

The testing of the existing instrument to measure quality management practice or dimensions typically developed using samples of large companies in well developed industry such as construction, but in a less well studied context such as SMEs. Furthermore the study extends the work of Sousa and Voss (2002). Furthermore, this is the only study that has focussed exclusively on construction, and in particular SMEs. The empirical validation of the TQ-SMART measuring instrument for the TQM strives to enrich the subject of theory building in view of the scarcity of empirical research works in constructional related literature. This contributes towards producing contingency knowledge.

4. Measuring and Assessing TQM Activities and Outcomes

This study has evaluated the implementation of TQM within UK Construction related SMEs through three distinct different types of assessment as recommended by Hackman and Wageman (1995). Firstly this involved the empirical demonstration that TQM is in fact being implemented through the operationalisation of constructs of constructs found in literature and grounded in the principles of TQM advocated by the Quality gurus and current Excellence Models.

5. Contribution to Impact of TQM Maturity and Organisational Size

The findings of this study are that there are no significant differences in the deployment of TQM constructs between the less experienced and more experienced; however, there is a "degree of decline" in certain TQM constructs such as Executive Commitment, Training and Supplier Focus.

6. Contribution to Time Lag Analysis

Reed et al (1996) presented valid reasons why some of the gains from TQM are far from instantaneous. According to their studies, this was due to the continua of either orientation or uncertainty being undimensional where for the purpose of this study, UK Constructional related SMEs could either be Customer Oriented or Process Oriented and exist in either high or low uncertainness. They provided a framework and 10 factors that need to be addressed in order to address the issue of time lags. This study contributes to the body of knowledge of time lag studies by testing part of the model and find the UK Constructional related SMEs to have medium level customers orientation and existing in the medium range of uncertainty. Therefore through the competitive assessment-orientation matrix generated, UK Constructional related SMEs can be able to determine as to when the benefits of TQM would start. By addressing some of those 10 factors articulated by

Reed et al (1996), the study is effectively contributing to the body of knowledge on time-lags particularly with the Construction Industry and specifying that form of orientation and range of uncertainty is desirable for the SMEs.

7. Contribution to existing body of knowledge

This study contributes to the existing body of knowledge on TQM by answering some of the questions left answered by various researchers. Fillippini (1997) identifies these as;

- the components of total quality and their measurements
- relations between these
- the impact of different practices on performance
- and conditions under which various interventions can be applied and their effects.

1.5 Methodology

The methodology adopted in this thesis is both an exploratory and explanatory nature of inquiry. The positivistic paradigm is used for the survey aspect of the data collection methods. Detailed description of the data analysis used and the justification of the methodology adopted based upon the research purpose are in Chapter 2.

1.6 Structure of the thesis

The thesis is structured into nine chapters.

Care was taken to ensure that each Chapter would stand alone while maintaining the relationships between Chapters. The overall purpose was for the individual Chapters to stand out as potential research papers. A brief description of the Chapters and the contents are outlined as follows: The Chapters in chronological order are:-

1. General Introduction
2. Research Design and Methodology
3. Overview of the Construction Industry and The Implications of TQM
4. TQM as a Potential Competitive Advantage
5. Organisation Antecedents to the Implementation of TQM
6. Data Collection and Synthesis
7. Model Redevelopment and Validation
8 Discussion and Summary
9 Conclusions and Recommendations for Further Research

The following presents a brief overview of the Chapters:

1.6.1 Chapter One

This Chapter outlines the general introduction to the thesis and describes the rationale for undertaking research in TQM within UK SMEs. It provides the aims and objectives of the study in the form of a research methodological model. Principally the thesis adopts the triangulation approach in which three stages are involved. These being: exploratory, descriptive and empirical analytical research.

The above approaches are explained as follows:

Exploratory aspect focuses on the extensive literature review into the management writings on TQM. The main objective of this approach is to gain preliminary insight into the application of TQM and provide a basis for more in-depth survey.

Descriptive and Empirical aspect details the field studies of the organisations. This is aimed at understanding the relevance of a certain phenomenon and describing the distribution of the phenomenon in a population. Analytical modelling of the TQ- SMART is applied by using the AMOS and SPSS Software. An explanatory approach (or confirmatory) examines the implementation method utilised in a few organisations via a case study approach. The ultimate purpose of this Chapter is to show the clear relationship with existing research, in order to achieve the first criteria on which the thesis is to be judged.

1.6.2 Chapter Two

This Chapter outlines the methodology adopted and contains the aims and objectives. It sets out the research and design methodology utilised and touches on the reliability and validity issues in quality management. The rationale behind this stance is that conducting empirical research without considering its reliability and validity is pointless because the researcher will not be able to generalise from the results. Chapter two can further be described as a demonstration of a disciplined attack on a determinate problem using appropriate methodology. The constructs used in the model development are introduced and issues of model validation are highlighted. The differences between the exploratory and confirmatory factor analyses are explored. The justification for the paradigm and methodology are presented and defended. Relationships with existing research are explored and the conceptual framework that explores the interrelationship between the performance measures, TQM practices and the competitive environment in light of the contextual factors such as organisational size, union density and TQM maturity is presented.

1.6.3 Chapter Three

Total Quality Management is introduced in this Chapter. It starts by defining the UK Construction Industry and the focus of the study, then progresses to how the industry is structured in terms of the SMEs share of the business',employment and turnover. Various definitions of SMEs are provided and the importance of the Industry is highlighted by way of the Industry and market structure, concentration, operating characteristics, foreign ownership, the entries and exits. The utilisation of TQM among SMEs is examined and the differences between small and large organisations are provided. The application of TQM within the Construction Industry is highlighted and the focus shifts to the rationale for the application of TQM within SMEs. This Chapter further highlights the contribution and priority areas identified by the Latham (1994) report. It explores the linkages between the drivers of change as advocated by Egan (1998; 2002) to the implementation constructs utilised in this study. The potential application of the concept such as six-sigma as advocated by Banuelas and Antony (2001) is explored to match the requirements of Egan and the compatibility with this study.

1.6.4 Chapter Four

The linkages between TQM and sustainable competitive advantage are explored in this Chapter. By establishing the business forces necessary for attainment of a competitive advantage, the definition of competitive advantage is provided and how competitive strategy and TQM are linked. A further linkage between organisational performance and TQM are explored. The theoretical background to the issue of time-lag are explored in form of a conceptual framework as envisaged by Reed et al (1996) and through an examination of a series of propositions. This Chapter is the main focus of achieving objective four as it relates to providing the theoretical foundations for the attainment of competitive advantage and implementation of TQM. The thesis also relates to the impact of TQM within SMEs by examining Porter's 'five forces model'. The Chapter concludes by stating the necessary conditions for attaining a sustainable competitive advantage and explores the four components of TQM contents in light of the requirements set out by Egan (1998).

1.6.5 Chapter Five

Organisation antecedents to the successful implementation of TQM are explained in this Chapter by examining the theoretical advocated steps in the implementation process as well as the associated problematic issues of deployment. A brief comparison in terms of implementation of quality initiatives, related problems and their advocated solutions, measurement instrument applied between manufacturing and construction is provided. Constructional related problematic issues to the implementation process and identification of the key success factors are presented. The focus is more on the implementation and not the concept. A thorough literature review of existing TQM implementation constructs is examined and rationale provided for the choice of constructs to be used in the study. The impact of organisation size on the implementation of TQM is explored through a literature review. The rationale and justification of using the Powell Instrument is provided in this Chapter. The Chapter further explores the benefits to be gained from benchmarking.

1.6.6 Chapter Six

Chapter six presents both the exploratory and explanatory aspect of research. One of the main purposes of this approach is to build a theory about the application of quality management within constructional related SME's.

Three case studies are presented. This is an in-depth examination of the application of quality initiative within one TQM and two non-TQM deploying organisations. The premise of this Chapter is to highlight the differences in terms of advancement and commitment of organisations to the quality initiatives. A brief overview of data collection method is given along with the types of data analysis. As opposed to the positivistic paradigm of merely confirming or refuting hypotheses, this Chapter helps explain and describes the patterns which evolved in the three organisations. Data analysis and methods used are presented in this Chapter. The revised instruments are empirically tested for undimensionality, reliability and construct validity, using a confirmatory factor analysis approach. As the Instrument used in data collection of the critical success factors is based on the refined Powell (1995), the methods used in the refinement process are reported in this Chapter. The methodological triangulation is used in order to ascertain the broader picture.

1.6.7 Chapter Seven

Chapter seven focuses on the validation of the TQ-SMART model. It also examines the potential of emerging Artificial Intelligence (AI) based technologies as a vehicle for TQM systems and communication throughout the organisation. Application of fuzzy based scoring to the assessment model is explored. Problems associated with the transferability of concepts from the manufacturing setting to construction are highlighted. The role of AI and how it could compliment TQM in order to obtain its full implementation benefits are investigated. It explores the possibility of the application of Fuzzy Logic in the Model Development. This Chapter further presents a comparison of existing assessment models such as the MBNQA and EFQM Excellence Model to the development of TQ-SMART. The results of Structural Equation Modelling (SEM) in which the path method is employed are examined and discussed.

1.6.8 Chapter Eight

This Chapter provides a discussion of the findings. The inadequacies of existing models are explored with particular emphasis on the contribution of TQ-SMART to Aim and Objectives of Study. The selection of the EFQM Excellence Model for comparison and the deployment constructs of the TQ-SMART are explained. Finally the potential applications and managerial implications of TQ-SMART Model are discussed.

1.6.9 Chapter Nine

This Chapter provides a recap of the research problem, methodology, and the major findings presented. The limitations of the study are explored with particular emphasis placed on the validity and sample restriction issues. Inadequacies of existing models are examined and the application of TQ-SMART at different levels of the organisation and managerial implications are presented. The contribution to knowledge through the application and theory development of Quality Management is highlighted through the different steps of theory development. Finally, existing gaps in the study are summarised and presented as recommendations for future research.

1.7 Definitions

From the theoretical development viewpoint, the constructs or concepts can be defined as abstractions in the theoretical domain that express similar characteristics (e.g. construction effectiveness, executive commitment and organisation culture). For clarity purposes and to avoid the generally accepted confusion throughout this thesis, the terminology used will be that of constructs. Generally, there is confusion as to what constitutes TQM, though it can be regarded as a set of concepts and tools for getting all employees focussed on continuous improvement. A concept may be defined essentially as a business philosophy, a company ideal or a policy statement (Nilsson et al

2001). The confusion in the terminology can lead to uncertainty, as noted by Hellsten and Klefsjo (2000). They further argue that what might be called core values such as customer focus, continuous improvement, or process orientation are one and the same thing as principles (Sitkin et al, 1994), dimensions, elements or cornerstones (Waldman, 1994) and interventions (Hackman and Wageman, 1995).

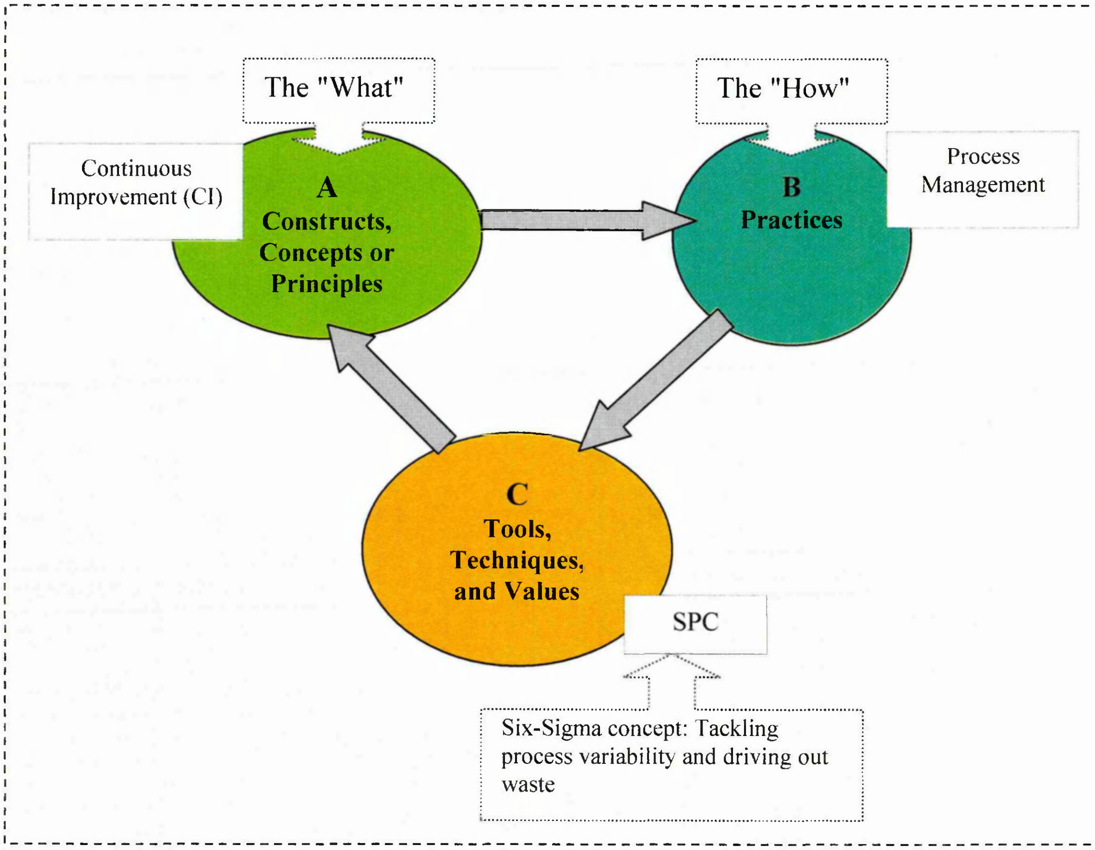

Fig 1.3: *The Precepts of TQM*

A brief explanation of Fig 1.3 is provided as follows; Practices (B) are the observables facet of Quality Management, and it is through them that Managers work to realise organisational improvements (Sousa and Voss 2002), whereas Principles (C) are too general for empirical research. Techniques can be described as too detailed to obtain reliable results. For example the Quality Management Principle (A) of "Continuous Improvement" can be supported by the Practice (B) of "Process Management", which in turn can resort to several Techniques (C) such as "Statistical Process Control" and

"Pareto Analysis". According to Sousa and Voss (2002), this has led to conflicting results being reported in the literature and may have to do with different levels of analysis of Quality Management. Accordingly, as suggested by Gustafsson et al (2003), the strength of quality management compared with other business philosophies should focus on the practical methodology, namely the Practices (B) and Techniques (C). According to Holti et al (2000), the concept, and the practice of Continuous Improvement (CI) though well established in manufacturing, is still relatively unfamiliar to the Construction Industry. However they observe that the theme of CI underpins the philosophy of TQM. Escrig-Tena (2004) observes that TQM is delimited taking into account its basic principles (the what) as well as the practices used in its implementation (the how). From various contributions in literature, Escrig-Tena deduced four dimensions that represent a minimum common denominator of TQM principles and practices as customer orientation (CO), Continuous Improvement (CI), Focus on People (FP) and Global Vision of the Organisation (GV). Quality Management may be viewed as a combination of A+B+C from Figure 1.3, which is a combination of principles, practices and technique (Dean and Bowen, 1994)

The study through its objectives will strive to offer a comprehensive and yet simple methodology for scientifically examining how the multitude of precepts, Concepts (A) and Practices (B) involved in Quality Management can be structured into a systematic framework (as shown in Chapter Two) for the development of an empirical understanding of TQM through the usage of fine grained methods such as Structural Equation Modelling (SEM).

1.8 Delimitations of Scope and Key Assumptions

The unit of analysis used in this thesis is that of the organisation, even though the respondent is an individual i.e. Quality Manager. It is assumed it represents the view of the organisation, thus the unit of measure is at plant level and it would be difficult to secure adequate sample sizes of all employees within that plant. This is one of the problems with research in operations management. In contrast, in the field of psychology, the unit of measure is the individual. Malhotra and Glover (1998) emphasise that the person(s) most knowledgeable about the construct of interest should be chosen. In this thesis the majority of respondents were either Quality Managers or Quality Directors and in one case the Chief Executive Officer (CEO). Furthermore, as the study's main focus was on the SMEs, it is assumed that they are knowledgeable due to the low number of employees. (Nilsson et al 2001). The Construction Industry has been regarded as not being part of the service industry due to the absence of any specific literature which includes the industry as part of the service industry when conducting empirical studies. There was a possibility of assuming that unlike the suggestion in literature, that implementation change is a linear process, and should be taken as non-linear consisting of peaks and troughs.

This study posits that the route organisations undertaken to achieve the world class status is in a spiral form, denoted as "spiral approach" which involves ascending and descending due to lack of focus in either commitment or advancement of the implementation. However, it is acknowledged that such a study would require observations at two different points in time, which calls for a longitudinal study as opposed to the "snap shot" approach utilised in this study. One of the dangers of the latter was lack of assurance as to whether the same organisation would be in existence at a later point as evidenced by the number of firms which go into liquidation, in particular in the Construction Industry. The author further acknowledges that this type of approach (longitudinal) is more suited to some organisations within the Service Industry; notable among those are hospitals or the NHS where government is likely to pump more money into it to keep it afloat. From the methodological point of view, while the longitudinal study may improve the stability of the measures according to Hensley (1999), there are practical problems of time requirements and finding subjects willing to be involved in such a study.

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Chapter Two

Research Design & Methodology

CHAPTER TWO: RESEARCH METHODOLOGY

2.1 Introduction

Chapter one provided the general introduction and background to the research question. It provided the justification and outline of the thesis. Chapter two describes the research design and methodology of which a brief introduction was provided in section 1.5 of Chapter one. One of the requirements for a PhD research is to show proof of logic and mastery of research methodology. The research design and methodology is explained in order to achieve that requirement. As Kekale (2001) posits, the Chapter has to address one major question, namely: 'Am I following a logical research approach, and do I give enough description of what I have done in order for others to decide if I have mastered the methods or not?

The Chapter is organised around eleven major topics outlined as follows:

2.2	Different types of research are introduced
2.3	Presents the paradigms of research
2.4	Compares the Quantitative and Qualitative approaches
2.5	Highlights The Theoretical Model
2.6	Formulates the hypotheses
2.7	Reliability and Validity Issues
2.8	Data Collection Methods
2.9	Data Analysis
2.10	Scale Development vs. Usage of Existing Scales
2.11	Model Validation
2.12	Summarises discussion in this Chapter

2.2 Types of Research

Bresten (1990) cited in Simiter (1995) that there appears to be a limited number of methodologies which are particularly favoured and in current use within construction management research. Therefore it is not often possible to provide examples from construction management research when discussing aspects of a particular methodology. There are two major types of survey research, namely exploratory and explanatory. The importance of different research methodological approaches available with their inherent strengths and weaknesses have been fully considered.

Particular attention is drawn to comparing and contrasting the qualitative and quantitative approaches. The choice of research tools is guided by Wing et al (1998) who advocates that many research issues in construction management are practical problems, which involve generalization of experience and the formulation of hypothesis that can generate empirically testable implications. For problems of this nature the testability of hypothesis and reproducibility of results are important. The naturalist approach of discovering casual relationships is more likely to produce practical solutions.

2.3 Paradigms of Research

According to Vignali and Zundel (2003), there are two dominant paradigms striving for dominance in Social Sciences. These are positivism and phenomenology.

2.3.1 Positivism

Positivism as a paradigm, assumes that human behaviour is determined by external stimuli and that it is possible to use the principles and methods traditionally employed by the natural scientist to observe and measure social phenomena. Vignali and Zundel (2003) state that paradigms deal with the proper domain of a science, the research question it should ask and the rules to follow in the interpretation of the results. The two major assumptions that underline the positivist paradigm according to Vignali and Zundel (2003) are that reality is external and objective and second, that knowledge is only significant if it is based on observations of external reality. Therefore the implication of this paradigm is nested in the following: Independence, Value-Freedom, Causality, Hypothetical-deductive, Operationalisation, Reduction, Generalisation and Cross-Sectional analysis. These implications are discussed in detail in Chapters five and six. One of the disadvantages of this paradigm is the over reliance of data dependant on statistics (McCabe, 1996), as Verma and Goodale (1995) contend, researchers in social sciences are not primarily interested in just describing summary statistics of the sample but to make inferences about the whole population. Another criticism is its assumption of value freedom.

2.3.2 Phenomenological or Interpretative

On the other hand, the primary objective of the phenomenological paradigm is the direct investigation and description of phenomena as consciously experienced without theories about their causal explanation and as free as possible from unexamined preconceptions and presuppositions (Vignali & Zundel, 2003). One of the major problems and limitation of this approach is the difficulty in generalising the results, because the observations are normally made in a few case organisations that the researcher has or has time to develop personal understanding in (Kekale, 2001). McCabe et al (1995) used the interpretative approach in their study of Quality Managers. As opposed to the positivist approach of over reliance on statistics, they argue that this method allows the ideas of the Quality Managers to be presented in their own words, hence the probability of learning from them. It is against this background that the case studies in Chapter 6 are reported directly as the Quality Managers stated.

2.3.3 Emerging Paradigms or TQM Tailored?

Post Modernist Paradigm

As Vignali and Zundel (2003) observe, coupled to the positivist and phenomenological paradigms, the recent development of postmodernism must be mentioned. Hendricks and Singhal (2001) attribute the demise of TQM due to emerging paradigms such as re-engineering, customer-centred organisations, process-oriented organisations, learning organisations, supply-chain management, six sigma etc. This study's results support the findings of the above authors as the emerging picture from non-TQM deploying organisations were reasons put forward, indicated the desire of them not wanting to be associated with TQM yet inherently exhibiting some tenets of TQM. It is interesting to note that in most of the Non-TQM deploying organisations, the designation or the person responsible for "Quality" was either a Business Improvement Manager and/or the word "Quality" did not feature in the job title.

2.4 Quantitative and Qualitative Approaches

One of the objectives of this Chapter is to provide a comparison between quantitative and qualitative methods. It is acknowledged that any disciplined inquiry can either follow the qualitative or quantitative rationale. As Hiles (1999) points out, what defines human science is not its methodology but its paradigms. The approach used in this section draws heavily from the framework advocated by Hiles (1999). This makes a clear distinction between paradigm, strategy, methodology and (data) analysis. The two distinct methodologies shown in Figure 2.1 can be compared by examining their emphasis on the validity and reliability issues. Qualitative inquiry emphasises validity while downplaying reliability, while the quantitative approach seeks the reversal, i.e. emphasising reliability while downplaying validity.

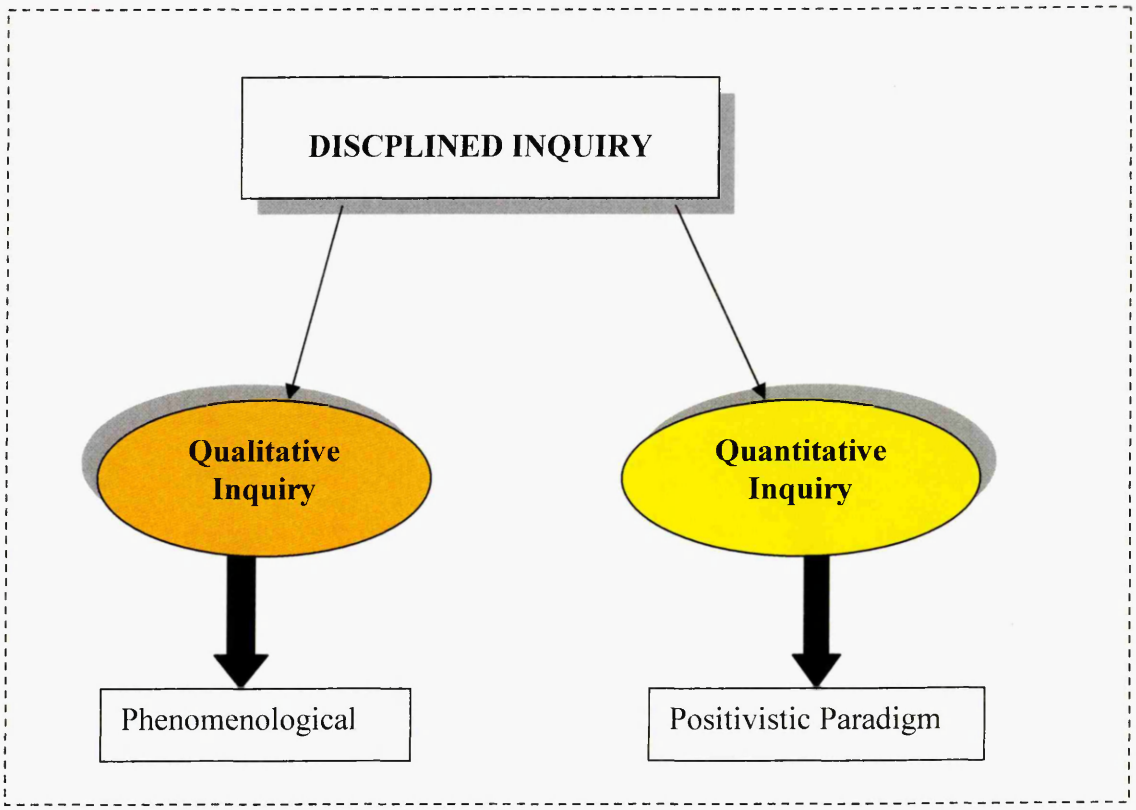

Figure 2.1: The conventional model of research
Author's own interpretation as adapted from Hiles (1999)

It can further be argued that regardless of the research techniques used under quantitative research, the aim of the research activity could be summarised under the three broad areas of understanding, prediction and control.

For the purpose of this study and in the application of the above explanation, the researcher is attempting to gain an *understanding* of the phenomena under study so that they may use this *understanding* in order to make *predictions* about the real world, and thus develop technologies or procedures which allow a degree of *control* to be exerted over those phenomena.

The main method of quantitative enquiry used in this study is that of *survey research.* According to Malhotra and Glover (1998), survey research has three characteristics, which help distinguish it from other field-based methods. These can be classified as follows:

- It involves *asking people* for information in some structured format

- Usually a *quantitative method* that requires standardized information in order to define or describe variables, or study the relations between variables

- Information is gathered via a *sample*

Literature review identified the following major objectives of quantitative research as:

- quantifying data and generalising results from a sample to the population of interest
- measuring the incidence of various views and opinions in a chosen sample, sometimes followed by qualitative research, which would be used to explore some findings further.

Based on the above assumptions, this study could be classified as survey based in that it satisfies the characteristics thus stated. For example this study involves collection of information from Quality Managers or *people* responsible for quality management using a questionnaire *(quantitative method), which* defines the application of TQM variables from a *sample* of Small and Medium Sized (SME's) Constructional related organisations.

The quantification is in the form of descriptive statistics such as frequencies, means, sums etc. In arguing between qualitative and quantitative research, studies have shown that in terms of data, the picture that emerges from it is less rich than that obtained from qualitative analysis. Quantitative analysis can further be described as an idealisation of the data in some cases. Guba and Lincoln (1998) argue: 'from our perspective, both qualitative and quantitative methods may be used appropriately with any research paradigm.

Fellows and Liu (1997) define triangulation as the use of qualitative and quantitative techniques together to study the topic. This has been described as being very powerful to gain insights and results, to assist in making inferences and in drawing conclusions:

- The fact that services have a tangible and intangible dimension and are often vague with no clear cut boundaries between various aspects of construction activities. The adaptability and flexibility of qualitative research methods and techniques throughout the entire research process can allow the research at an early stage to become familiar with the area of interest, explore the field and consider dimensions involved because of its open-ended, pre-ordained nature.

- The fact that during the development of research, the adaptability of qualitative research allows for a relatively flexible plan of action to be followed, evolving with the experiential learning and development of the researcher as new themes, ideas and topics of interest emerge.

- The fact that quantitative research methods can easily help the researcher to understand quickly the context in which a phenomenon takes place.

- The fact that qualitative research allows the researcher to experience directly the world of informants and all of its variations and by living through the 'highs' and 'lows' of their lives, the researcher is able to know the phenomenon under investigation in a way that few other methodologies can permit. And the fact that qualitative research takes a holistic approach permits the researcher to gain a comprehensive and complete picture of the whole context in which the phenomenon of interest occurs. According to Vignali and Zundel (2003), the scientific research paradigm has the strengths of clarity, precision, standardisation and generalisation:

2.5 The Theoretical Model

According to Forza (2002), prior to starting theory testing survey, the researcher has to establish the conceptual model. This study draws heavily from Forza and highlights the steps undertaken through the following Figure 2.2.

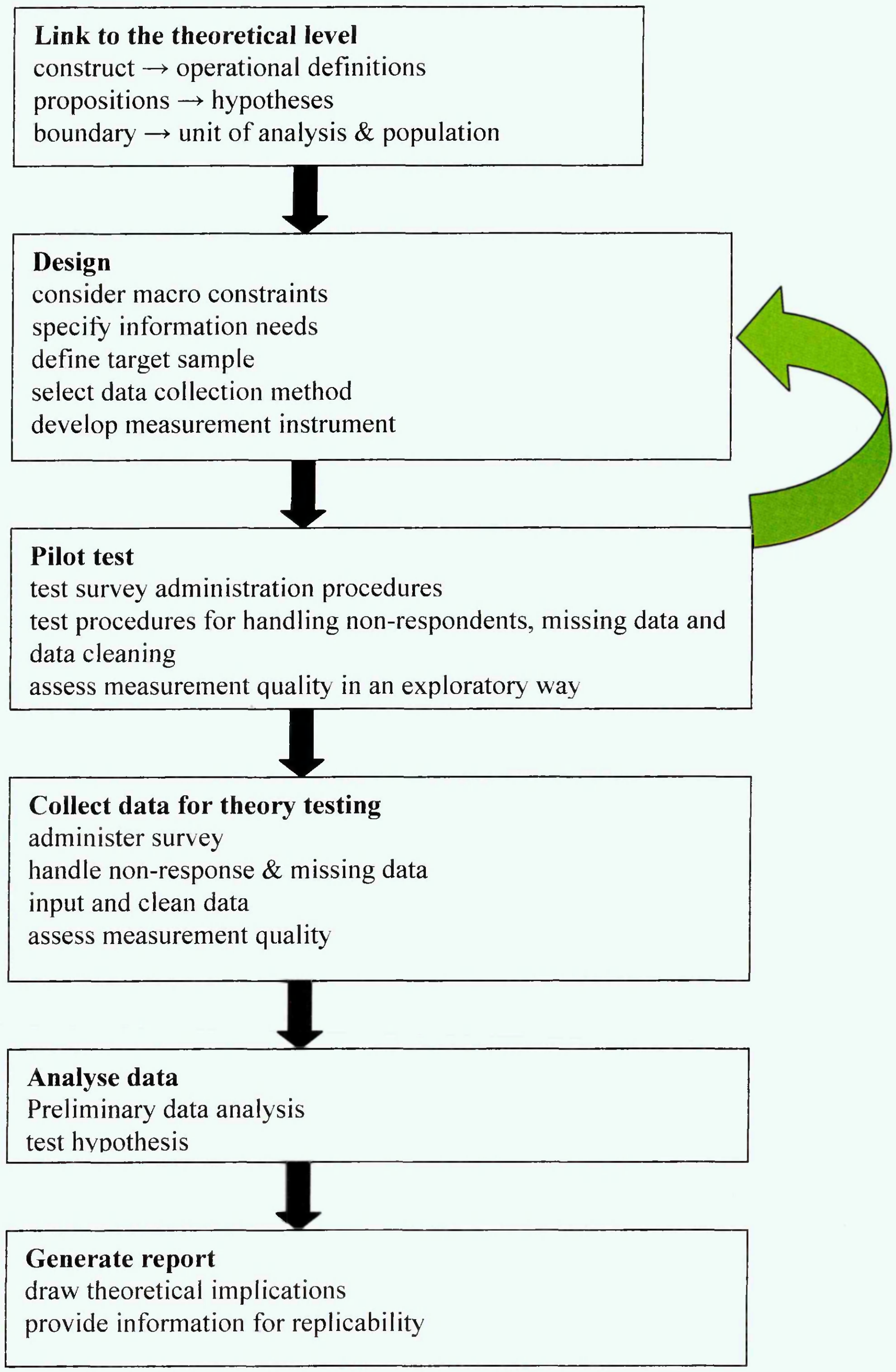

Figure 2.2 The theory-testing survey research process

2.6 Formulation of Hypothesis

A series of questions are posed based on the assumption that organisations adopt TQM with the purpose of achieving sustainable competitive advantage. These sub-hypotheses will be explored in the **main** using empirical evidence drawn from the UK Construction Industry. Research hypotheses are the questions which researchers hope to answer by conducting an empirical study. These hypotheses may represent deductions or derivations from a formal theoretical explanation of a phenomenon of interest, or they may simply represent speculations concerning the phenomenon.

Fellows and Liu (1997) defines hypotheses as statements which are produced to be tested objectively. They propose having one main hypothesis, derived from the aim of the research, and sub-hypotheses relating to the objectives where appropriate. Similarly the approach adopted in this thesis draws from Fellows and Liu (1997).

In order to promote rigour in considering what the research is investigating about and what can be achieved realistically (Fellows and Liu, 1997), one aim and six objectives are posed:

2.6.1 Hypothesis

One of the implications of the positivist paradigm is its generally hypothetical-deductive in nature. Science proceeds through a process of hypothesising fundamental laws and then deducing what kinds of observations will demonstrate the truth or falsity of this hypothesis (Vignali and Zundel, 2003). Hypotheses 1-10 through, are based on the proposed quality framework showing the linkages and summary of the relationship between TQM, competitive environment and organisation performance.

H_1: Extent of TQM implementation in UK Construction related SMEs has a positive impact on organisation performance.

H_2: Organisation performance is positively associated with each of the ten quality constructs

H_3: Executive commitment is directly related to customer focus, supplier focus, benchmarking, training, open organisation, employee empowerment, zero defects and measurement.

H_4: Employee satisfaction is associated with customer satisfaction.

H_5: Medium TQM deploying UK construction related SMEs exhibit a high level of advancement of the ten TQM constructs than small TQM deploying UK construction related SMEs.

H_6: Medium TQM deploying UK construction related SMEs perform better in each of the four measures of TQM and organisation performance than small TQM deploying UK construction related SMEs.

H_7: Medium TQM deploying UK construction related SMEs exhibit a high level of advancement of the ten TQM constructs than medium non-TQM deploying UK construction related SMEs.

H_8: Small TQM deploying UK construction related SMEs exhibit a high level of advancement of the ten TQM constructs than small non-TQM deploying UK construction related SMEs.

H_9: Experienced TQM deploying UK construction related SMEs exhibit a high level of advancement of the ten TQM constructs than less experienced TQM UK construction related SMEs.

H_{10}: Experienced TQM deploying UK construction related SMEs perform better in each of the four measures of TQM and organisation performance than less UK construction related SMEs.

Hypotheses 5 to 8 are designed to test the impact of organisation size (small or medium) of UK Construction related SMEs in TQM implementation. Small organisations are defined as those with less than 100 employees, while medium are those with more than 100 but less than 500 for the purpose of this study.

Hypotheses 9 to 10 are designed to test impact of the time lag between inception of the TQM program and improvement. Based on Ahire (1996) and Ahire and Dreyfus (2000), TQM deploying organisations are classified into two groups, depending on the number of years TQM was in place. Recent TQM implementers are those with less than 3 years of TQM implementation, where as those with more than 3 years were classified as experienced TQM Implementers.

2.6.2 Overall Aim

The main aim of the research is to improve on the existing scale development, notable the Powell (1995) instrument by re-analysing its existing scales and modifying it to suit the UK Construction Industry. This would be achieved by empirically testing the re-analysed or improved scales by calculating the levels of TQM initiatives with UK construction related SMEs. The overarching objectives of this thesis are six fold;

2.6.3 Overall Objectives

1. To identify the major constructs of Total Quality Management (TQM) and refine the scales for measuring the constructs.

2. To review and evaluate validated Instruments used to measure Quality Management within the Manufacturing and services Industries.

3. To determine if they are any differences in quality management implementation and quality outcomes across UK Construction related SMEs and if so, how and why they differ.

4. To investigate the relationships among TQM practices and to identify the direct and indirect effects of TQM practices on the various dimensions of performance within the context of organisation size, age, union density and competitive environmental factors.

5. To identify the linkages between attainment of a sustainable competitive advantage and implementation of TQM.

6. To develop an operational framework of TQ-SMART that is theoretically grounded. Draw conclusions and empirically validate the model developed.

2.6.3.1 How the Objectives were developed:

Objectives 1 and *2* are concerned with the identification of major constructs of TQM and the review of validated instruments as used within the manufacturing and service industries. This is achieved through the first stage of the theory survey research process as illustrated in Figure 2.2 by linking to the theoretical level through the extensive literature review. Some of the existing studies and major instruments of quality management were stated in Chapter One.

Porter (1990) advocates that potential sources of competitive advantage are everywhere in a firm. Every department, facility, branch office and the organisational unit has a role that must be defined and understood. *Objective 5* is concerned with the identification of the linkages between the attainment of a competitive advantage and the implementation of TQM; this was achieved through an extensive literature review on strategic related issues. *Objective 2* of this thesis is primarily to establish the business forces necessary for the attainment of competitive advantage in UK construction related organisations. This was achieved by applying the Porter's competitive forces model. It is further acknowledged that organisations can achieve sustainable competitive advantage by the application of Porter's techniques. Porter's value chain model can be used to segregate a firm or an industry into strategically relevant components in order to understand the cost and existing potential sources of differentiation. A firm might therefore gain a sustainable competitive advantage by performing one or more of these strategically relevant components more cheaply or more efficiently than its competitors.

Powell (1995) developed a model designed to bridge the gap between manufacturing and non-manufacturing applications of quality improvement methods. This approach will be used for achieving *Objective 2* of this thesis. The model has been adapted to comply with the requirements of construction activities. Camp's (1989) generic benchmarking process will be adopted for fulfilling the impact of benchmarking on the implementation of TQM.

In order to assess the level of quality management initiatives within constructional organisations, the Powell (1995) instrument was used as a criterion to measure the critical success factors. This instrument was however refined in order to suit the construction setting. This forms the core of this thesis. This is necessary as organisations could be at various stages with respect to TQM deployment, and therefore their perceptions of the effectiveness of TQM may vary. In this thesis, the findings are on redeveloping and validating a short instrument to obtain an overall perspective on the level and quality of the UK construction related SMEs implementation of Quality Management, an idea referred to as the organisation's "QM Advancement"

This has been necessary as after reviewing the literature related to Quality Management; it became clear that most of the instruments developed for measuring Quality Management, critical success factors have been tailored for the manufacturing industry, particularly large organisations. Where studies have included both manufacturing and service industries, there is an obvious omission of construction industry with regards to service industry. Earlier instruments to measure service quality, in particular the seminal work of Parasuraman et al (1988) and the development of SERVQUAL, this was focussed in the four service industries of Credit Cards, Banking, Telephone Repair, and Maintenance. Furthermore this work has had its fair share of criticism, for example some of the dimensions in the SERVQUAL are not applicable to all service industries. The key dimensions of SERQUAL are tangibles, reliability, responsiveness, assurance and empathy. A brief comparison of the differences between the quality service and manufacturing goods are presented in Chapter five with a view of highlighting the omission of construction goods. As a consequence, many SMEs have experienced problems or difficulties in implementing TQM. In order to bridge a gap between the UK Construction SMEs and the service and manufacturing industries, the proposed model is aimed at bridging that gap and testing the advocated benefits and possibility of transferability as argued for in the literature.

Summary of the Relationship between TQM, Competitive Environment and Organisation Performance

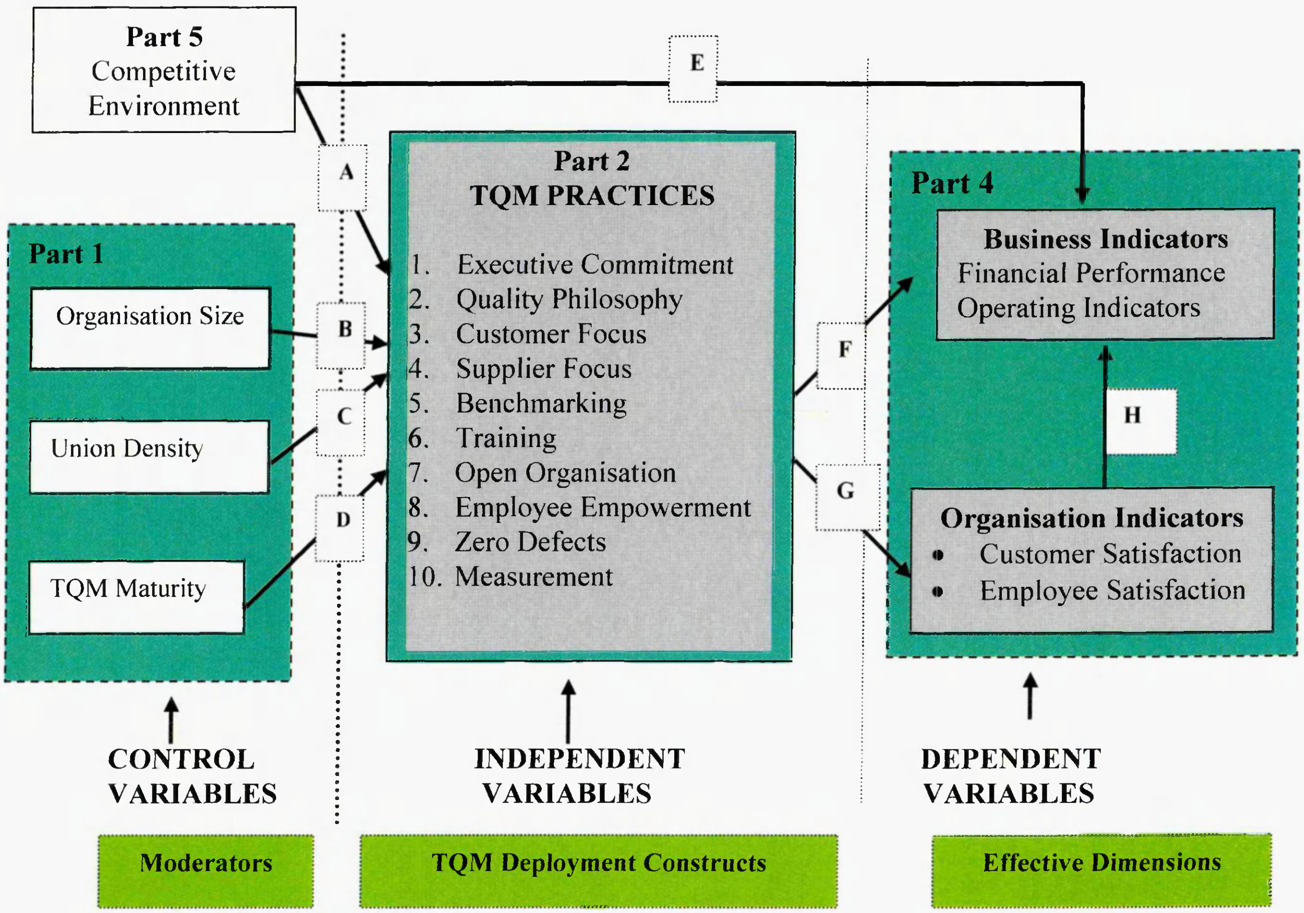

Figure 2.3 Relationship between the control, independent and dependent variables used in this study.
Source (Adapted from Harel and Tzafrir, 1999)

As stated by Forza (2002), there are six necessary steps in the theory-testing survey research process, the first step as illustrated in Figure 2.2 is the link to the theoretical level which includes the constructs and operational definitions.

The theoretical model representing the casual and spurious relationship between the control variables, independent and dependent variables. Fig 2.3 and its associated eight hypothesised paths (A $\rightarrow$ H) represent a theoretical conceptual model of the role of contingency factors and TQM practices on business and organisation performance. While the hypothesised model relationship is rooted in literature, the intensity of execution of various implementation constructs and the resulting business and organisation performance are contingent upon some organisation and industry characteristics (Ahire and Dreyfus, 2000). These are indicated in the model as control variables and are as follows; competitive environment, organisation size, union density, and TQM maturity.

A Research Framework illustrating the hypothesis and relevant variables
the control, independent and dependent variables are linked by a series of paths. These are explained below as follows;

Each path indicated in Figure 2.3 can be considered as a research question which can be examined through the series of models depicted as paths A to H.

Path **A** focus on the Impact of Environment Factors on the Implementation of TQM. This is covered in detail in Chapter four based and Porter (1980) framework and the results are discussed in Chapter Six.

Path **B** highlights the Impact of Organisation Size on the Implementation of TQM. This is discussed in full details in Chapter Six.

Path **C** highlights the Impact of Unions on the Implementation of TQM.

Path **D** highlights the Impact of TQM Maturity (Age) on the Implementation of TQM.

Path **E** discusses the Impact of Competitive Factors on The Organisation Performance of the UK Construction Related SMEs. In light, it can be established that Business and Organisational Performances are positively related to the fit between TQM content, business orientation and environmental uncertainty.

Path **F** and **G** explores the Impact of TQM Practices on the Organisation Performance which is made up of the Business and Organisation Indicators.

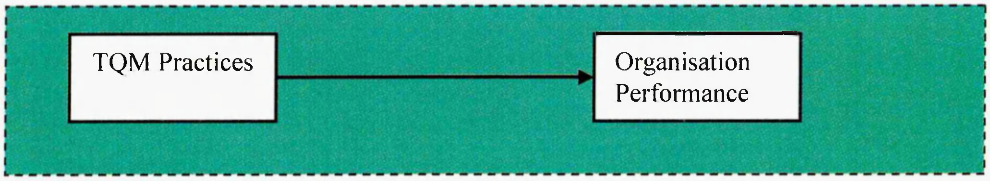

Figure 2.4: Direct Impact of TQM Practices on Organisation Performance

Path(s) A to G can be described as propositions which are later translated into hypotheses. This forms the basis of the first step as illustrated in Figure 2.2 in which the link to the theoretical level is established. The responses generated from the survey provided the data for answering the research questions addressed by this study which are

(1) What impact does the implementation of TQM practices in UK Construction related SMEs have on organisation performance?

(2) What insights can be gained regarding variable findings for quality management-organisation performance relationship?

Hence, the model illustrated in Fig. 2.4 proposes a direct relationship between implementation of TQM practices and organisation performance and is reflected in the following hypothesis;

H_1: Extent of TQM implementation in UK Construction related SMEs has a positive impact on organisation performance.

This forms the basis of Objective No. 4 which examines the role of Total Quality Management as a direct contributor to Organisation Performance. Consistent with Quality Management research, TQM is treated as a source of competitive advantage (Powell 1995; Reed et al. 1996).

Path **H** explores the relationship between the Business and Organisation Indicators.

This framework can be considered as the second phase of theory development as it involves the construction of a framework which defines and justifies the relation between the variables. It has been constructed and described so as to generate testable hypotheses. ($\mathbf{H_1}$ through $\mathbf{H_{14}}$). Hypotheses act as the vehicle by which the researcher discards old variables and relationships which have not been able to pass through the screen of falsifications and replaces them with new variables and relationships.

Using Meredith (1998) methodological applicability relative to number of units and dividing the factors of interest into three sets namely Parameters, Independent variables and Dependent variables as shown in Figure 2.3 will enable the conclusions to be drawn accurately.

Control Variables

Germain and Spears (1999) define the control variable as context which refers to factors, descriptive of the organisations environment and operations that are fixed or immutable in the short run. They provide size as an example where indicators would include number of employees, annual sales etc. The Research Framework shown in Figure 2.3 could be summarised as follows

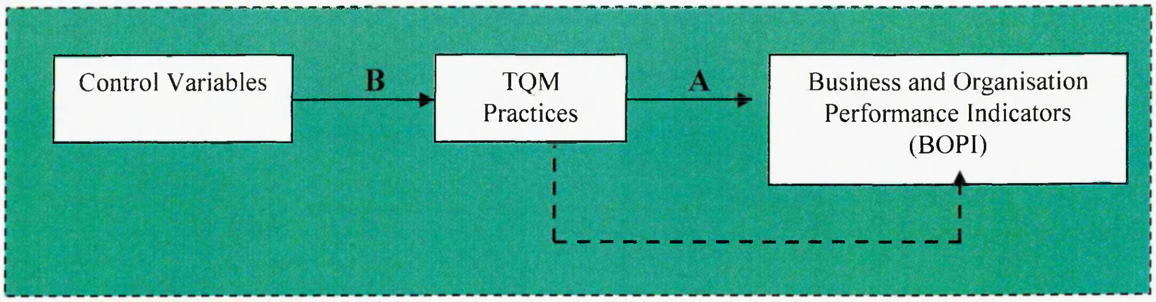

Figure 2.5 Condensed Research Framework (Adapted From Garvin 1994)

Figure 2.5 illustrates a mechanism in which the contributions of TQM to business and organisation performance are moderated by control variables. Three possible interpretations exist for the observed correlation between TQM practices and business and organisation performance.

Interpretation 1: TQM has a direct effect on BOP

Interpretation 2: BOP has a direct effect on TQM

Interpretation 3: Some other set of control variables has an effect on both TQM and BOP.

Using the approach of Germain and Spears (1999), the hypotheses are generated as follows

The effects of TQM practices on Organisation Performance (Path **A**) as seen in Figure 2.5, the elements of the ten latent dimensions of TQM that have been identified by literature review and refining of the Powell (1995) Instrument are modelled:

1. Executive Commitment (EC)
2. Quality Philosophy (QP)
3. Customer Focus (CF)
4. Supplier Focus (SF)
5. Benchmarking (BM)
6. Training (TR)
7. Open Organisation (OO)
8. Employee Empowerment (EE)
9. Zero Defects (ZD)
10. Measurement (ME)

8. Employee Empowerment (EE)
9. Zero Defects (ZD)
10. Measurement (ME)

The ten TQM practices can be defined as those activities performed to display and embody the principles of Quality Management. The Model shown in Figure 2.3 proposes that the Context or Control Variables of Size, Competitive Environment, TQM Maturity and Union Density predict TQM (Path **B**). Furthermore Fig 2.5 proposes that TQM practices transmit the effect of context/control variables to organisation performance. However, no direct relationship is proposed between the context and organisation performance. The generation of hypothesis helps satisfy one of the implications arising from the assumptions that underlie the positivism paradigm.

TQM and Environmental Uncertainty

According to Organization theory literature, how firms react with their environment is important for performance. Sitkin et al (1994) argue that TQM should include two goals namely: control and learning. They draw their basis on contingency theory. They describe the goal of control as that of focussing on improving repetitive activities, whereas learning focuses on new product and process innovations. Furthermore the primary objective would be to find the perfect fit. Reed et al (1996) suggest best fit for control where uncertainty is low and concentrating on learning where uncertainty is high. One of the questions asked in this study was the ability of organisations to reduce construction uncertainties, and secondly redefining market uncertainties.

Business Environment - Internal Environment Linkage

Industrial organisation (competitive environment) external variables influencing upon the internal environment linkage shown as Path **A** in Figure 2.3. The external business environment is considered through the external variables as the competitive forces (Porter, 1990) and this in turn links to the field of Industrial Organisation.

Internal Environment - Organisation Behaviour

Filippini (1997) recommends that research be developed within a broader perspective so as to take into account the multiplicity of variables that intervene in operations management. The following sub-section demonstrates how this study integrates with other disciplines, such as Organisation Behaviour, Service Marketing and Management, Human Resources (HRM), Business Policy and Strategy, and Mathematics and Statistics.

Linkages to Other Disciplines

This study demonstrates links to other disciplines. The second middle block in Figure 2.3 can be referred to as the Internal Environment of the UK Construction related SMEs. The ten TQM practices identified have links with the disciplines of Organisation Behaviour, Human Resources Management (HRM), Service Marketing and Management, Business Policy and Strategy, Economics and Mathematics / Statistics. These are elaborated upon in Chapter Six and forms the basis of the theory triangulation approach.

In order to address how the research contributes to the application and development of TQM, some factors that might impede the application of TQM are presented in the form of a conceptual framework shown in Figure 2.3 for the research. Although previous empirical work has shown the importance of various TQM dimension improving the business and organisation performance, this study takes a step further of how the other factors such as the competitive environment, organisation size, organisation age and union density might impact on the implementation process and affect the business and organisation performance. The external factors which are outside control of the organisation, are termed as control variables. The source of data for these control variables apart from the "competitive environment" can be found in part one of the survey document,. the competitive environment factor is the last Part 5 of the survey document. All the independent variables, designated as "TQM Practices" are in the second part of the questionnaire whereas the dependent variables are in Part four, titled "Measuring the success of TQM and Assessment of Organisational Performance". The only omission of the survey document from the Figure 2.3 is the advocated advantages associated with the implementation which is however covered in the overall conceptual framework for the study as shown in Figure 1.2 in Chapter One.

The arrows linking the control variable to the Independent and dependent variables, Independent variables to the dependent variables are the linkages which forms the basis of the hypothesis. Figure 2.3 is viewed as the holistic approach as some of the linkages can further be broken into a series of propositions of which are analysed in Chapters Six and Seven. For example, the entire Figure 2.3 can be viewed from the following objective:

"To ascertain the combined effect of the TQM practices on the performance of UK Constructional related SMEs within the context of organisation size, age, union density and sectors".

On the other hand, the linkages between the Independent and dependent variables would form the basis for the regression analysis and SEM. This will explore the impact of certain TQM practices on the performance outcomes.The combination of the Ten TQM practices forms the basis of Model 1 in the regression analysis as described in the original submission. This is improved upon by employing Structural Equation Modelling (SEM) techniques in order to ascertain the direct and indirect effects which cannot be done through simple regression analysis. Further analysis is undertaken by splitting the TQM practices into "Hard" or "Mechanistic" or also known as "Control" factors and "Soft" or "Organismic" also termed as "Learning" aspects. This generates two further models whose impacts on the organisation performance are examined. Finally the contribution of the refined model is examined in the light of its developments and contributions to the original aims. For example, Chapter Three presents the linkages between the noted areas for improvement in the Latham (1994) and Egan (1998 ; 2002) reports to the key research aim and objectives of this study.

One of the identified shortcomings in research on Quality Management is the lack of investigation into the interplay between the core and infrastructure constructs to the organisation performance. As these are known by different names, Table 2.1 provides the classification of the TQM deployment constructs into core and infrastructure for clarity.

Table 2.1 Classification of TQM Deployment Constructs into Core & Infrastructure

No.	CORE	INFRASTRUCTURE
1	Formal Tools	Behaviour Factors
2	Tangibles	Intangibles
3	Hard	Soft
4	Mechanistic / Process / Technical	Organismic (non-mechanistic / social behavioural)
5	Control	Learning

Based on empirical evidence of the relationship between QM practices and performance, various models as suggested by literature will be tested. For example the Powell (1995) suggested the following linkages

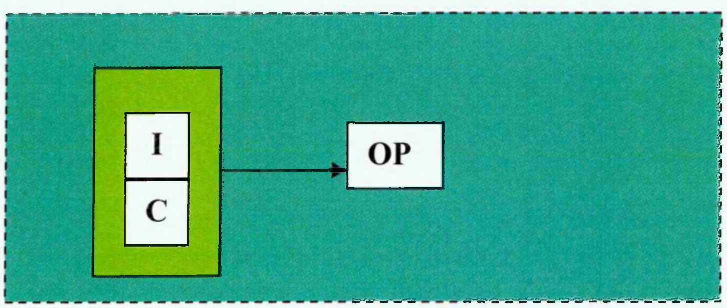

Figure 2.6 - Powell Linkages of Infrastructure (I) and Core activities (C) to Organisation Performance (OP).

However, there are different results obtained from researchers such as Flynn et al (1995); Samson and Terziovski (1999) and Dow et al (1999) concerning the above model. These authors are mentioned as their studies were based on the Powell (1995) Instrument. Through the usage of Structural Equation Modelling, the interplay between the core and infrastructure practices are investigated further and the results are presented in Chapters Six and Seven.

2.7 Reliability and Validity Issues in Quantitative Methods

One of the major problems with survey-based research is the issue of internal validity errors. Internal validity error addresses the question of whether differences in the dependent variables are indeed caused by the independent variables (Malholtra and Grover, 1998). According to Hubley and Zumbo (1996), it can be argued that of all concepts in testing and measurement, validity is the most basic and far-reaching; for without validity, a test, measure, or any inferences made from it are meaningless. Hickin (1997) posits that the greatest difficulty in conducting survey research is assuring the accuracy of measurement of the constructs under examination. According to Hickin (1997) many measures have acceptable levels of internal consistent reliability, yet may in fact lack content validity due to multi-dimensionality or inappropriate representation of the construct under examination.

Further TQM reliability measures that could be adopted include; Cronbach (1951) alpha coefficients, which will be computed to test the reliability of the TQM scales. Cronbach's alpha is a commonly used measure of reliability of a set of two or more construct indicators. However, depending on the usage of coefficient Cronbach alpha as a measure of reliability it has its own weaknesses (Spector, 1992). To overcome this, it is recommended that an additional method should be used. In this study the Kaiser-Meyer-Olkin (KMO), which is a measure of sampling adequacy was adopted. Reliability is a measure of internal consistency of the construct indicators, depicting the degree to which they indicate the common latent (unobserved) construct. There are three recognised methods for determining the reliability of a measure. All three are based on the assumption that high correlation between measures indicates reliability.

According to Nunnally (1967) there are four methods of reliability tests for survey studies: namely test and retest, the alternative method, the split-halves and the internal consistency. A brief description is given:-

The methods are:

1. Test and retest method
2. Parallel-form or alternate form method
3. The split half method
4. Inter-item or internal consistency method

These are now discussed as follows; the test and retest method entails administering the same test to the same subjects or processes after a uniform period of elapsed time. A TQM example would be measuring order processing time. Reliability is advocated if the two measures have a high positive correlation coefficient. The reliability index for this is the measure of stability.

The first three methods have major limitations such as, requiring two independent administration of an identical instrument on the same group of people or requiring two comparable sets of the measuring instrument. Cronbach's (1951) procedure involves obtaining a mean correlation for all possible ways of dividing the data in half. Coefficient alpha is the procedure recommended by most qualitative researchers. (Shepherd and Helms, 1995). The advantage of this method over the first three options is that it requires only one administration of a single measuring instrument. The reliability assessment to be adopted in this research will be Cronbach'sα Co-efficient. This is generally accepted as one of the most popular methods for assessing reliability (O'Leary-Kelly and Vokurka 1998). Qualitative measures are growing and becoming increasingly important to quality processes. TQM relies on qualitative measures such as, customer satisfaction, employee commitment, team performance, supplier co-operation, and an organisation's reputation. Valid measurement is the *sine qua non* of science (Shepherd and Helms, 1995). Without sound measurement techniques there is no science and possibly no concrete evidence of TQM success (Shepherd and Helms, 1995). A further description and the advantages and disadvantages of the methods are summarized in Table 2.2.

2.7.1 Validity of the TQM Measurement Instrument

Studies by Brah et al (2000; 2002) found that the success of a TQM program as measured by quality performance would lead to success in the two secondary measures of customer satisfaction and employee satisfaction. In respect of factor scores and Cronbach alpha for the following four dimensions of TQM Success and Organisational Performance was conducted:

- Financial performance (4)
- Employee Relations (4)
- Customer Satisfaction (3)
- Operating Indicators (3)

These are described in more detail under the section "Rationale for the Questionnaire" and in Chapter Six were the results are presented. Figure 2.7 below shows the steps in the validation process.

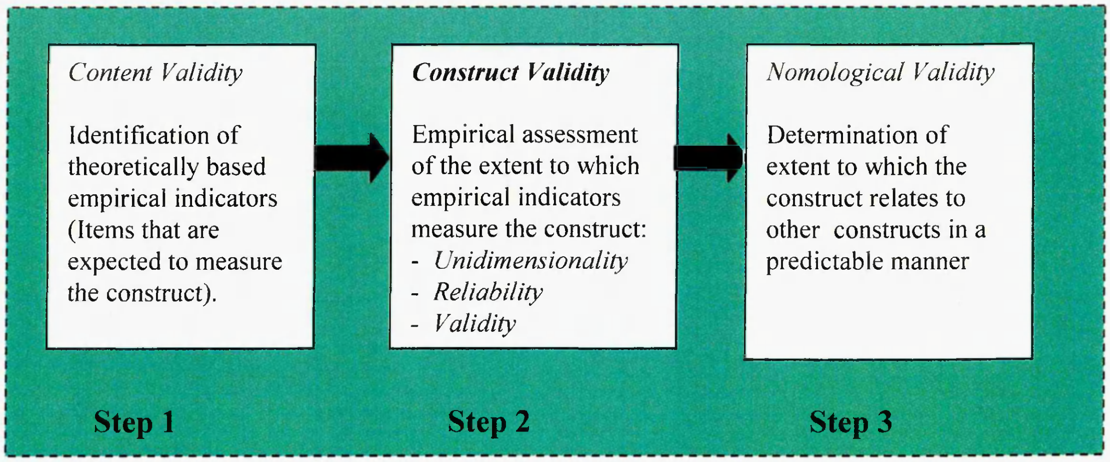

Figure 2.7: Construct Validation Process

(Source: Adapted from O'Leary-Kelly and Vokurka, 1998)

Construct validation can be described as a multifaceted process that is comprised of three basic steps outlined in the above Fig 2.7. (O'Leary-Kelly and Vokurka, 1998). The first step requires the identification of a group of measurement items (empirical indicators), which are thought to measure the construct. It is acknowledged that it is difficult if not impossible to measure constructs accurately or completely with single-item scales (Spector, 1992). On the other hand it can be said that validity is a unitary concept, whereas validation is an *ongoing process.* (Hubley and Zumbo, 1996).

2.7.2 Content Validity (or face validity)

Identification of theoretically based empirical indicators (items that are expected to measure the construct). This is also similar to face validity except that the researcher deliberately targets individuals acknowledged to be experts in the topic area to give their opinions on the validity of the measure. As this study did not develop any new measures or constructs, it was found to be inappropriate to conduct content validity. Definition according to Hickin (1997), content validity refers to the adequacy with which a measure assesses the domain of interest. Woon (2000) asserts that unlike the other validity analyses, content validity is not evaluated numerically; rather, it is subjectively judged by the researcher. As the instrument used for this study is based on a previously validated one (Powell, 1995), it can be said to have content validity.

2.7.3 Criterion Validity

Criterion-related validity pertains to a relationship between a measure and independent measure. In addition, the definition of Criterion-related validity taken from the research methods glossary is the requirement of the researcher to identify a relevant criterion or 'gold standard', which is reliable and valid, to provide an independent check of the new measure. Whereas internal consistency refers to the homogeneity of the items in the measure or the extent to which the items responses correlate with the total score. The ten constructs as measures of Quality Management initiatives in constructional related SME's would be deemed to have criterion-related validity if the measures were collectively, highly and positively associated with the level of implementation. Hensley (1999) defines criterion-related validity as a measure of the relationship between the scale and surrogate measure of the constructs. Various studies have used different organisation measures as surrogates. For example, Flynn et al (1994) picked two measures of quality: percent of product shipped without rework and the perception of the quality program's contribution to the plants distinctive contribution. Similarly this study has the following measures of organisation and business performance. Organisation performance measures relate to customer satisfaction and employee indicators such as overall satisfaction, customer complaints, whereas the employee indicators are based on the attendance, number of useful suggestions to mention a few. The business performance measures used are financial performance such as market share and sales per employee; whereas operating indicators are reliability and product lead time. Full descriptions of the measures are provided in Chapter 6 and the questionnaire document in the appendix A.

2.7.4 Construct Validity

Definition according to Hickin (1997), is that construct validity is concerned with the relationship of the measure to the underlying attributes it is attempting to assess. One major problem with the research process is that of ensuring the measurement of constructs is free of error. According to O'Leary-Kelly and Vokurka (1998), this omission leads to ignoring the many corrupting elements embedded in measures such as measurement error and informant bias, which could affect the conclusions drawn. Construct validity pertains to the degree to which the measure of a construct sufficiently measures the intended concept. This study considers the different components of construct validity - undimensionality, reliability, convergent and discriminate validity.

Construct validation can be described as a multifaceted process that is comprised of three basic steps outlined in Figure 2.7, (O'Leary-Kelly and Vokurka, 1998). The first step requires the identification of a group of measurement items (empirical indicators), which are thought to measure the construct. According to Rahman and Sohal (2002), one of the reasons for a thorough reliability and validity analysis on measuring instruments in empirical research, is it provides confidence that the empirical findings and accurately reflect the proposed constructs. Factor analysis, internal consistency, and test-retest reliability provide evidence of construct validity.

Previous studies in scale construction and reliability by early pioneers in development of Quality Management constructs such as Saraph et al 1989; and Sakakibara et al (1993), Flynn et al (1994, 1995) omitted to carry out a check on the undimensionality of scale. The same studies including Ward et al (1994) did not even compare oblique to orthogonal rotation.

2.7.5 Four Components of Errors

It is acknowledged that in translating latent constructs such as Executive Commitment, adopting the Quality Philosophy to measurable variables or manifest variables, a number of sources of error can be introduced. These errors are measurement, sampling, internal validity and statistical in nature. Subsequent chapters explore them in greater detail. It is proposed to minimise the four types of error.

The advantages and disadvantages of different reliability methods can be summarised as below (Table 2.2)

Table 2.2: Summary of Reliability Methods

Reliability Method	Assumptions	Advantages	Disadvantages
Test-retest: involves measuring a variable at two points in time (t and t+1) using the same scale and sample	Variables are stable Measures are parallel	Appropriate for measures comprised of single indicators	Not appropriate for variables that are not stable over time Perceptual based measures susceptible to carryover effects Cost of administering two surveys can be prohibitive
Alternative forms: involves measuring a variable at time (t) using one measure and again at time (t+1) using a different measure. Both utilise the same sample	Variables are stable over time Measures are parallel	Appropriate for measure comprised of single indicators Less susceptible to carryover effects than Test-retest method	Not appropriate for variables that are not stable over time Cost of administering two surveys can be prohibitive. Require development of two unique measures
Cronbach's α: involves deriving an index, which ranges from 0 to 1, based on the correlation's of the indicator that comprise the measure	Measures are τ-equivalent Measures are comprised of multiple indicators	Assumptions of τ-equivalent measures is a less restrictive assumption than parallel measure Requires only a single sample Virtually no chance of carryover effects Reliability of a measure may be improved by increasing the number of indicators	Underestimates reliability of measures that are not τ-equivalent Require multiple indicators for a measure

2.7. 6 Convergent and discriminant Validity

Test scores should not only relate strongly and positively with behaviours or other variables which theory predicts it should, but also negatively with variables theory hold that it should not discriminate.

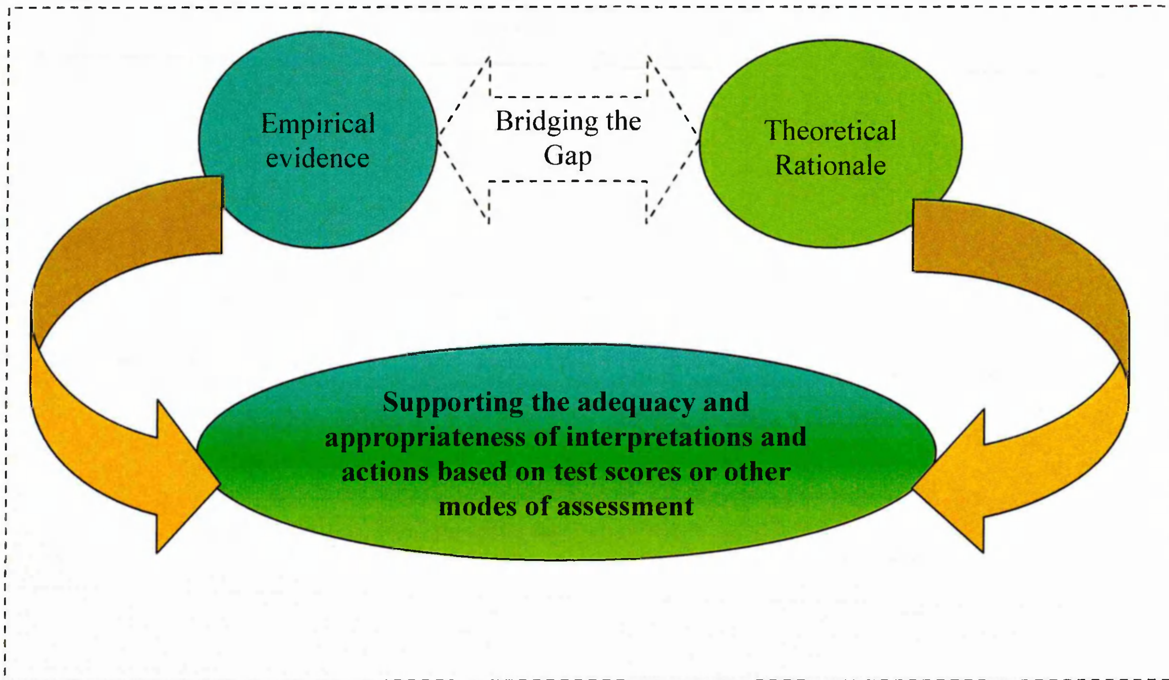

Figure 2.8: Definition of Validity

(Author's interpretation from Messick's (1980) definition)

Churchill (1979) and Spector (1992) state that convergent validity is shown when different measures of the same construct have high correlations. Discriminant validity achieves the opposite; accordingly if a construct has discrimant validity, scales measuring different constructs should have low correlation. Other methods used are a subjective method involving the use of correlation matrix and structural equation modelling. Convergent and discriminant validity are both considered to be subcategories or subtypes of construct validity. It is further suggested that demonstration of evidence for both convergent and discriminant validity is sufficient evidence for establishing construct validity. The results of the convergent and discriminant analysis are detailed in Chapter Six.

2.8 Data Collection Method

This study adopts a triangulation methodology involving both a qualitative and quantitative approach. As noted from the research methodological model, the following methods will be used for data collection. The choice of data collection is governed by Malhotra and Grover (1998) who purport that survey designs with questionnaires are the most commonly used methodology in empirical Production and Operations Management (POM) research. One of the requirements of a PhD is theory building; survey research contributes to this with an ultimate aim that is to contribute to theory development.

- Survey methodology with survey tools of questionnaires
- Semi- Structured Interviews and Case Study.

2.8.1 Literature Review

The purpose of the literature review is to compare various insights from authorities on the writings of TQM, service Quality Management, measuring instruments and competitive advantage, to develop a contingency model of assessing the levels of the quality initiatives and dimensions of competitive advantage. The literature also identified methodological problems, which are associated with previous studies into the relationship between TQM, Performance and Competitive advantage. Some of these are:

- Not controlling for industry factors - According to Handfield and Melnyk (1998), this has to be considered when setting boundary assumptions on observations as it leads to a biased sample, which affects the way observations are interpreted and affects therefore parameter estimation.

- Exclusion of non-TQM firms in the research - This inevitably leads to sampling error, as one of the most critical elements of the sampling procedure is the sample frame used to represent the population of interest. (Malhotra and Grover 1998).

- Studies conducted by parties with vested interests in their outcomes that did not conform with generally-accepted standards of methodological rigor;

- Exclusion of medium sized or small sized firms - where research conducted included SMEs, it found that the implementation of BS EN ISO 9000:2000 series improved the management operations of organisations, (Rayner and Porter, 1991). The limitation was that there was no evidence to suggest that BS EN ISO 9000 series could be used as a vehicle for the attainment of TQM.

- **Not tracking the performance of comparable non-TQM firms over the same time period.**

According to Ahire et al (1996b), existing TQM literature did not provide a detailed comparison of the various element of quality strategies implemented in TQM and non-TQM firms. This study redresses this imbalance by examining quality initiatives deployed in both TQM and non-TQM organisations.

Choi and Eboch (1998) conducted studies in relations among TQM practices, plant performance, and customer satisfaction. It was found that the implementation of TQM practices in manufacturing plants have been geared more for customer satisfaction than for plant performance.

- **Studies and claims based on personal experience and anecdotal evidence**

Lemak and Reed (2000) argue that much of what has been written about TQM in the service sector remains anecdotal and prescriptive. Thiagaragan et al (2001) lends further support by stating that literature is full of "everything you need to know about TQM implementation". Most of the information is based on personal experience and anecdotal evidence. As Lemak and Reed (2000) pointed out, the lack of theoretical grounding that has plagued the TQM literature, though being rectified, is still evident in TQM service literature. This is supported by Ghobadian and Gallear (2001) who state that the process of implementing TQM continues to be largely directed by anecdotal evidence or prescription rather than empirical data.

- **Determination of Validity using a single method**

  One of the shortcomings of many measures used in operations management has been the acceptance of validity determined by using a single method. (Boyer and Pagell, 2000).

- **Omission of Time Lag Effects**

  Reed et al (1996); Powell (1995), Hackman and Wageman (1995), Taylor and Wright (2003), Hendricks and Singhal (2001). This leads to difficulties in ascertaining the time between implementation and actual benefits.

- **Impact of Contextual Factors such as Organisation Size on TQM**

  Implementation. Ghobadian and Gallear (1997); Taylor and Wright (2003); Brah et al (2002), and Powell (1995).

2.8.2 Questionnaire and Field Research

The questionnaire was designed and administered under guidelines established in Wilson and McCleans's Questionnaire design: a practical introduction (1994) and Youngman's (1978) designing and analysing questionnaire. The questionnaire was pre-tested by sending it to randomly selected UK construction organisations.

Based on the feedback, the questionnaire was modified. The rationale for having a random sample would be to ensure that all organisations within the UK construction industry have an equal chance of selection. Piloting is necessary as it is very difficult to predict how respondents will interpret and react to questions (Gill and Johnson 1991). Another reason for piloting would be to estimate the probable numbers of refusals and non-contacts and then compare the effectiveness of various ways of reducing non-responses. (Moser and Kalton, 1979)

Even though the data collected from the questionnaire would not be more accurate as respondents could give false information. According to Hensley (1999), there is no perfect accuracy in statistical data; the data collected from the questionnaire would not be more accurate as respondents could give false information.

In designing and managing the questionnaire, careful consideration was given to the following questions and factors:

- **Geographical Dispersion**

To which areas would the questionnaires be sent and for what reasons for the limitations? In order to overcome methodological problems associated with surveys, Moser and Kalton (1979) reported that the first step is to define the population. For this research project the geographical delineation of the target population comprises England and Scotland. Though the research title refers to the U.K Construction Industry, areas which are thinly populated in terms of construction organisations have been excluded from this research and emphasis placed on small and medium sized organisations.

- **TQM Respondents**

An additional methodological shortcoming of the existing TQM and performance measurement construct involves the choice of which respondent should answer the questions. It is recommended to employ multiple respondents at multiple levels to obtain a more holistic representation of the organisation's performance measurements (Boyer and McDermott, 1999). Therefore the following questions were posed, "Is there any particular person in the host organisation to be addressed?" and "to whom would the pilot questionnaire be sent?" These questions raise the issue of whether the respondent would possess the required information and knowledge. Moser and Kalton (1979) described one of the six primary conditions for postal questionnaire as that of the researcher not being sure that the right person completes the questionnaire.

This problem is overcome in the questionnaire design by asking the respondent to state their job title, thereby indicating the nature of views provided and credibility and authority of those views (Fellows and Liu, 1997). The questionnaires in the research projects were addressed to the Quality Manager. However, relying on the Quality Manager could affect the response as previous studies conducted in the areas of Operations Management showed that the informant's position within an organisation can systematically affect his responses, thereby creating biased measures (Kumar et al, 1993). However as Boyer and Pagell (2000) argue, though single respondent studies run a significant risk of bias, it is suggested that higher ranking managers have more accurate perceptions which may be true for strategy and performance related studies.

- **Response Rate**

For any research, it is recommended that the response rate should be reported to indicate the extent of the sample frame polled. What then should be the acceptable response rate? Also, what should be the appropriate mechanism for managing the questionnaires? According to Moser and Kalton (1979), the probable numbers of refusals and non-contacts can be roughly estimated from the pilot survey and the effectiveness of various ways of reducing non-responses can be compared. It is generally acknowledged that the main problem with mail surveys is that of getting an adequate response rate. Moser and Kalton (1979) identified among the factors influencing the response rate as that of its sponsorship, population and subject matter. Depending on the nature of research, response rates may vary. However for survey-based research, a 20% response rate is acceptable. (Malhotra and Grover, 1998). Based on Frolich (2002), the following techniques were adopted to improve the response rate: existing scales, results, pre-notice and multiple mailings.

- **Patterned Response Bias**

One major drawback with survey-based research is the danger of respondents to answering all items with the same response. Grandzol and Gershon (1998) suggest reversing the meaning of responses. Hensley(1999) concurs that reversing the direction or meaning of responses is an appropriate tool to control this error. However, none of the items in this study, in particular part two of the questionnaire, were reversed. i.e. (1 = highly advanced and 5 = least advanced). The rationale for focussing on the second part is because it is the only section with the majority of multiple responses i.e. thirtyfour in total. Furthermore the rationale was concerned with the critical factors for TQM implementation.

Even though these responses can then be recorded and later reversed prior to analysis, this method of reverse scoring has its own advantages and disadvantages which are further explored in the final design (sub section 2.7.6 of this Chapter). Instead of adopting the reverse score method, other mechanisms can be used. One of the appropriate tools is to include a control mechanism in the questionnaire. This was achieved by asking the respondents to state their position (Question 1 "Designation of Respondent", Part 1) and state the length of service in the organisation (Question 2, "Number of years respondent has been employed by the organisation" Part 1). According to Fellows and Liu (1997), this mechanism indicates the nature of view provided and the credibility and authority of those views.

2.8.2.1 Survey Document

The questionnaire was separated into five parts:

- **Part 1:** Organisations Characteristics - (For example size, number of employees, years in operation);

- **Part 2:** The identification of critical success factors appertaining to the implementation of TQM. (Powell , 1995);

- **Part 3:** The identification of advocated advantages associated with the implementation process;

- **Part 4:** Measuring the success of TQM and Assessment of Organisational Performance (Based on Usilaner and Dulworth, 1992);

- **Part 5:** Assessment of Competitive Environment (Based on Lau, 1996)

The following sub-section presents a brief description and rationale behind the questions:

Part 1: Organisations Characteristics

In Part one, the questions posed was: "How many employees does your organisation have in the UK? This was necessary in order to identify that only the representative sample took part in the research. According to Ahire (1996b), it is critical to identify the cut-off, which could distinguish small, medium and large firms from a "Quality Management" standpoint. From the UK perspective, the Statistical Bulletin Small and Medium Enterprises (SME) Statistics classifies them as having less than 500 employees. Another classification is small defined up to 50 employees, medium (50 to 249) and large as 250 or more employees. (Source – Statistical Press Release – dti P/99/662) available online http://www.dti.gov.uk/SME4/pn993.htm for statistical purposes. The Department of Trade and Industry (DTI) usually use the following definitions:

- micro firm: 0 - 9 employees
- Small firm: 0 - 49 employees (includes micro)
- Medium firm: 50 - 249 employees
- Large firm: over 250 employees

Employee relations can equally affect the implementation of TQM. Literature review showed that organisations with trade unions had a major impact on the internal culture of a firm. For example a unionised work force can limit the effectiveness of such TQM elements as flexible work assignment, merit based promotion rules and formal performance appraisals (Kochan et al, 1986). In order to address this aspect the following question was posed: "Is your organisation unionised?". The frequency of the responses are reported in Chapter Six.

Part 2: The identification of critical success factors appertaining to the implementation of TQM (Powell, 1995);

The first linking to the theoretical level is concerned with the operational definitions of the constructs. As this study did not aim to create new critical success factors, existing bodies of research have covered this area to a greater depth. The definitions of constructs provided is designed to meet the requirements of the UK Construction Industry as envisaged in the Latham and Egan Reports. The operationalisation is covered in depth for the constructs in the Chapter Three and the justification for the selection of the Powell (1995) instrument is provided for in Chapter Five. The ten constructs used in this study are as follows; Executive Commitment, Adopting the Quality Philosophy, Customer Focus, Supplier Focus, Benchmarking, Training, Open Organisation, Employee Empowerment, Zero Defects and Measurement.

Table 2.3: Operationalisation of TQM Implementation Constructs

TQM Constructs	Definition
1. Executive Commitment	A near-evangelical, unwavering, long-term commitment by top managers to the philosophy, usually under a name something like Total Quality
2. Adopting the Philosophy	using tools like the mission statement, and themes and slogans.
3. Customer Focus	determining customers (both inside and outside the firm) requirements, and then meeting those requirements no matter what it takes.
4. Supplier Focus	working closely and cooperatively with suppliers (often sole-sourcing key components) ensuring they provide inputs that conform to customers end-use requirements.
5. Benchmarking	researching and observing best competitive practices.
6. Training	usually includes TQM principles, team skills, and problem solving.
7. Open Organisation	lean staff, empowered work teams, open horizontal communications, and a relaxation of traditional hierarchy
8. Employee Empowerment	increased employee involvement in design and planning, and greater autonomy in decision-making.
9. Zero Defects	a system in place to stop defects as they occur, rather than through inspection and rework.
10. Measurement	goal-orientation and zeal for data, with constant performance measurement, often using statistical methods.

Source (Powell, 1995)

The above table provides the definitions of the constructs as employed in this study.

Part 3: The Identification of advocated advantages associated with the implementation process:

Literature Review identified several advocated benefits of TQM. Therefore, this study drew on that information and used only seven of the main advocated benefits, and sought the views of SME's as whether implementation of TQM did result in the following improvements or reduction where applicable;

- Sustainable Competitive Advantage
- Improved the Effectiveness and Efficiency
- Improved Understanding of Customer Needs
- Improved Internal Communication
- Resulted in Fewer Errors
- Reduced Material Waste
- Resulted in Stronger More Beneficial Relationships With Suppliers

The results of the findings are explained and discussed in detail in Chapter Six.

Part 4: Measuring the success of TQM/Assessment of Performance (Based on Usilaner and Dulworth, 1992)

(i) Financial performance indicators: The following indicators were employed: market share, sales per employee, return on assets, return on sales profitability, internal and external efficiency, in order to determine whether organisations with TQM perform better than those without. The most popular indicators of marketing effectiveness and competitiveness are market share and profitability (Day and Wensley, 1988). However Bounds et al. (1994) disagree "Likewise, market share reveals little about how and why customers are delighted or dissatisfied. To evaluate performance against customer expectations, managers must use direct measures from the market. "

(ii) Employee relation's indicators: Employee satisfaction, attendance, number of suggestions received and turnover: As stated by Brah et al (2002), employee satisfaction is the second of the secondary measures which are based on the principle that success is achieved through people, and not through the use of systems, no matter how good they are. Although this study adopted only four business indicators, these are not mutually exclusive as other performance measures exist such as supplier performance, product and service quality. Brah et al (2002) used six performance measures because some were manufacturing oriented.

(iii) Customer satisfaction indicators: Overall satisfaction, customer complaints, and customer retention. Companies may enjoy higher customer satisfaction by using TQM concepts, but the question is how much they are willing to pay for this result, and whether it is worth the effort. (Sigouras, 1994). Customer satisfaction can be considered as a measure of a business performance. Consistent positivity here would indicate a degree of confidence in sustainable competitive advantage (Robson et al 2002). Other measures of customer satisfaction found in literature are those of Waterhouse and McCabe (1999) who conceptualised the measurement of customer care as having the following four dimensions: understanding your client, measuring and improving client care, client care communication, and client care performance. However, though the studies were focussed on SMEs, they only considered the Surveying practices in the West Midlands. According to Felikova (2004), achieving customer satisfaction is the main goal of business. The strong relationship between the TQM practices, customer satisfaction and profitability are highlighted in Figure 2.3 through the following path analytic links G → H. This modified version is illustrated as follows;

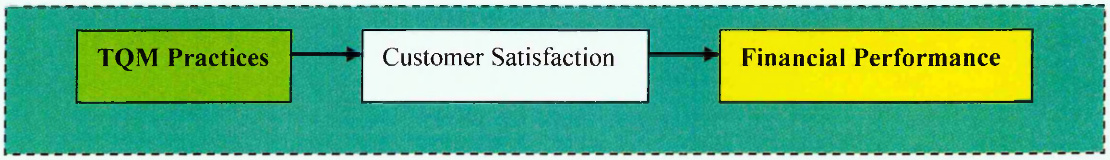

Figure 2.9: Linkages between TQM Practices, Customer Satisfaction and Financial Performance

(iv) Operating indicators: Reliability, timeliness of delivery, order processing time, errors or defects, product lead-time, inventory turnover, cost of quality and cost savings.

Part 5: Assessment of Competitive Environment, Based on Lau (1996)

Not controlling for industry factors has been acknowledged as one of the major omissions in exploratory research. In order to assess the impact of TQM on the organisation in terms of Industry and Firm levels, this study adopted the theory based on Porter's (1990) work and sought the effects of the five competitive forces. This is covered in greater depth in Chapter Four "TQM as Potential for Competitive Advantage". Caution is exercised, as the effects of TQM age should be taken into consideration when assessing the perceived impact of TQM Implementation on the Environment.

Identification of potential sources of competitive advantage: - Is it only systems, people or work processes that contribute to competitive advantage? This objective is achieved through an exhaustive literature review and the empirical studies based on the theory that the implementation of TQM leads to an improved organisation performance. The improvement in itself can be regarded as a source of potential sustainable competitive advantage.

2.8.2.2 In-depth Interviews

Interviewing as a form of data collection, used to overcome the noted disadvantages of mail questionnaire. Interviews lasted approximately 90 minutes and followed a standardised format. After a brief description of the research project, each manager was asked a series of open-ended discussion questions relating to their understanding of the quality concept, the link between implementation of TQM, service quality and the attainment of a competitive advantage.

2.8.3 Case Studies

The argument for case studies has been championed by several authors. Boyer and Pagell (2000) identified four primary areas where deficiencies exist. One of them is concerned with a need for greater variance in the methods used to develop and validate measures. In additional to simply using mail surveys, finer grained methodologies such as case studies are proposed.

This research adopts the case study approach for the very reasons put forward and evidenced in literature. Following the parameters set by Malhotra and Grover (1998), the following questions were addressed;

- What would constitute the study?
- Would smaller and medium sized organisations be included, or would it be restricted to large organisations?
- How many stated organisations to be considered?

This method of data collection encourages in-depth investigation of particular instances within the research subject. (Fellows and Liu, 1997). Case studies can incorporate several different methods, including participant observation, structured or unstructured interview and examination of documentary materials. Though having its benefits, Simon et al (1996) identified the following weaknesses:

- Case studies are largely descriptive
- Usually only tell about positive aspects;
- Generally do not seek to analyse issues

Sohal et al (1996) have highlighted a number of difficulties associated with case study research; a few are mentioned below;

- Research "purists" or quantitative advocates tend to see case studies as lacking academic rigor.

- An obvious difficulty is the labour-intensive nature of such research. Processing interview transcripts can be a laborious task.

- Conclusions may be statistically limited in that often only a handful of cases are used to generalise about certain research questions.

Among the advocated key benefits of case study research as shown by Simon al (1996) are as follows:-

- Collaborative research either on a national or international scale can offer rich insights into similar issues and themes in different geographical, social, political and other contexts. Collaboration also reduces the time consuming problem normally associated with case studies.

- Case studies provide a wealth of examples and stories for use in teaching and training courses on TQM.

- Cases permit multiple sources of information and materials.

- One or several cases can lead to a range of further research needs to be identified. In this particular case, issues relating to the impact of TQM on competitive advantage for Small/Medium sized Constructional related organisations could emerge.

- The findings of case study research tend to be widely accepted by industry. This may be related to individual curiosity about what others have done. The style of writing is often more readable than is the case with quantitative research.

- Case research enables varying perspectives from a range of organisational personnel on selected research focuses to be developed. Questionnaires usually reach one person, whereas an extensive case study programme can involve many interviews with a cross-section of people.

Dwyer (2000) presents a clear reason for the usage of case studies as most studies have assumed all Quality Management initiatives to be Total Quality Management, and research has been conducted using predominantly quantitative research methods. By comparing the four organisations, the meaning and reality of the quality phenomenon would be explained.

Rationale

According to Moser and Kalton (1979), the probable numbers of refusals and non-contacts can be roughly estimated from the pilot survey and the effectiveness of various ways of reducing non-response can be compared. It is generally acknowledged that the main problem with mail surveys, is getting an adequate response rate. Fellows and Liu (1997) collaborate further by stating that for a given sample size of responses required, particular consideration must be given to the response (i.e. the percentage of subjects who respond) and number of responses obtained.

The following approach is adopted:

Determine the sample size and decide on appropriate procedures to be followed to assist in securing the matching of responses to the sample selected. Ehrenberg (1981) defines a sample as a selection of objects or measurements taken from a specific *population* of such items. The aim being to obtain results from a sample to tell us more or less what we would have found by measuring the whole population. However, in selecting the sample, problems arise such as sample bias. It was decided from the onset to be very critical with the information obtained through the literature review by challenging and interrogating the information.

2.8.4 A General Model

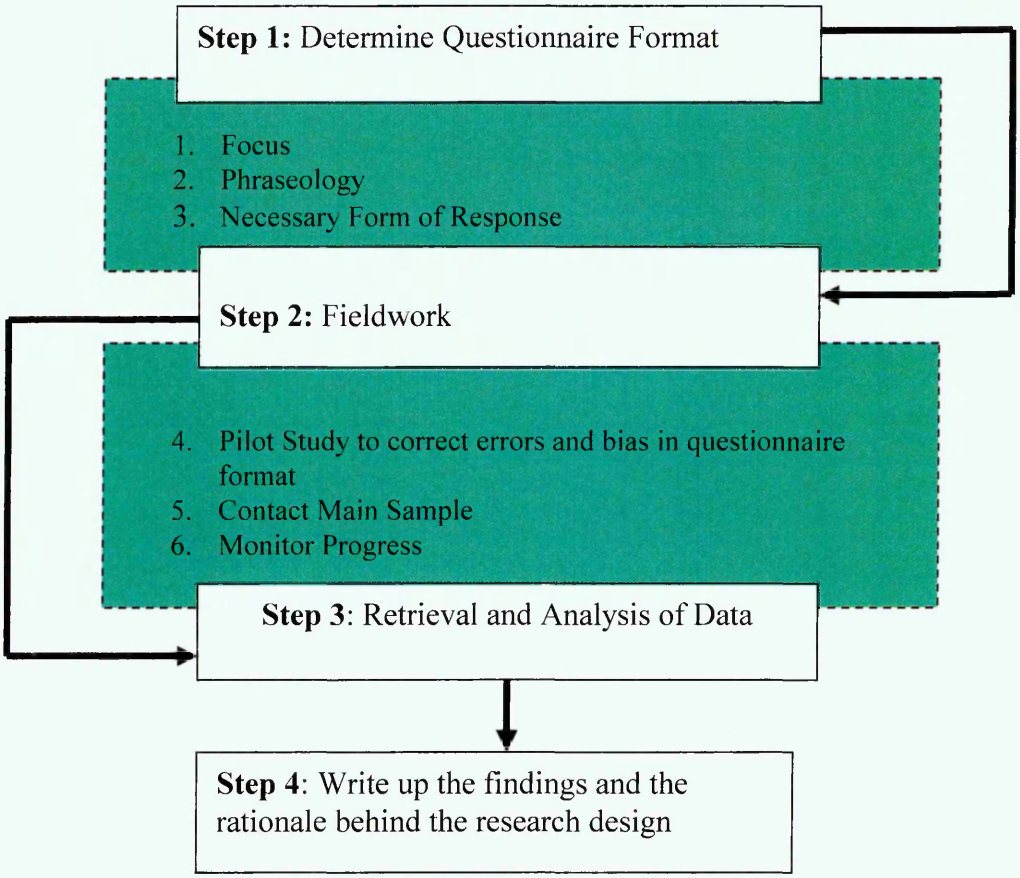

Figure 2.10: Model for the questionnaire format

Source: Gill and Johnson (1991.85)

2.8.5 Pilot Survey

For the purposes of pilot testing the questionnaire, small samples from the constructional related SME's were chosen from the sample of organisations that were willing to take part in the survey. The total number of respondents in the pilot was 30. According to Hensley (1999), pre-testing the survey provides helpful information not only on content and use of terminology but on clarity and understanding of wording. Furthermore, careful pre-testing of instruments in the field can serve as a reality check, indicating to the researcher how well conceptualisations of the problem match the actual experience of the practitioner. (Malhotra and Grover, 1998). Another reason for conducting pilot studies according to Verma and Goodale (1995) is the usage of its results which can be used to calculate the sample size required to get a reasonable power level in full-scale empirical studies.

2.8.6 Final Design

Based on Hensley's (1999) recommendations, additional considerations related to questionnaire composition were included. These relate to:

(i) The length of the questionnaire and its impact on the response rate. The questionnaire was limited to seven pages with a section for further contacts placed at the end.

(ii) The number of points on the Likert scale should be considered carefully. As reported by Lissitz and Green (1975) cited by Hensley (1999), reliability increases as the number of scale points increases to five and continues to increase at a much smaller rate for additional points above five. This study opted to retain the five-scale approach.

(iii)The usage of reverse-scored items approach. Despite the recommendations of some researchers like Spector (1992) reversed scored items were kept out of the questionnaire as previous research indicates that respondents would complain if such items resulted in negative descriptions of their business operations. Other researchers as identified in Hensley (1999) have argued that the validity may be lowered and the possibility of systematic error may be increased if reverse-scored items are used

2.8.7 Sample Selection & Mailing

The research methodology was centred upon a review of literature, interviews and 350 postal questionnaires administered to Chief Executive Officers (CEOs), Owners, Managers, and Quality Managers in small and medium, Organisations within the UK Construction Industry.
An element of the list of small and medium sized organisations was obtained and managed from the Financial Analysis Made Easy (FAME) database within the School of Environment and Development.

2.8.8 Triangulation

Triangulation is used in this study in order to achieve validation and completeness of results (complementary). Chapter Six elaborates how the analysis of the quantitative study and the qualitative study can be combined to obtain a broader picture of the application of the TQM deployment constructs. Two of the four types of triangulation as advocated by Denzin (1989) and also used by Love et al (2002), are applied. These are as follows;

- Methodological triangulation
- Inter-disciplinary triangulation

A brief description of each method is explained below in sub sections 2.8.8.1 and 2.8.8.2. A detailed analysis of the application is presented in Chapter Six.

2.8.8.1 Methodological Triangulation

Methodological triangulation, where multiple methods of data collection and analysis are used; and

2.8.8.2 Inter-Displicnary Triangulation

Where the research process is informed not only for example by psychology, but also by other disciplines such as economics, law and sociology - This requires the testing of developed theories against the same body of objective data.

2.9 Data Analysis

Data analysis can be in two phases: preliminary data analysis and hypothesis testing. According to Forza (2002), the following preliminary data analysis is necessary to acquire knowledge of the characteristics and properties of the collected data: checking of central tendencies, dispersions, frequency distributions and correlations.

2.9.1 Missing Data

It is acknowledged by various researchers that missing and incomplete data of TQM implementation studies could lead to wrong conclusions being drawn. Missing data is normally of two types, one called item non-response, where a question is left unanswered, and unit non-response, where the whole questionnaire is omitted. The first type was resolved by a commonly used method known as 'simple mean imputation'. Alternatively, the approach would be to exclude the data, though this approach could be misleading. Where a value for a sliding scale was missing, the 'median' for that particular question was included. The median was used for a number of different reasons. Firstly, the rest of the questions were all whole numbers and to include the 'mean' would have moved away from this. Secondly, a number of questions were skewed (see the results of the descriptive statistics in the appendix D), with a number of outlying responses lowering the mean. Therefore the median value can be seen to give a more accurate picture of what the average respondent thought.

2.9.2 Descriptive Statistics Using SPSS

Descriptive statistical analysis comprised calculation of mean scores, standard deviation, the mode, and the range. The mean score was used as a basis for analysing where differences lie, when significant results are found between the TQM and Non-TQM deploying organisations. However, the type of statistical test applied is dependant on whether the data was parametric or non parametric, therefore, the following conditions as suggested by Bryman and Cramer (1997) were tested.

- The level or scale of measurement should be on interval or ratio.
- The distribution of the population scores normal.
- The variances of variables in comparison groups or samples are homogeneous.

For the perceived TQM Impact (Objective 4) on organisation and business performance, Structural Equation Modelling and Multivariate Analysis of Variances (MANOVA) was conducted. Gill & Johnson (1991) define multivariate analysis as a generic term for the use of various statistical procedures to indicate the amount of variance in the dependent variable, which can be attributed to the action of each independent and extraneous variable. The responses to the questionnaire were scientifically analysed and statistically validated. Using factor and cluster analysis, the identified and proposed critical factors of TQM were used to provide common dimensions for classifying the components of TQM. Statistical software packages used include SPSS and AMOS. Other methods utilised include that of transposition scale of aggregate survey (Holt, 1996), in order to measure the respondent's strength of agreement and level of significance. This relates to responses for questions based on the Likert Scale. The rating of assignment scores will be on a 1-5 Scale. (1 = strongly agree, 3 = neutral and 5 = strongly disagree)

2.9.3 Structural Equation Modelling (SEM)

Path Analysis is used in this study in order to establish the effects of the paths in Figure 2.3. Furthermore, it is acknowledged as one method that can be employed in Structural Equation Modelling (SEM) in order to estimate the strength of each construct. Malhotra and Glover (1998) suggest that in order to enhance the internal validity of any model, usage of Structural Equation Modelling or any other path analytical approaches in order to test causality and concurrent relationships among the multiple variables helps achieve that goal. Chen (2001) provides further support for usage of SEM in that it helps to examine a series of dependence relationships simultaneously thus helping to address complicated managerial and behavioural issues.

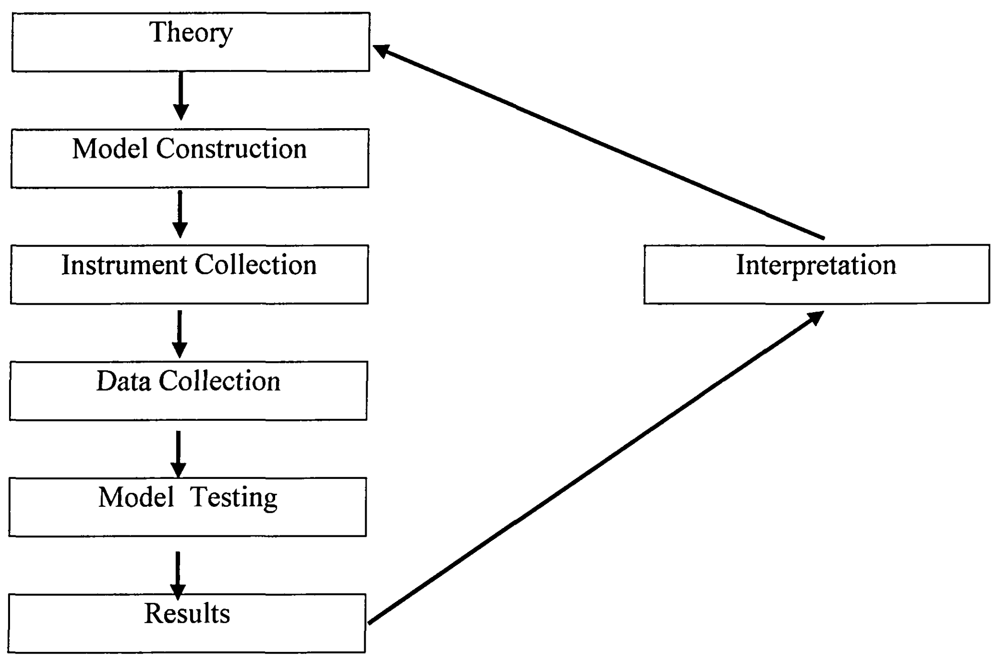

Figure 2.11: Basic approach to performing a SEM analysis

Usage of SEM further allows for testing the overall fit of the model i.e. how well all the indicators of all the constructs, taken simultaneously, satisfy the criterion validity requirement (Grandzol and Gershon, 1998). The basic approach undertaken to perform a SEM analysis is illustrated in Figure 2.11. The rationale behind Figure 2.11 is that the Researcher first specifies a model based on theory, and then determines how to measure the constructs, collects data, and then inputs data into the SEM software. The package fits the data to the specified model and produces the results, which include overall model fit statistics and parameter estimates. This procedure is utilised and elaborated in Chapter Seven.

Furthermore, SEM techniques allow the specification of models that describe relationships between latent variables, which are employed in an investigation. These techniques allow testing of measurement models between latent variables, which are the constructs that are represented by the researcher's measures, and their measurement, or manifest variables. Bozionelos (2003) describes casual path modelling as being based on the utilization of data analytic techniques such as Regression Analysis and Structural Equation Modelling (SEM) which makes use of quantitative data. Therefore, SEM is a generic term to signify techniques.

2.9.4 Partial Least Squares (PLS)

Partial Least Squares (PLS) regression is a multivariate data analysis technique, which can be used to relate several response (Y) variables to several explanatory (X) variables. The method aims to identify the underlying factors, or linear combination of the X variables, which best model the Y dependent variables. An example of the X variables in this study would be all the 10 deployment/implementation constructs, whereas the Y dependent variable would either be of the "Measures of TQM Success" such as Customer Satisfaction, Employee Relations or Financial Performance.

PLS can deal efficiently with data sets where there are many variables that are highly correlated and involve substantial random noise.

The method has been applied in many areas of research and technology. Some of the advantages and disadvantages are as follows;

Advantages:

- Flexibility of algorithm.
- Size dimensions do not matter e.g. there can be more variables than observations.
- Some versions of the algorithm can accept missing data.
- Can data fit with fewer components than other modelling approaches.

Weaknesses:

- Distributional properties of estimates not known and sometimes difficult to interpret loadings.

Detailed analysis is illustrated in Figure 6.1: Data Analysis Map and presented in Chapter Six "Data Collection and Synthesis".

2.10 Scale Development Vs Usage of Existing Scales

For this thesis no new scales were developed; instead validated implementation constructs were used as "a means to an end". Therefore although this author is familiar with the steps involved in scale development and its associated principal methods used in extracting factors, research shows that it is possible to use existing scales. Hoxley (2000) used the SERVQUAL as a model for comparing his SURVEYQUAL model. Hensley (1999) further states that the development of valid and reliable scales is in itself not a contribution to theory development approach. Moreover existing scales have covered the topic of critical success factors adequately. The other reason for not going down the new scale development is that researchers must work on theory building instead of reinventing measures for each study. Caution was nevertheless applied to the genuine concerns about the publishing of studies whose purpose is to further claims of predictive validity.

2.11 Model Re-Development and Validation

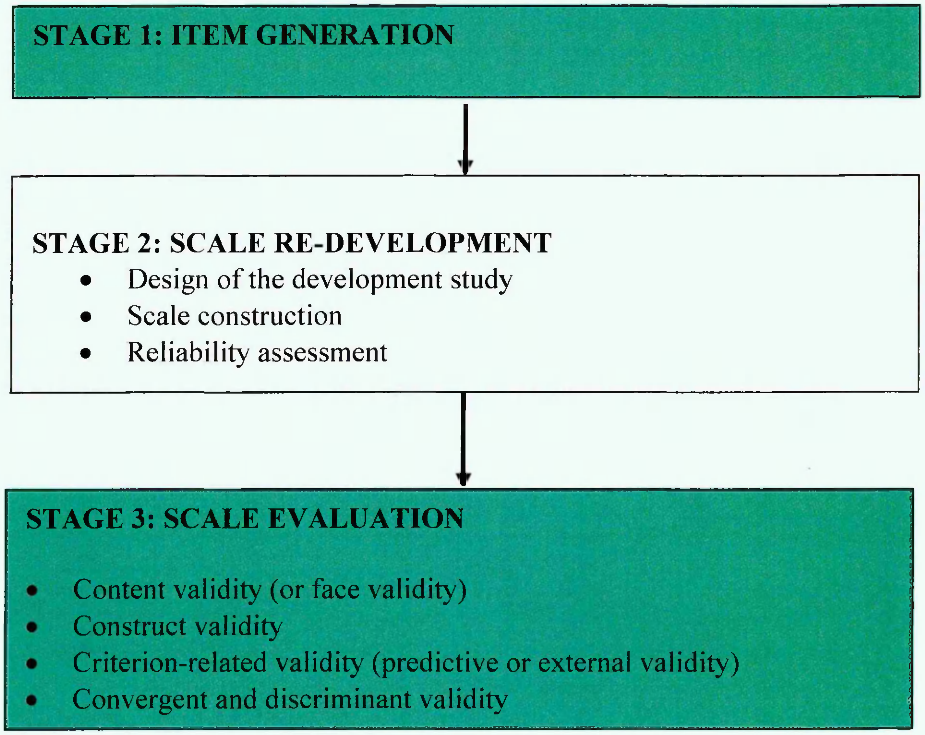

Figure 2.12: Model Re-development and Validation Adapted from (Schwab, 1980)

Cui et al (2003) provide further evidence in support of using existing measures. They state that a measurement instrument can be developed through basis research, or may be adapted from received studies that have passed test of validity and reliability (Cui et al 2003:193). The Powell (1995) instrument which is used as a basis of criteria meets the said requirements.

The steps involved in the model re-development and validation process are discussed below;

Stage 1 - Item Generation

Hensley (1999) purports that the ultimate purpose of item generation is to ensure that the questionnaire items have content validity and that they capture the specific domain of interest, yet contain no extraneous content"

Stage 2 - Scale Development

Scale construction, also known as development was conducted to test the stability of the existing scales. Whereas Powell (1995) used 12 Constructs, this study omitted 2 which were manufacturing specifics such as "Flexible Manufacturing" and "Process Improvement". Cronbach alpha's and spilt half values test conducted upon the ten scales and individual items. The results of which are reported in the appendix D.

Stage 3 - Scale Evaluation

The following test, as earlier described, is used to evaluate the TQ-SMART. Chapter Seven presents the results of the model fit

- Content validity (or face validity) - Pre-testing the instrument
  Literature Review and Pre-test

- Construct validity

Principal Component factor analysis was conducted to assess the construct validity. It is acknowledged that Principal Component analysis with orthogonal rotation as the frequently used factoring method. Factor analysis achieves parsimony by explaining the maximum amount of common variance with communalities in the range 0.5, above 0.6 is accepted for relative samples above (less than 100) may be perfectly adequate.

- Criterion-related validity (predictive or external validity)

Canonical correlations of scales to self reported TQM performance. Pearson's correlation was used to test the relationship between the constructs and the outcome variable.

- Convergent and discriminant validity

Using the correlation matrix, also convergent validity is assessed using both EFA and CFA

2.12 Summary

This section highlighted the research methods to be used in this study. It has presented the advantages and disadvantages of the two approaches used, , quantitative and qualitative. Particular attention has been drawn to the methodological shortcomings in the survey-based research and measures to overcome those suggested. The rationale for the TQM implementation constructs utilised is explained (justified). Further comparisons of existing validated scales are presented, and specific reasons given for their non applicability. The dangers of using existing scales are explained and measures to overcome them stated.

A brief, if not detailed description of the survey document and considerations undertaken in its development are given. Statistical methods to be used in the data analysis are presented. The Chapter also establishes the theoretical foundations for the research, selecting an appropriate research design and data collection method. Having highlighted the methodological aspects of this study, Chapter Three provides a brief overview of the Construction Industry and the implications of Total Quality Management. The following Chapters are designed to act as the literature review and highlight the issues explored in the questionnaire survey. The contents of the three Chapters are summarised in Figure 2.13 below.

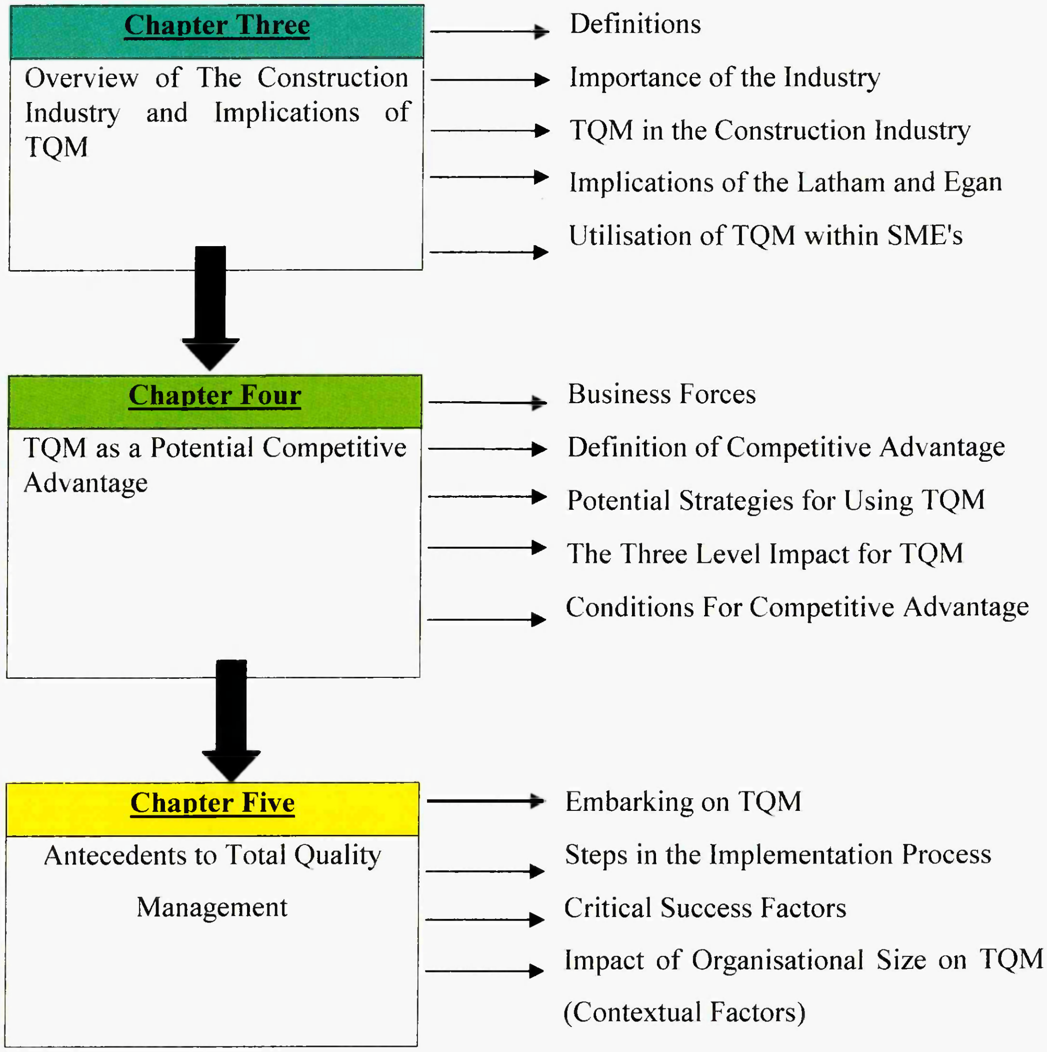

Figure 2.13: Overview of chapters three, four and five.

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Chapter Three

Overview of the UK Construction Industry & the Implications for TQM

CHAPTER THREE: OVERVIEW OF THE UK CONSTRUCTION INDUSTRY AND THE IMPLICATIONS FOR TQM

3.1 Introduction

The purposes of this chapter are threefold. Firstly it is to present an overview of the structure of the UK Construction Industry, secondly to present various definitions of the industry and finally to examine the role it plays in the economy of the country, highlighting the challenges facing the industry today and to state the implications for TQM.

The chapter is divided into eight sections as follows

Section 3.2	defines the Construction Industry
Section 3.3	highlights the importance of the Industry
Section 3.4	analyses the implications and tests the compatibility of the Latham and Egan Reports.
Section 3.5	highlights the importance of the Industry
Section 3.6	provides various definitions of TQM
Section 3.7	introduces TQM in the UK Construction Industry
Section 3.8	explores the utilisation of TQM within SME
Section 3.9	summarises discussion in this chapter

In 'The UK Construction Challenge' (a summary report prepared by Lyton (1996) in comparing it to manufacturing) he made the following comment:

> "The challenge to the UK construction industry is to show innovation in delivering the improved value that the country requires without losing our tradition of excellence in the built environment. Such an approach would place the UK construction industry in a strong position to take advantage of the challenges offered by the single market"

3.2 Definitions of the Construction Industry

Langford and Male (1992) describe the construction industry not as a single industry but made up of several different market areas. For the purpose of classification they divide it into four market areas:

- Building
- Civil engineering
- Repair and maintenance
- Materials manufacture

In Japan it is customary to divide construction activities into construction and civil engineering, whereas the US industry does not make this distinction (Hasegawa, 1988)

In defining the construction industry, Pheng (1993) notes certain important characteristics of the industry as being;

- Size
- Fluctuations in workload
- Wide variety of participants,
- Duration,
- Site-specific
- Custom-made product

While there are various definitions of the construction industry, for the purpose of this research project, the characteristic adopted by Pheng (1993), namely that of size, forms the focus of the study. Similarly from Langford and Male (1992) definitions, the small and medium-sized construction organisations studied are from the building sector. In differentiating between building and civil engineering work, Stone (1993) states that civil engineering work encompasses the essential services needed to make buildings operative.

Mathews (1992) concluded in the report 'Barriers to value and competitive advantage in the UK Property industry' that the inefficient and uncompetitive nature of the UK development and construction industry is the result of two principal factors which affect the structure of the industry by impeding the efficient creation of value and sustainable competitive advantage. These are:

- the significant cultural polarisation within the industry
- the weak linkages between the elements and participants in the industry's value systems

Several features of the construction industry make direct comparison with others difficult:

- Immobility of the product
- Construction is taken to include both the design/engineering side of the industry, and the production on and off site. This method of organisation has evolved since the master builders of the 18th century in the UK.

WG 11 (Latham 1994) decided to adopt a wide definition of the construction industry, including engineering construction and small house-builders, as there were lessons to be learned in and from all sectors.

3.3 Competition in the UK Construction Industry

According to Hasegawa (1988) the demand placed upon the Japanese construction industry for making strategic decisions is greater than ever. He notes the demand for construction work is changing dramatically in terms of both quantity and quality, and the competition is intensifying. Whereas contractors have emphasised the ability to manage labour and subcontractors as the key element in competitive pricing in the US Construction markets, Tatum et al (1987) states that many key changes in the industry are forcing a shift in the basis of competition from managerial to technological issues. Brah et al (2002) posit that factors such as foreign competition and the rise of internationally recognised quality awards force companies to compete to world class standards. While this is true for large organisations, smaller ones have been less impacted by the quality awards, in particular constructional related organisations.

3.4 Implications of the Latham and Egan Reports on TQM

The UK construction industry has constantly been criticised for its inefficiency in terms of time, cost and quality. Time and cost overruns are the basic factors which can invalidate the economic case for a project turning a potentially profitable investment into a loss maker. This led to Sir Michael Latham's report 'constructing the team' (1994), which reviewed procurement and contractual arrangements in the UK construction industry. Following on from this report the Construction Industry Board (CIB) has commissioned various working groups to review the development and research areas and topics which Sir Michael's report addressed

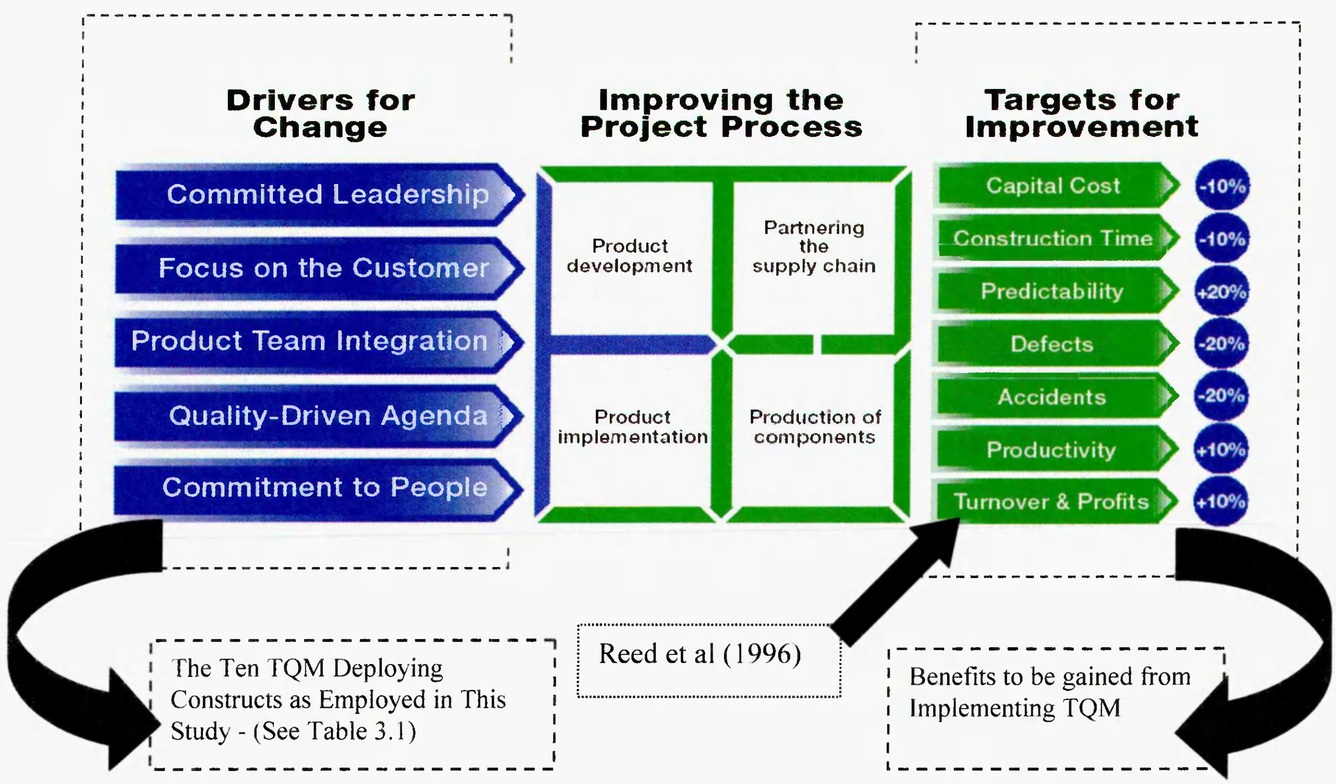


Figure 3.1- Linking the Egan Model to this Study
(Adapted from Egan, 1998)

Figure 3.1 identifies the five "drivers" which need to be in place to secure improvement in Construction; four processes that had to be significantly enhanced and set seven targets for improvement.

Prior to "Latham" (1994) and "Egan" (1998, 2002) there had been a succession of previous studies carried out in Britain since the Second World War, including the reports by Simon (1944), Banwell (1964), and Wood (1975). Their authors all agreed that the construction industry needed to be improved and presented alternative organisational models for the industry, which they believed might facilitate that improvement. All failed to result in significant improvement across the industry and as a result these reports and their authors are not remembered by the average construction professional. The next sub section demonstrates the compatibility of the TQ-SMART model requirements with those of the Egan Report. A similar approach has also used by Sherif and Price (1999) who linked the principle of teamwork to the requirements of both Latham and Egan by showing the complementarily of Alignment and Culture concepts, Greasley et al (2003) highlighted the important role of empowerment and recognised teamwork and leadership as key components of effective empowerment, Chileshe et al (1999) also linked the five pillars of TQM as advocated by Creech (1994) to the key drivers of change. This is illustrated in Figure 3.6 in which the process and team are integrated around the product.

Table 3.1 clearly establishes the compatibility of the TQ-SMART Model and the key drivers of change advocated by Egan (1998; 2002). This is also illustrated in Figure 3.1 which shows the linkages between Key drivers of Change as identified in the Egan Report and TQM Deployment Constructs used in this Study

Table 3.1: The Compatibility of TQ-SMART Model and the requirements advocated by Egan (1988 ; 2002)

TQ-SMART Model	Egan (1998, p. 13-14)
Executive Commitment	"Committed Leadership"
Customer Focus	"Focus on the Customer"
Supplier Focus Open Organisation Measurement	"Product Team Integration"
Adopting the Quality Philosophy Benchmarking Zero Defects	" Quality-Driven Agenda"
Training Employee Empowerment	"Commitment to People"

A comparative analysis of the issues contained in Table 3.1 is now provided to further corroborate the link between TQ-SMART Model and Egan (1998, 2002)

Executive Commitment /"Committed Leadership"

Both the TQ-SMART Model and Egan (1998; 2002) are concerned with having an effective management support in for the quality initiatives. The requirements incorporate the 3c's defined as

- Commitment
- Championing
- Communication

The TQ-SMART Model considers all of the above and requires a top executive decision to commit fully to a quality program, actively champion the quality and communicate a quality commitment to employees. This is very much in line with Egan's (1998) committed leadership which is about management believing in and being totally **committed** to driving forward an agenda for improvement and **communicating** the required cultural and operational changes throughout the whole of the organisation. (Egan, 1998)

Customer focus/ "A Focus on the Customer"

The TQ-SMART Model enables the organisations to increase direct personal contact with customers, actively seek customer's input in order to determine their requirement which can then be used as a basis for quality. Furthermore it involves customer in product or service design. This certainly is indicative of being customer oriented. It is evident that the TQ-SMART Model addresses the Egan's focus on the customer as it seeks to audit the client satisfaction.

By seeking the customers input, the TQ-SMART Model contributes to the Egan's key drivers of change through the elimination of "non-added value" activities.

The remaining constructs of adopting the quality philosophy, benchmarking, zero defects, supplier focus, open organisation, measurement, training and employee empowerment as illustrated in Table 3.1 are linked with the fundamental concepts of Egan (1998, 2002).

3.4.1 Fundamental Concepts of TQ-SMART Model and Interlinking with Egan (1998;2002)

The TQ-SMART Model is split into 'Process' and 'Outcomes' and the following is the establishment of clear links.

Drivers for change under Egan (1998) encompass:

- Leadership which is matched by the TQ-SMART Model. Both have a realisation that top management support should take an active role in communicating, championing and being committed to the quality initiatives. According to Greasley et al (2003), leadership and teamwork are the key components of effective empowerment.

- 'Focus on the Customer' is matched by 'Customer Focus' in the TQ-SMART Model. Customer focus is one of the basic elements of total quality management philosophy

- 'Product Team Integration' is covered under TQ-SMART Model by 'Supplier Focus', 'Open Organisation' and 'Measurement'. The aspect of team integration can be found in the 'Open Organisation' elements which is based on a more open and trusting organisational culture and its usage of empowered work teams. Baiden et al (2003) highlighted the need for teams to integrate in order to achieve acceptable performance.

- 'Quality Driven Agenda' is addressed in the TQ-SMART Model through the 'Adopting the Quality Philosophy', and 'Benchmarking' and 'Zero Defects'. As stated in Egan (1998), quality means the total package-exceeding customer expectations and providing real service. Both the TQ-SMART Model and Egan share the same desire through "the announced goal of zero-defects", "an overall theme based on the quality program" and " researching best practices of other organisations"

- 'Commitment to People' is addressed in the model by 'Training' and 'Employee Empowerment'. Both the Egan (1998) and the TQ-SMART Model recognise the need to care for the work force. This can be achieved through commitment to training as well as respect for all participants in the process.

3.4.2 The Compatibility of This Study with "Targets for Improvement" as advocated by Egan (1998;2002)

The Egan Report identified the scope for sustained improvement by the 7 indicators as indicated in the 5-4-7 Model in Figure 3.1. A comparative analysis of these indicators with the issues raised in this study complemented by findings from the literature review is discussed as follows;

"Reduced Capital Cost"/ "Increased Turnover and Profits"

As advocated by the seminal work of Reed et al (1996), the model matches the aspirations of the Egan requirements in that it posits that competitive advantage can be composed into components that either generate improved revenues or reduced costs. The theoretical background is based on the customer orientation approach, which uses the market advantage to increase revenue, and the product design efficiency to reduce cost arising from reworks. The notion of product depends on the process element and role played. One of the main objectives of this study was to identify the linkages between attainment of a sustainable competitive advantage and implementation of TQM. This study thus the application of TQM contributes as the concept of continuous (process) improvement is considered the main tool for improving efficiency. The thesis' objectives also tie in with the establishment of the construction task force's remit. This was to advise the Deputy Prime Minister from the client's perspective on the opportunities to improve the efficiency and quality of delivery of UK construction, to reinforce the impetus for change and make the industry more responsive to customer needs.

It has been demonstrated by Holit et al (2000) that long term relationships can drive up quality and drive down both capital and through-life costs for clients. Therefore the targets for improvement envisaged by Egan (1998) for reducing costs by -10%, and increasing turnover and profits by +10% are matched in this study by testing the benefits to be gained from implementing TQM. The time lag analysis as established by Reed et al (1996) is also taken into account. Therefore, if the respondents report an increase in beneficial relations with suppliers, then it must lead to the said improvements.

3.4.3 Fundamental Concepts of this Study and the Four Key Processes needed to achieve Change

This study advocates certain benefits to be gained from the implementation of TQM and the following is the establishment of the clear links. The four key projected processes needed to achieve change encompass;

- "Partnering the supply chain" which is matched through the "supplier focus" construct. While Egan (1998, 2002) recommends developing long-term relationships based on continuous improvement with a supply chain, one of the advocated benefits in implementing TQM is that it results in stronger more beneficial relationships with suppliers. This concept is similar to Alliancing as suggested by the European Construction Institute.

- Construction Process which emphasises on the elimination of waste is matched by the "Zero Defects" construct and the advocated benefit of an improvement in the reduction of waste.

- "Components and Parts" through the sustained programme of improvement for the production and delivery of components can be equated to the "Supplier Focus" construct they are responsible for the delivery of components which mostly comes from the manufacturing sector.

3.4.4 The Latham Report

This research addressed some of the issues raised, in particular how TQM can be linked to the recommendations. For instance: Working Group 4 (WG4) report 'Framework for a National Register of Consultants' (1994) reviewed the best practice for the consultation of construction professionals through the development of ConReg (Consultant Register) developed by the Department of the Environment (DoE)

The Latham Report Research Aims

1. The elimination of waste and the efficient use of project resources. The priority being to secure a constantly improving UK construction industry, this should be measured against a target of 30% reduction in real costs by the year 2000 when compared with the current trend. Research indicates that the targets were not met.

2. The scope of WG 11's remit required an assessment of the impact of BS 5750 (now BS EN ISO 9000) on construction performance

3. To make recommendations on how to achieve the target of a 30% real cost reduction by the year 2000, taking into account the entire UK construction industry.

4. To promote value-for-money in UK construction, and to achieve and maintain international competitiveness. This will include consideration of the roles of TQM and BS 5750/ISO 9000 accreditation in improving project delivery and site performance (WG 11 Terms of Reference).

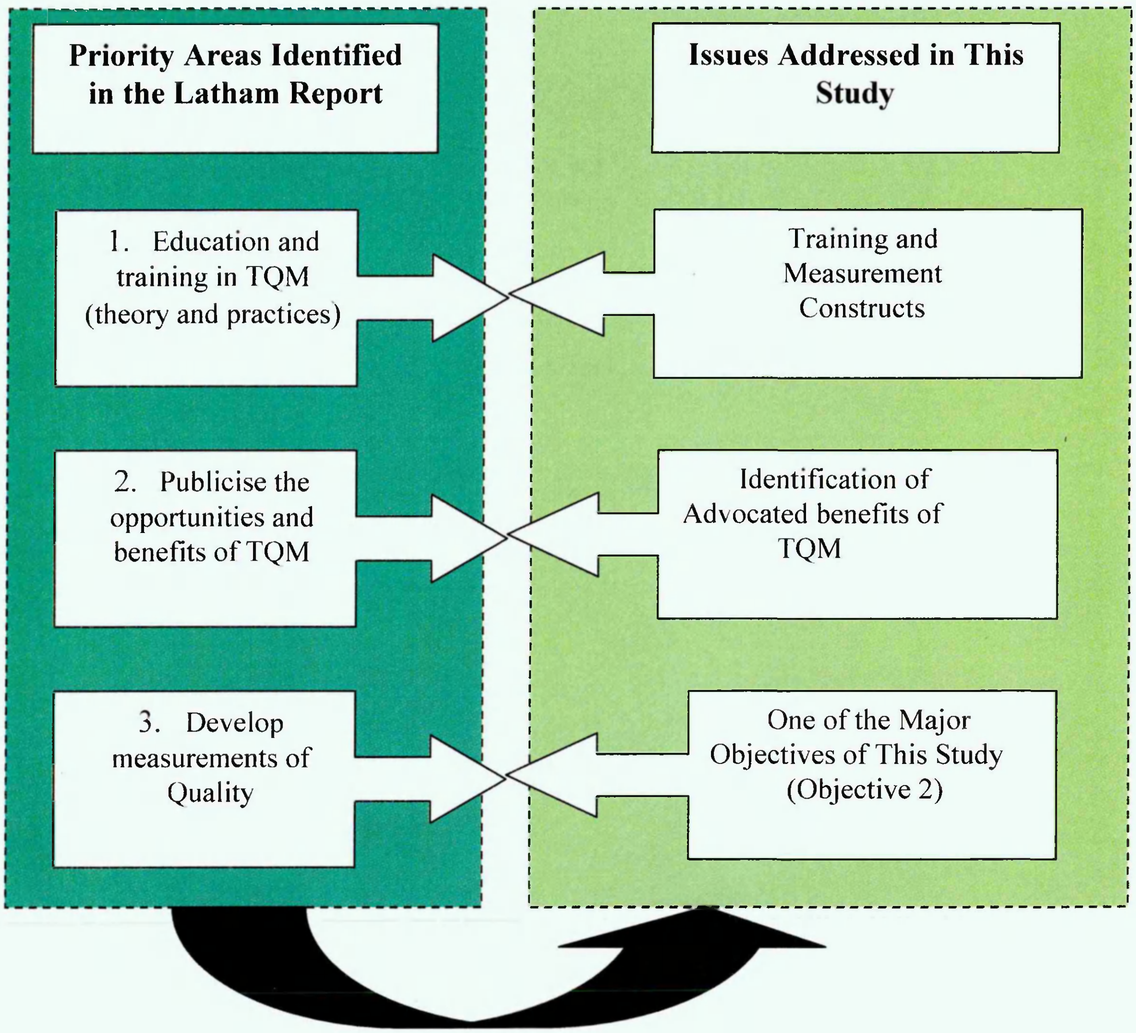


Figure 3.2: Linkages Between Priority Areas Identified by the Latham Report and Issues addressed in this Study

A comparative analysis of the issues contained in Figure 3.2 is now provided to further corroborate the link between the TQ-SMART Model and Latham (1994)

3.4.5 Fundamental Concepts of TQ-SMART Model and Interlinking with Latham (1994)

- 'Education and training' in TQM (theory and practices) is matched by 'Training' as a deployment construct via the practices of Management training in Quality principles, Employee training in Quality principles, problem-solving skills and teamwork. The Measurement construct also has education through the training in Statistical methods for measuring and improving Quality. The information pertaining to the education and training is extracted from Section 2, "Factors for the Implementation of TQM" of the survey document. Furthermore, the case study also elaborates on the training and education issues. This is presented and discussed in more detail in Chapter Six.

- 'Publicising the opportunities and benefits' is matched by Identification of Advocated benefits of TQM. The main area of interest for this research project is the aspect of opportunities and benefits of TQM, in particular to small and medium-sized enterprises (SMEs) with regards to attaining a competitive advantage. The benefits as advocated by the Latham Report are summarised in the following statement

> "Quality assurance certification should continue to be encouraged within the construction industry as a potentially useful tool for improving corporate management systems. But more evidence is needed that it will also raise standards of site performance and project delivery before it should be made a qualification condition for consideration for public sector work. "
>
> (Latham, 1994)

The benefits advocated in this study are as follows; Sustainable Competitive Advantage, Improved Effectiveness and Efficiency, Improved Understanding of Customer Needs, Improved Internal Communication, Fewer Errors, Reduced Material Waste, and Resulting in Stronger More Beneficial Relationships With Suppliers. The results of these findings are presented and discussed in Chapters six and eight.

- 'Developing measurements of Quality' is matched by one of the objectives of the thesis which is to review and evaluate validated instruments used to measure Quality Management within the manufacturing and service industries

3.4.6 Comparison of the Conclusions drawn by WG11 (reference) and this Study

1. According to the WG 11, BS EN ISO 9000 was not a panacea for all ills but a useful management tool This study drew similar responses from the case methodology were SMEs regarded Quality Assurance as a source of benefits and in satisfying customers. Many construction companies saw BS 5750 as an essential prerequisite for getting onto tender lists

2. It's use, while not fulfilling high expectations, led to some gain, attributable to the discipline instilled and, more importantly, to people's positive attitudes in wanting to improve

3. Its purpose was to ensure consistency of output, but it did not offer the wider reaching potential of total quality management (TQM) where there is an emphasis on continuous improvement

3.4.7 Comparison of the conclusions drawn by the Latham Report and this Study

- Whereas the Latham Report argued that TQM would contribute to changing the culture of the construction industry, this research examines through its critical success factor number seven, how the "open organisation" can be utilised by UK construction-related SMEs. In particular through the use of empowered work teams, less bureaucracy and a more trusting organisation culture.

- The report clearly identified that using Construction quality awards would encourage organisations to adopt the management principles and practices of TQM. Though this study found that SMEs are less interested in entering an EFQM award competition, this is to be encouraged as evidence has shown that it leads to improvement.

- The model, mechanisms and administration for the award already exist under the auspices of the British Quality Foundation, who could manage the assessment and validation.

3.5 Importance of the Industry

According to the Statistical Bulletin Small and Medium Enterprises (SME) Statistics for the UK 1998, of the entire business population of 3.7 million enterprises only 25 thousand were medium sized (50 to 249 employees) and less than 7 thousand were large (250 or more employees). Construction accounts for around 6 per cent of UK gross domestic product and employs about two million people (DERT 2002). It contributed 6.5 % of GDP in 1988. The construction industry's role as a provider of work matches its GDP contribution. With regards to commercial property industry in the UK, it plays an important part in the economy and makes a significant contribution to GDP. Data abstracted from the Central Statistical Office (CSO), commercial property in the UK contributed about 6 % of total GDP in 2002. Table 3.2 summarises the employment in the construction industry by size of firm

Table 3.2: Employment in the Construction Industry by Size of Firm

Number of Employees in Firm	Approximate Number of Firms	% of total
1-13	78,000	85.04
14-59	11,000	12.00
60-114	1,400	1.53
115-599	1,100	1.20
600-1199	125	0.14
1200 and Over	80	0.09

Table 3.2 provides the evidence of the contribution that the construction, and in particular SMEs makes to the employment sector. SMEs account for 96% of the number of all organisations in the construction industry by employment. It is evident that excluding such a group from any research would be wrong as they perform an important role in the economy. Though the above figure relate only to the construction industry on a national scale, SMEs account for approximately 99.8% of total UK

business (The ECI, 1996) and support approximately 67.2 per cent of total UK employment. (DTI 2002).

There is no shortage of statistics on the construction industry. It contains 200,000 firms of which 95,000 are private individuals or one person firms. Only 12,000 contracting firms employ more than 7 people. About 45% of registered architects are sole principals or employ five qualified staff or less (Source: RIBA, 1993). The value of output in the whole industry in 1993 was £46.3 billion, which represented about 8% of Gross Domestic Product (Source DOE). Large construction firms (employing 80 people or more) carried out over 40% of the workload by value in 2002. The industry is vital to the economy. Most people in the contracting sector work alone, or in small firms, but a limited number of large firms undertake a substantial proportion of the work (Latham 1994)

The importance of TQM is shown in Figure 3.3. The majority (50%) of the faults are at the design stage, followed by (40%) at the construction stage with the remaining 10% attributed to the suppliers. The inferences to be drawn is that everyone involved in the construction process contributes one way or another to the faults, therefore the concepts of TQM would need to be addressed by those involved in the construction process.

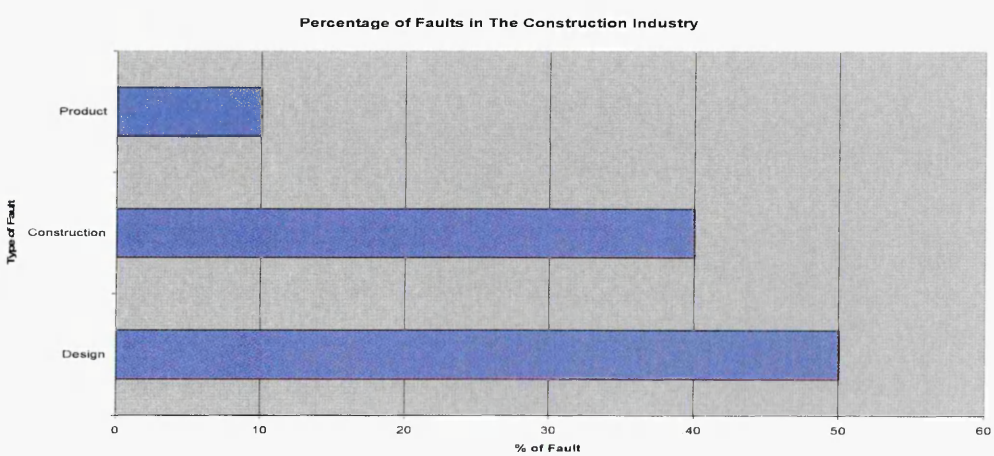


Figure 3.3: Percentage of Failures / Faults in the Construction Industry
(After Building Research Establishment, 1982)

The above citation though conducted 22 years ago, draws the conclusion that the awareness of quality in the industry has not changed much. This is supported by recent research as the statistics from the digest of data for the Construction Industry (1997) shows that preliminary defects data analysis for residential forms as shown in Table 3.3

Table 3.3: Analysis of percentage of defects for residential forms (after DoE 1997)

Area	Percentage of defects
Drawings	1%
Construction	19%
Testing / Inspection	4%
Post Practical completion	13%
In-Use	63%

The significance of this information illustrated in Figure 3.3 and Tables 3.3 is that more than half the defects are not detected during the crucial stages in the design-construction phase. It reinforces the strong need for an effective Quality Management System to be in place if the defects are to be prevented.

Table 3.4: Comparisons of SMEs definitions: UK vs. Europe and Asia

No.	Country	Category of Industry	Criteria/Country's Official Definition
1	United Kingdom	SME	No fixed Definition
2	Australia	Manufacturing	Small Enterprises £ 100 employees
3	France	SME	1- 499 employees
4	Germany	SME	< 500 employees
5	Korea	Manufacturing	< 300 employees
6	Japan	Manufacturing	< 300 employees or asset
		Wholesale Trade	< 50 employees or capitalisation < 30 million Yen
		Retail Trade & Services	< 50 employees or capitalisation < 10 million Yen
7	USA	Very Small Enterprise	< 20 employees
		Small Enterprise	20 – 99 employees
		Medium Enterprises	100 – 499 employees
8	Portugal	SME	< 500 employees

Table 3.4 illustrates that there is no universal definition of what constitutes SMEs. The classifications vary by Industry, Sector and Country (See Table 3.4). For

example, according to the Eurostat (EC-Directorate General), the following classification is used

- Micro- Organisation (0 – 9 employees)
- Small Firm (10-99 employees)
- Medium-sized organisations (100– 499 employees)
- Large organisations (500 + employees)

According to Levy and Powell (2001) in citing Storey (1994), they observe that the number of employees is thought to be more appropriate because of the difference in organisational structures that occur with size. According to Bennett and Smith (2002), another rationale for adopting the European Union (EU) definition of SMEs of up to 500 is used in order to obtain a wide range of firm sizes which can be examined for differences in competition, and also in order to replicate the study across Europe. A recent study by Jashapara (2003) used the commission of European Communities (1994) definition for organisational size so that future cross-European studies could be compared. In this study the size classification used by the Eurostat was adopted for the purpose of this research, for the simple reason that it would be easier to replicate the studies across Europe. Whilst acknowledging that there is no single definition of a small firm, mainly due to the wide diversity of businesses (DTI, 2002), various distinctions have been applied, ranging from size by number of employees to turnover.

3.5.1 Industry Structure

The economic rationale for the structure of the Construction Industry as exemplified by Jones and Cockerill (1984) can be found in the following:

- nature and pattern of demand
- nature of product
- the methods of production
- The ease of entry to the industry.

Firstly, demand in the industry is geographically dispersed, with the additional complication that the major part of the production process must take place at the location of demand. The pattern of demand is such that most orders are relatively small in value while very large contracts are very few in number. The result is that there are a fairly small number of large firms who undertake large contracts and a very large number of small firms who undertake small contracts (Jones and Cockerill, 1984). The Construction Industry, unlike most of manufacturing, remains a fragmented industry with relatively few large firms. Robert Donald, Construction Industry analyst at Nat west Securities, writing in the Observer (5/11/95) argued that Britain had too many major construction companies as compared to its European counterparts. Whereas Germany had four, France five, Britain had twenty. Despite having a large number of major companies it is behind in terms of construction output in Europe. The table below shows the distribution of construction output in Europe based on a total output of 560 Billion ECUs (European Currency Unit)

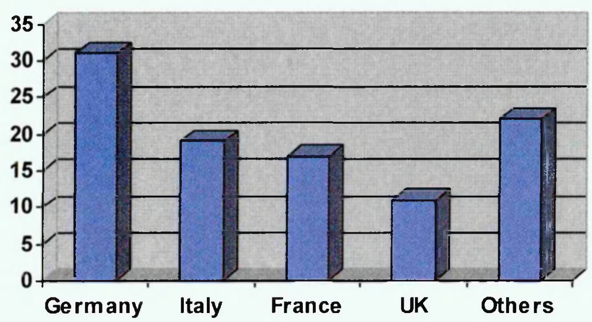


Figure 3.4: European Construction Output (%)

Source: Proceedings of the Institute of Civil Engineers, Feb. 15, 1996. pp16

Construction is defined in Division 5 of the Standard Industrial Classification (SIC) Revised 1980 in to include:

- general construction and demolition work;
- construction and repair of buildings;
- civil engineering;
- installation of fixtures and fittings;
- Building completion work.

3.5.2 Market Structure

The importance of SMEs can be summarised under the following catergories of business, employment and turnover. Table 3.5 illustrates the following contribution by both the manufacturing and construction sector:

Table 3.5: SME share of businesses, employment and turnover by industry, start 1998

Businesses			Employment		Turnover
Sector	Total No.	SME % Share	Total Employment (000s)	SME % Share	SME % Share
Manufacturing	332,135	99.2	4,451	49.5	36.8
Construction	728,705	100	1,536	86.1	75.1

(Source: DERT, 2002)

The share of employment provided by SMEs varies greatly from one industry to the another. In construction 86% of employment is accounted for by SMEs while in manufacturing it is only 50%. On a regional analysis SMEs accounted for over 99% of businesses in all regions. The share of employment in SMEs was highest among Northern Ireland based businesses and lowest among those based in London. For statistical purposes the Department of Trade and Industry usually use the following definitions:

- micro firm: 0 - 9 employees
- small firm: 0 - 49 employees (includes micro)
- medium firm: 50 - 249 employees
- large firm: over 250 employees

Another classification of SMEs is by the turnover. According to section 249 of the Companies Act of 1985 (DTI, 2002) an organisation is classified as "Small" if it satisfies the following criteria:

- a turnover of not more than £2.8 million;
- a balance sheet total of not more than £1.4 million;
- not more than 50 employees

And a Medium sized organisation satisfies the following criteria:

- a turnover of not more than £11.2 million;
- a balance sheet total of more than £5.6 million;
- not more than 250 employees

3.5.3 Definition of Small and Medium-Sized Enterprises (SMEs)

For the purpose of this research project, there is the need to define what constitutes large contractors, Medium-sized Contractors and Small Contractors. As Stone (1983) has shown that there is no general optimum size of construction firm, as the size is affected by the nature of the work, the conditions under which it needs to be carried out and the nature of the organisation and the ability of the management.

An example is shown of the classification given to builders

(i) Large Contractors: Opinions vary as how to classify a large firm and the parameters vary from in excess of 300 employees to over 1200 employees. These firms have the capacity to undertake large building and civil engineering contracts throughout the United Kingdom and often overseas

(ii) Medium-sized Contractors: These contractors generally employ between 50 and 300 operatives and are most likely to operate on a regional basis

(iii) Small Contractors: Small contractors rarely employ more than 50 operatives

Based on the above definitions and comparing with the latest figure showing the employment in the construction industry by size of firm (Table 3.5)

Table 3.6: European Commission SME Definitions

Criterion	Small	Medium
Max. number of employees	49	249
Max. annual turnover	7 million Euro	40 million Eurasia
Max. annual balance sheet total	5 million Eurasia	27 million Eurasia
Max. % owned by one, or jointly by several, enterprise(s) not satisfying the same criteria	25%	25%

3.5 TQM in the UK Construction Industry

Oakland and Aldridge (1995) found that the Construction Industry is associated with a patchy reputation, with many projects that are not completed on time. Similarly

Chileshe (1996) showed that most organisations in the Construction Industry are quite happy with accreditation to the ISO 9000 series rather than pursuing TQM programs. Among the reasons given for non-implementation was that ISO 9000 was enough of a "culture shock", secondly due to the current industrial climate, particular in the construction industry, most directors had more 'pressing' matters to consider, e.g. those of financial survival. However some organisations are beginning to see the positive side of TQM. One contracting organisation that participated in the case study, equated the cost and inefficiency and waste in the contracting industry as being equal to giving away a house a day. Hence in order to avoid this, a quality approach through TQM could substantially improve matters. As Kangari (1988) observes, implementing total quality management (TQM) in construction has lagged behind other industries due to the perception that TQM is for manufacturing only.
Lack of implementation of TQM is captured in the following comment by a Director of a SME

> In our area of work TQM tends to be overwhelmed by everyday problems arising out of the traditional construction industry difficulties. It is an achievement to complete a scheme on time and to our client's reasonable satisfaction so quality as a definable factor is ephemeral at best !
>
> Given that the industry operates in an essentially under-trained/ under capitalised way for consultants who are similarly limited and that our clients demand Rolls Royce quality for sub-Ford prices, TQM / EFQM and similar concepts have more in common with deck chairs on HMS Titanic!
>
> Our industry will remain mixed in the dark ages until we take ourselves seriously and change accordingly so that we can train our workforce, employ sufficient supervisors and insist on competent designs and specifications.

3.6.1 Definitions of TQM

The literature is abound with definitions of TQM. Wilkinson and Witcher (1991) provide the following: TQM is greater than the sum of quality control, quality assurance and total quality. TQM is about continuously improving satisfaction by quality-led company-wide management. This goes beyond the mere application of total quality to being a form of management itself:

Tobin (1990) defines TQM as the totally integrated effort for gaining competitive advantage by continuously improving every facet of organisational culture. However, he proposes a new definition of system quality as: "A quality system is one that is delivered defect-free and meets the expectations of all potential customers." Mohrman et al. (1995) view the key to TQM as the definition of quality as meeting customer requirements and the belief that the organisational capability to deliver quality is enhanced by continuously improving the capacity of the work processes of the organisation to deliver value to the customer. Perhaps the best definition of the goal of TQM is " Do the right thing, right the first time, on time, all the time; always strive for improvement, and always satisfy the customer " (Laza and Wheaton, 1990)

Quality may further be defined in respect of buildings as:

> The totality of the attributes of a building which enable it to satisfy needs, including the way in which the individual attributes are related, balanced and integrated in the whole building and its surroundings

Sigouras (1994) has defined TQM as managing the entire organisation so that it excels in all dimensions of products and services that are important to the customer. It is evident from all these definitions that the common denominator is about meeting the customer's requirements. Organisations world-wide are applying quality theories, principles and methods to every business function. This TQM movement is an approach that involves all employees in continually improving products and work processes to achieve customer satisfaction and world-class performance (Boone and Wilkins 1995). In terms of construction quality professionals have typically defined quality as "conformance to the established requirements". This raises the question of what the established requirements are? In the construction industry these are derived from specifications and drawings, nationally recognised codes, and standard and self-imposed requirements. (Biggar 1990)

According to Sluyter and Barnette (1995) TQM can be defined as a leadership philosophy which helps organisations identify and reach quality outcomes for their customers through involvement of everyone. According to Sluyter and Barnett (1995) the key elements of TQM are leadership, philosophy, quality outcomes customer focus and employee involvement. In order to ascertain the perception of TQM, respondents in the survey were asked to provide a brief definition of Total Quality Management. The following is a typical definition from a Quantity Surveyor with six years of employment with a TQM deploying organisation:

> 'Finish the contract on time, work as a team (Q.S, Agent, Engineer, Foreman, and Contracts Manager) and have job satisfaction, early decisions and communication as keys to successes.

The Managing Director of a TQM deploying organisation with 28 years of experience had the following:

> 'All functions, department work towards satisfying each others needs and ultimately providing our customer's product/service that was asked for in a cost effective manner on time. Includes our suppliers and subcontractors as part of our team'.

Quality Manager with nine years of experience within a TQM deploying organisation makes the following observation:

> 'TQM advocates an organisation wide effort in continual Quality improvement. To attain high quality in Construction all parties involved must work together as a team. The practice of TQM promotes good relationships'.

Table 3.7 indicating the principles of TQM that can be summed up into the five interventions prescribed by Hackman and Wagemen (1995)

Table 3.7: Principles of TQM

No.	Principles
1	There must be agreed requirements, both for internal and external customers
2	Customer's requirements must be met first time, every time.
3	Quality improvements will reduce waste and total costs
4	There must be a focus on the prevention of problems, rather than an acceptance to cope in a fire-fighting manner
5	Quality improvement can only result from planned management action
6	Every job must add value
7	Everybody must be involved, from all levels and across all functions
8	There must be an emphasis on measurement to help to assess and to meet requirements and objectives
9	A Culture of continuous improvement must be established (continuous includes the desirability of dramatic leaps forward as well as steady improvement)
10	An emphasis should be placed on promoting creativity.

- Explicit identification and measurement of customer requirements
- Creation of supplier partnerships
- Use of cross functional teams to identify and solve quality problems
- Use of scientific methods to monitor performance and identify points of high leverage of performance improvement
- Use of process-management heuristics to enhance team effectiveness.

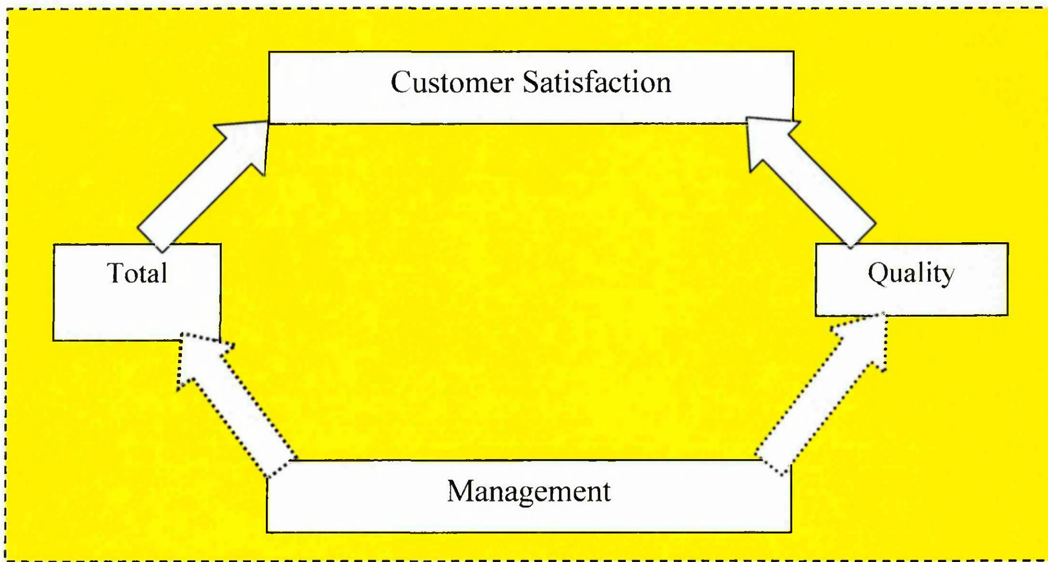


Figure 3.5 A Comprehensive approach to TQM (Adapted from Farquhar, 1991)

In the framework above, Farquhar explains how the three competitive imperatives, Total, Quality and Management must drive customer satisfaction. A systematic understanding can be developed by taking the term TQM and systematically working out a definition of it. Flood (1993) proposed defining the three component words and explaining how they should be read as a whole expression

There is no general agreed definition of TQM. The literature suggests that it is a management philosophy or a collection of techniques aimed at improving the efficiency and effectiveness of a given process. However the generally accepted definition of quality is that of "Conformance to the established requirements". In the Construction Industry these requirements are the established characteristic of a product, process or service (Wills and Wills, 1996) and are usually derived from the following sources of requirement:

- Customer Contracts , Engineering Specifications , Drawings and
- National recognised codes and standards, and self-imposed requirements

The above sources of requirements would be integrated into the construction process in order to highlight the potential sources of conflict, which would lead to project delays. The client normally determines the requirements at the initial stage; these are supplied to the designer, who translates them into design documentation. The contractor (depending on the form of contract used) uses the designer's plans and specification, processes the construction and supplies the completed facility to the client. It is clear that the roles of the three parties (client, designer and contractor) have not traditionally been viewed this way, but this clearly illustrates that construction is a process and the TQM view implies that if the customers (clients) are to be kept satisfied, the process must be constantly improving. Customer satisfaction at each stage of the construction process implies that the goals of the construction process are met.

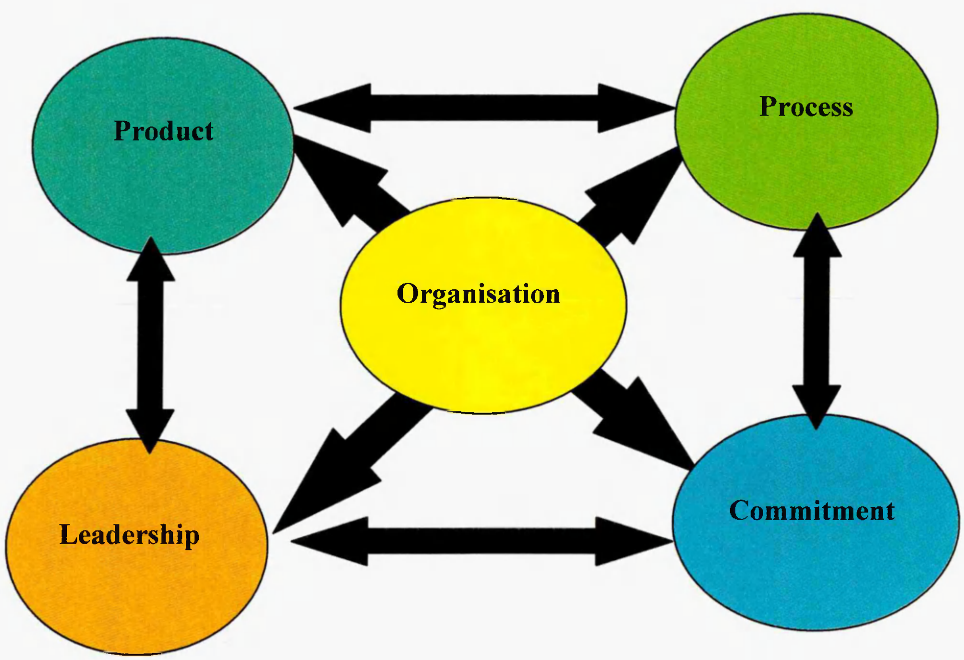


Figure 3.6: The five Pillars of TQM (Creech, 1994)

In order to address the problematic issues raised in the Egan report, the Figure 3.6 shows how the *Product* should be taken as the focal point for an organisation's purpose and achievement. Quality in the product is impossible without quality in the *process*. Quality in the process is impossible without *organisation*. The right organisation is meaningless without the proper *leadership*. Strong, bottom-up *commitment* is the support pillar for all the rest. (Creech, 1994.6)

3.6.2 Concepts of TQM

1. Quality is a customer perception
2. Quality is dynamic
3. Quality is process oriented
4. Quality requires total involvement

(Laza and Wheaton, 1990)

The European Construction Institute (1996) identified the following nine key concepts as being central to the running of a TQ project. The concepts are as follows; Teamwork, Leadership, Communication, Empowerment, Alliancing, Benchmarking Recognition and Reward, and Culture.

Application of the TQM concept should result in improved organisational efficiency through teamwork, personal responsibility, customer orientation and institutional openness. Reed et al (1996) considered TQM in relation to firm orientation and identified market advantage, product design efficiency, process efficiency, and product reliability as the key features of its content whereas, Shiba et al (1993) related TQM to the concepts of "company focus" and "customer focus." According to Schonberger (1990) these competitive factors of high quality and short cycle time (in design, production, and delivery) have been elevated to a place in the mission statements of a number of Western-(not just Japanese)-companies and non-profit organisations. If we add a few related words e.g. employee involvement, supplier and customer partnerships, flexibility, reduced variation, waste elimination, and continuous improvement, we capture the main elements of total quality management (TQM) which has become a remarkably strong influence in Western management.

3.6.3 Elements of TQM (Burati et al, 1992)

Management Commitment and Leadership, Training, Teamwork, Supplier Involvement and Customer Service

(1) **Corporate culture**

Top management commitment (leadership), and continuous improvement (Kaizen)

(2) **Employee participation**

Training and education and incentive and reward

(3) **Quality assurance programme**

Product/Service design, Quality materials, Process control and Distribution and Services

(4) **Benchmarking**

Various authorities on this subject such as Zairi and Youssef (1995a, 1995b), Lema and Price (1995) and McCabe (2001) explore the applicability of benchmarking within construction and its associated benefits. Zairi mostly focuses on the Manufacturing Industry. The findings relating to the applicability of benchmarking within the construction SMEs are presented in Chapter Six.

Figure 3.7 presents the four main parts of TQM as three (denotes as **A**, **B**, and **C**) overlapping and related circles, with a central overlap, vital to this tri-relationship. These are labelled as teams, methods, internal markets and leadership respectively. Hellsten and Klefsjo (2002) propose three components of TQM view comprising values, tools and techniques

Components of TQM

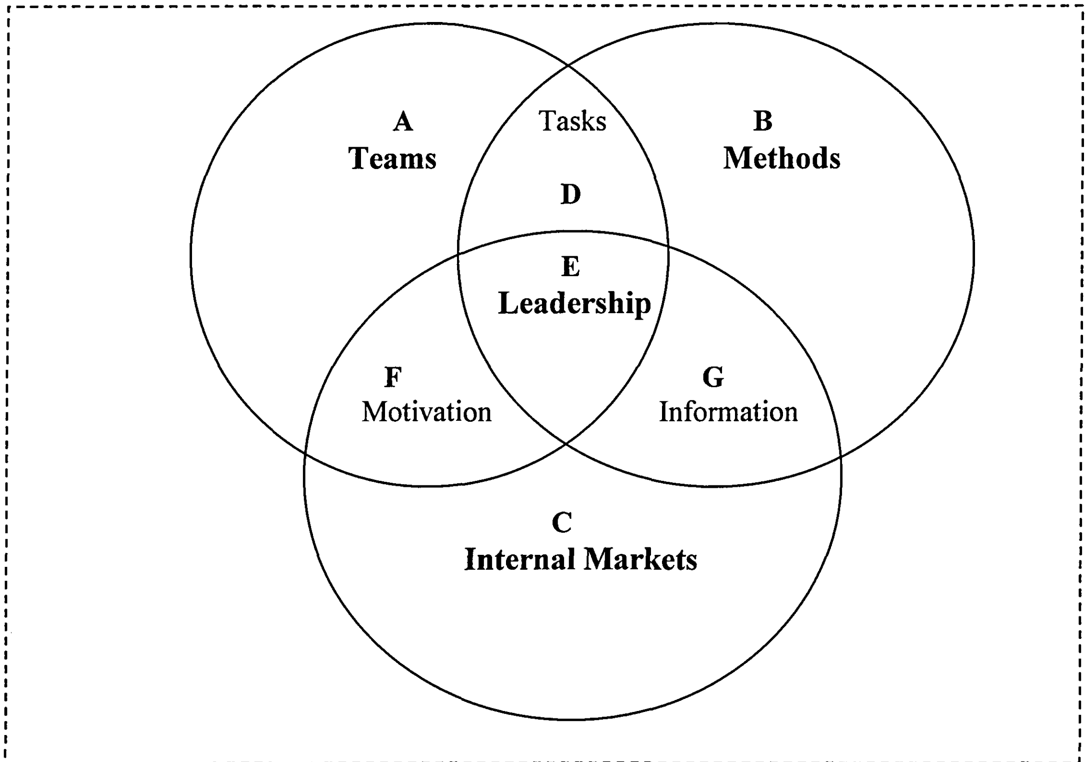


Figure 3.7 : The TQM Model Source: Adapted from Wilkinson and Witcher (1991)

In Construction terms, the digest of data for the construction industry have the following definition:

'TQM is a management philosophy which aims to produce a better performance from a whole project team and to result in better quality products and services, delivery and administration, which ultimately satisfy the client's functional and aesthetic requirements to a defined cost and completion time. For this to work, the client himself has to accept the responsibility as being part of that project team.'

A. Leadership - This is equivalent to executive commitment or senior management support which is vital for the success of any initiative.

B. Methods:

Methods include both quality tools and systems, and conventionally have most to do with control of performance. TQM requires that everybody should have the tools and the systems which enable them to assess their own performance, to act immediately to keep things right, to review and continuously improve. (Wilkinson and Witcher, 1991). Burati et al. (1992) have identified the principles of TQM as being customer satisfaction and continuous improvement

C. Internal Markets

According to Hackman and Wageman (1995), TQM authorities specify the following four principles that should give any organisational intervention:

1. Focus on the work process
2. Analysing Variability
3. Management by Fact
4. Learning and Continuous Improvement

Table 3.8: Garvin's Eight Dimensions of Quality:

Dimension		Characteristics
1	Performance	• a product's primary operating characteristics.
2	Features	• the " bells and whistles " of a product
3	Reliability	• the probability of a product's survival over a specified period of time under stated conditions of use.
4	Conformance	• the degree to which physical and performance characteristics of a product match pre-established standards.
5	Durability	• the amount of use one gets from a product before it physically deteriorates or until replacement is preferable.
6	Serviceability	• the speed, courtesy and competence of repair.
7	Aesthetics	• how a product looks, feels, sounds, tastes or smell.
8	Perceived quality	• subjective assessment of quality resulting from image, advertising or brand names.

Source - Garvin (1987)

A further comparison is made in Chapter Five with the emphasis on the differences between Construction and Manufacturing

Competitive advantage can be broken down into component parts that either generate improved revenues or reduce costs. According to Reed et al (1996), TQM content can be described as having four main components as shown in Fig 3.8. Market advantage is described as when a service firm is able to attract more customers than competitors and retain them longer.

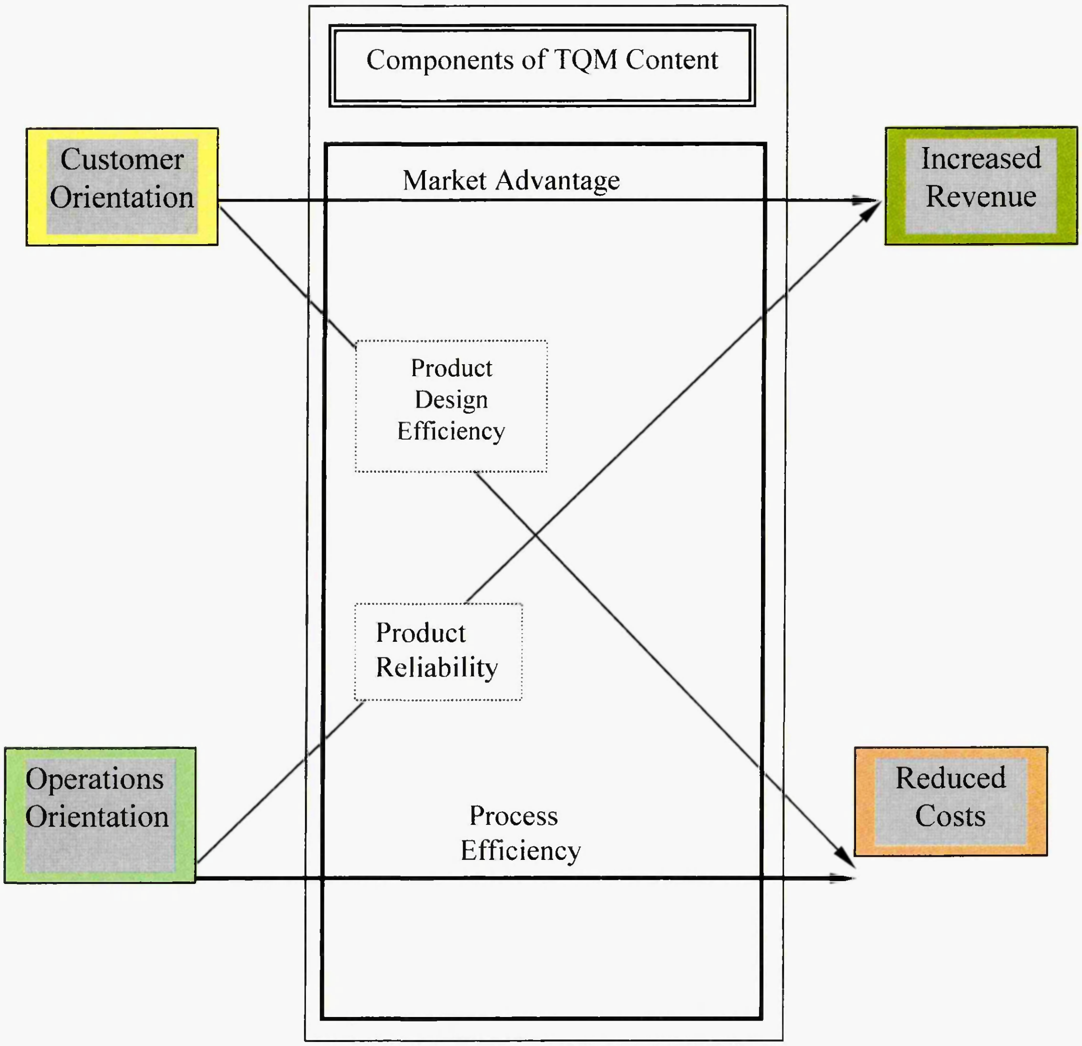
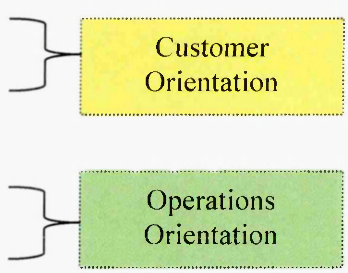


Fig 3.8: Firm Orientation, TQM Content, and Performance

(Source Reed et al, 1996)

Figure 3.8 highlights the Time Lag as stated by Reed et al (1996) which focussed on the four components of TQM content, namely

- Market Advantage
- Design Efficiency
- Process Efficiency
- Product Reliability



The interpretation of Figure 3.8 can be translated as follows; business results can be improved by increasing revenue or reduced by improving customer or operations orientation. The framework presented in Figure 3.8 is generic, therefore applicable to any organisation. Therefore, one could select a particular proposition to test depending on whether the organisation was customer oriented or operations oriented. As supported by Gustafsson et al (2003), Quality practices can be implemented to achieve both goals. Specifically, Reed et al (1996) recommended that the operations orientation components of TQM content (process efficiency and product reliability) must be tested considering time lags.

An example of the Market Advantage proposition is presented by Reed et al (1996) as follows:

> The Time lag after implementation of TQM for the appearance of either associated benefits or penalties would approach zero

In order to establishe the differences between the tradition management and the concept of TQM, Table 3.9 summarises these differences.

Table 3.9: The Differences between TQM and Traditional Management

<u>TQM</u>	<u>TRADITIONAL MANAGEMENT</u>
• Customer Focus • Quality First • Multiple Quality Dimensions • Management & Worker Involvement • Process-Oriented	• Management Focus • Focus First • Single Quality Dimension • No Worker Involvement • Result-Oriented

Source: Tobin (1990)

The noted differences in Table 3.10 which according to Ghobadian and Gaellear (1996) can lead to SMEs having both advantages and disadvantages can further be narrowed down to the six core areas as follows;

- Structure
- Procedures
- Behaviour

- People
- Contact.

Table 3.10: Differences between Small and Large Organisations

Large organisations	Small and Medium Organisations
1. Hierarchical with several layers of management	1.Flat with very few layers of management
2. Clear and extensive functional division of activities.	2. Division of activities limited and unclear
3. High degree of specialisation.	3. Absence of departmental/functional mind set
4. Strong departmental/functional mind set	4. Low degree of standardisation
5.Activities and operations governed by formal rules and procedures	5. Mostly organic
6. High degree of standardisation and formalisation	6. Short decision-making chain
7. Mostly bureaucratic	7. Top management close to the point of delivery
8. Extended decision-making chain	8. Top management highly visible
9. Top management a long distance away from the point of delivery	9. Span of activities narrow
10. Top management's visibility limited	10. Single-sited
11. Wide span of activities	11. Unified culture
12. Multi-sited and possibly multinational	12. People dominated
13. Cultural diversity	13. Fluid culture
14. System dominated	14. Flexible organisation
15. Cultural inertia	15. Very few interest groups
16. Rigid organisation and flows	16. Incidence of gut feeling
17. Many interest groups	17. Dominated by pioneers and entrepreneurs
18. Incidence of fact-based decision-making more prevalent	18. No specific budget
19. Dominated by professionals and technocrats	
20. Range of management styles: directive; participative; paternal etc.	
21. Meritocratic	

Source: Ghobaddian and Gaellear (1996)

3.7 Utilisation of TQM within SMEs

The importance of TQM for SMEs is widely acknowledged by various authors (Parkin and Parkin, 1996; Quazi and Padibjo, 1998; Wiklund and Wiklund, 1999; Yusof and Aspiwall, 2000, 2001; and Ghobadian and Gallear, 1996) who state that SMEs are often suppliers of goods and services to larger organisations and therefore a lack of product quality from SMEs would adversely affect the competitive performance of larger organisations. This study seeks to understand whether organisational performance is directly linked to the adoption of TQM. Empirically identified sources of competitive advantage are presented along with the necessary conditions for attainment. Although Quality Management has been advocated there is no research to date to underpin the pursuit of this strategy. If such a strategy did not lead to the attainment of the set objectives, then construction related enterprises would be wasting valuable organisational energy. This would in fact detract from obtaining an increase in productivity.

3.7.1 Problematic Issues in Implementation of TQM

Literature review indicates that the main barriers to TQM Implementation in SMEs are due to :

- Cultural Barriers
- Management awareness barriers
- Financial barriers
- Training barriers

Shammas-Toma et al (1998) found the following obstacles to the implementation of TQM due to poor co-ordination, the use of one subcontractor and the use of D&B contracts among others.

Two out of three organisations engaged in the TQM implementation process consider it a failure, Stockdale (1998). This high failure rate is due to the factors that follow, which though listed separately are not mutually exclusive and most organisations experience a combination.

- **Insufficient commitment by senior management**

Senior management must instil in all employees of the host organisation a desire to improve the competitiveness of the company. TQMs three vital elements are systems, people, and resources. Successful implementation is dependent upon senior management developing and organising these key elements. Oakland (1993) notes that TQM "requires total commitment, which must be extended to all employees at all levels and in all departments". Therefore senior management must be fully committed to the implementation processes, which can be evidenced by senior management providing all resources required for the TQM initiative.

- **Incorrect corporate culture**

TQM requires a corporate culture based on trust and a desire to identify problems in order to eliminate them thus improving production processes. The concept of `empowerment' is a vital part of the TQM philosophy. However, if a climate of distrust exists between senior management and the rest of the organisation the implementation process is doomed to fail. Organisations must understand that a truly morphogenic change is necessary and that a cosmetic 'morphostatic' change will not sustain TQM. Organisational culture dictates the way a business operates and how employees respond and is treated. Organisational culture contains such elements as a guiding philosophy, core values, purpose and operational beliefs. These elements have to be integrated within a mission statement which interprets the cultural theory into tangible targets bounded by closed objectives.

- **Lack of formal implementation strategy**

TQM is a project and therefore requires planning as a project. To treat it as an organisational bolt-on activity will lead to failure. TQM is a means of improving the competitiveness, effectiveness and flexibility of an entire organisation. Achieving these noted advantages requires organisations to plan and organise every operational activity at all levels of the organisation. This process must be part of strategic implementation development and not treated in isolation. Senior management must also understand that the benefits of implementation are not instantaneous because TQM is a long term corporate investment.

- **Lack of effective communication**

The life-blood of any organisation is communication and the importance of this organisational activity cannot be over-emphasised. Within a TQM framework all employees of the company should be able to communicate as necessary, and not forget the concept of `internal' and `external' customers with its requirement for effective communication mechanisms. If employees are to become part of the organisational decision making process they need a means of expressing their views to senior management. Control within any organisation is dependent upon the communication systems function.

- **Narrowly based training**

The key to a successful TQM implementation is having staff that is competent to execute their allocated tasks. If employees are empowered to plan and perform work activities it is vital they possess all the necessary skills and competencies. A primary function for a construction related enterprise seeking to gain a competitive advantage is to implement "training and education in teamwork" (Hellard 1993). For example, if staff need to participate in group discussions, training in group dynamics and public speaking would be advantageous.

- **Emphasis on organisational strengths**

TQM is designed to provide a competitive advantage based upon the host organisation's strengths. Senior management should not lose sight of the fact that sustained competitive advantages are obtained by implementing strategies that exploit their strengths through responding to environmental opportunities, while neutralising external threats and avoiding internal weaknesses (Barney 1991). The following two standard corporate planning techniques can be utilised: firstly, Strengths, Weakness, Opportunities, and Threat (SWOT), analysis and secondly Political-Legal, Economic, Social-Cultural, and Technological (PEST) analysis.

3.7.2 Key Elements for Consideration in the Implementation of TQM

- Senior management must attain a full understanding of the philosophy and requirements of TQM; they are responsible for establishing a quality focused organisation.

- A common vision is required by all employees of the organisation. This may be accomplished by adopting awareness sessions, customer surveys, and benchmarking and common vision workshops.

- Provision of the necessary resources which include human as well as financial requirements.

- The development of an implementation strategy which may be based on an incremental process. Senior management must regularly review the quality management systems in order to maintain progress.

- Designing procedural systems appertaining to work practices. Concentration of organisational effort should be placed on prevention rather than corrective actions.

- A truly Post-Modernist organisational environment must be established and maintained.

Brah et al (2002) found that the key to successful quality management lies in the intangible factors and the TQM tools and techniques, while Ugboro and Obeng (2000) maintain that a successful adoption of TQM as a competitive strategy requires both structural and cultural transformation. Although the statistics used in this chapter are mostly taken from within the UK Construction industry, the problematic issues of TQM implementation are universal as shown by the research conducted by the Construction Industry Institute (CII) in the U.S. The studies identified the problems of quality in the construction industry and found deviations (rework, repair), not including impact costs, such as schedule delays, were costing the owner over 12% of the total project cost (Biggar 1990). Similarly, studies conducted by Rwelamila (1995) in Southern African Development Community (SADC) Construction industries drew the same conclusions.

3.8 Summary

This chapter addressed the following issues: firstly the application of TQM as applied to the construction industry was briefly examined. Secondly the established linkages between TQM and competitive advantage and their structural implications for competitiveness were presented via Porter's (1980) framework. The implications of the Egan and Latham reports were examined in light of their terms of reference. Egan's 5 Key drivers of change were found to be compatible with the major constructs as used in this study, therefore the potential outcomes of this research will be viewed as contributing to the scope of improving the construction efficiency. The third section investigated the necessary requirements for the attainment of a sustainable competitive advantage and finally the problematic issues concerned with the implementation of total quality management within a construction operational environment were explored. In order to investigate the relationship among TQM practices and to identify the direct and indirect effects of TQM practices on various dimensions of performance, and which essential elements contributed to total quality management and business and organisation performance indicators as a source of competitive advantage are identified in the next chapter. Also the next chapter will examine the relationship between TQM and strategy and identify the conditions necessary for competitive advantage. This Chapter has offered an overview of TQM within the Construction Industry. It identifies the major concepts of Total Quality Management and explores the utilisation of TQM within SMEs. In the next chapter the potential for TQM as a source of competitive advantage is examined. The next chapter will now examine the possible potential of TQM as a vehicle for Competitive Advantage. This is achieved by describing three kinds of strategies that can be applied to the construction organisation. It will also attempt to illustrate how management's adoption of TQM is necessary if the organisation is to keep a competitive edge and that the integration of the Key Drivers of Change can lead to reduction in cost and overall improvement.

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Chapter Four

TQM as a Potential Competitive Advantage

CHAPTER FOUR: TQM AS A POTENTIAL FOR COMPETITIVE ADVANTAGE

4.1 Introduction

Using the overview of TQM application provided for in Chapters 2 and 3 respectively, this Chapter describes and examines three kinds of strategies that can be applied to in construction organisation. It will also illustrate how management's adoption of TQM is necessary, if the organisation is to keep a competitive edge.

The chapter is divided into the following sections:

Section 4.2 Introduces the theories of strategy
Section 4.3 Explains the business forces necessary for competitive advantage
Section 4.4 Competitive strategy and TQM
Section 4.5 TQM as a potential for competitive advantage
Section 4.6 The three level impact of TQM
Section 4.7 Supporting strategies with TQM
Section 4.8 Conditions necessary for competitive advantage
Section 4.9 Summaries discussion in this Chapter

4.2 Theories of Strategy

For any organisation, developing a Quality Management System for the first time needs to be focused on developing a strategy for defining the overall objectives that will guide all participants. Managers spend more time and energy on implementing strategies than choosing them. Well chosen strategies will fail because of poor implementation. Getting the organizational structures right for a particular strategy is thus clearly critical to practical success. (Whittington, 1989)

Ansoff (1965) describes three types of competitive advantage as:

- Cost leadership
- Differentiation

- Focus

Through these strategies, an organisation can surpass its competitive rivals.

Newcombe et al. (1993) corroborates with Ansoff by stating that the outputs of the strategic systems are startegic decisions, administrative and operational-designed to meet the objectives of the stockholders in the business, and to achieve competitive advantage. Fig 4.1 illustrates the three generic strategies as asserted by Porter (1980). Porter identified two competitive advantages that provide a firm with a defensible position: *lower cost* and *differentiation.* The lower cost advantage is defined as the ability to efficiently design, manufacture, and distribute a comparable product than the opposition.

	UNIQUENESS PERCEIVED BY THE CUSTOMER	LOW-COST POSITION
INDUSTRYWIDE	**DIFFERENTIATION**	**OVERALL COST LEADERSHIP**
PARTICULAR SEGMENT ONLY	**FOCUS**	

Figure 4.1: Three Generic Strategies

According to Tenner, (1992) Capturing the competitive advantage offered by Total Quality Management is possible in all types of businesses, from manufacturing through to services. Furthermore, the techniques can be applied to all functions within an organisation including information systems, marketing, finance, engineering, administration, office service, and R&D. How can organisations in the construction industry compete on total Quality Management?

Theories of strategy

The four generic approaches to strategy:

- Classical approach - the oldest and still the most influential, relies on the rational planning methods dominant in the textbooks.

- Evolutionary approach - draws on the fatalistic metaphor of biological evolution, but substitutes the discipline of the market for the law of the jungle.

- Processualists - emphasizes the sticky, imperfect nature of all human life, pragmatically accommodating strategy to the fallible processes of both organizations and markets.

- Systemic - relativistic, regarding the ends and means of strategy as inescapably linked to the cultures and powers of the local social systems in which it takes place.

4.3 Business Forces Necessary for the Attainment of a Competitive Advantage

A Competitive advantage must be both a point of difference and an advantage, as defined with respect to the firms regarded as competitors. Aaker (1989). A different view of competitive advantage is provided by Porter (1985) who states that it is achieved when a firm's product is viewed by its customers as having a higher value than the product of its competitors. Robson et al (2003) operationalised competitive advantage as a set of measures from a balanced range of competitive result areas that indicated distinct gaps between themselves and others. These are; values (quality/price), market share, cash flow, overall productivity, return on assets and operating costs.

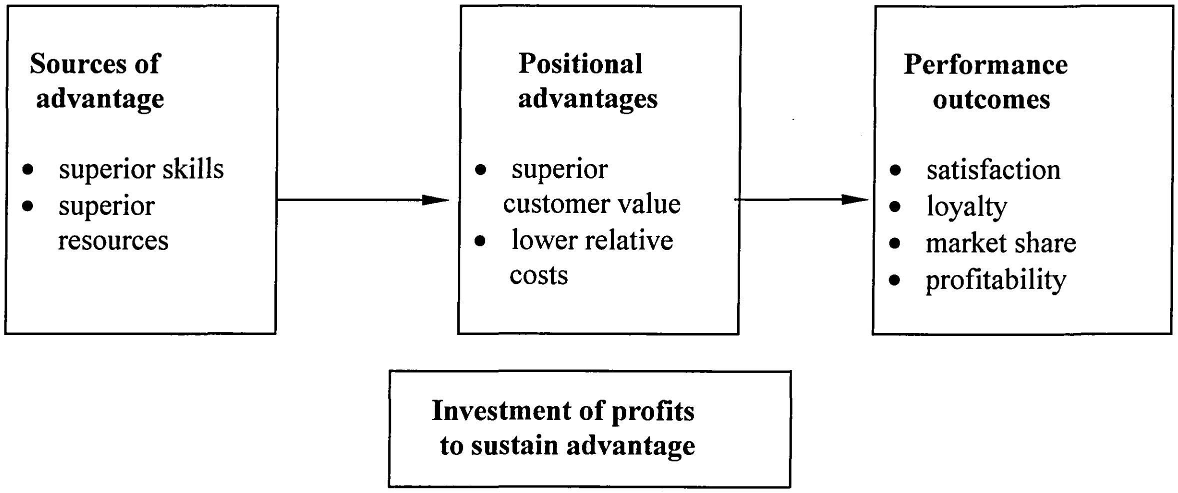

Figure 4.2: *The elements of competitive advantage* Source: Day and Wensley (1988)

It has been pointed out by Porter (1980) that there are essentially only three generic strategies for being a dominant player in an industry:

- gaining cost advantages
- product differentiation, or
- focusing on a particular niche

Porter further contends that competitive advantage is derived from four mutually reinforcing features of :

1. factor conditions
2. demand conditions
3. related and supporting industries
4. local competition draws heavily on the premise that individual firms are constrained by/or respond to the local conditions that they face.

Total Quality Management can assist in implementing any of these three strategies:

A firm is said to have a competitive advantage when it is implementing a value relating strategy, not simultaneously being implemented by any current or potential competitors (Barney, 1991). Competitive advantages often arise out of the ability to generate synergy's that increase customer value (Bounds.,1994) Competitive advantage can be decomposed into component parts that either generate improved revenues or reduce costs. Reed et al. (1996) concluded that market-driven firms can establish a market or position advantage that produces increased market share (or reduced elasticity of share). That in turn, provides improved revenues. Cherkasky (1992) states that when quality concepts are applied to every decision, transaction, and business process, quality becomes a competitive weapon.

4.3.1 Competitive Advantage Defined

Competitive advantage is best defined as follows:

> "A Competitive advantage is quite simply an advantage your competitors do not have. Once they have access to the special formulation, the new process, high speed machinery, or whatever your advantage is, then it is no longer competitive"
> (Hardy, 1983.129)

TQM works by inspiring employees at every level to continuously improve what they do,hence rooting out any unnecessary costs. The competitive advantage results from directing human resources on controlling costs and improving customer services.

A literature search identified that successful businesses, whether in the manufacturing or construction industry, are engaged in making and taking opportunities. Hardy (1983: 30) states that the development of a competitive advantage automatically creates an opportunity, and so the reasoning may be modified to: 'Successful businesses are engaged in the creation and exploitation of competitive advantages.'

4.4 Competitive Strategy and TQM

"Competitive strategy is the search for a favourable competitive position in an industry, the fundamental arena in which competition occurs. Competitive strategy aims to establish a profitable and sustainable position against the forces that determine industry competition" (Porter, 1985)

4.4.1 A Lower cost strategy

Newcombe et al (1993) found this strategy to be particularly relevant in the construction industry, where a majority of work is led by a competitive tender, usually to the lowest tender. A Firm that pursues a lower cost, competitive advantage strives to improve its profitability by having lower costs, relative to its industry (Porter, 1980, 1985, 1990)

4.4.2 Focus as a strategy

This strategy concerns organisation's ability to target niche markets within its industry, such as certain customer groups or on a regional area. The basis for competition is selective, but within the niche market competition is either on a low cost or differentiation basis. According to Porter (1985), the focus strategy has two variants: Cost *focus* and *differentiation.* In cost focus, a firm seek a cost advantage in its target segment, while in *differentiation focus* a firm seeks differentiation in its target segment.

4.4.3 Differentiation as a strategic alternative

Research has shown that this is a difficult strategy to achieve under competitive tendering. This calls for the building organisation to offer a distinctive service to its construction clients.

Through the application of TQM as Information Systems, it:

- Adds unique features to product/service directly
- Enhances the ability to differentiate the product/service through other functions

Sigouras (1994) has shown that depending on a type of competition a firm finds it in, different strategies have to be adopted. A *differentiation* competitive advantage, prescribes that a firm achieves and maintains a means of making its product unique from its competitor's. (Galbraith and Schendel, 1983; Kotha and Orne, 1989) as cited in Flynn and Flynn (1996). According to Newcombe et al (1993), within construction organisations, differentiation typically occurs firstly by function, then by market sector, for example;, civil engineering or housing, and then followed by region, which either be national and international offices.

4.4.4 The advocating of quality

Cherkasky (1992) states that when quality concepts are applied to every decision, transaction, and business process, quality becomes a competitive weapon. However, processes which have the greatest impact on customer satisfaction could be targeted for improvement, and only market research would identify the "key customer drivers" or, those products and service attributes of greatest concern to customers.

4.5 Potential Strategies for Using TQM To Gain A Competitive Advantage

Porter (1980) identified three generic types of competitive advantage. These were considered along with the characteristics of constructed products and processes, which suggested ways in which construction firms can use Total Quality Management to gain competitive advantages. Hasegawa (1988) has outlined the business strategies and approaches to strategy formulation used by leading Japanese contractors as being the following; product diversification, business diversification; and market segmentation

These are depicted in the following figure:

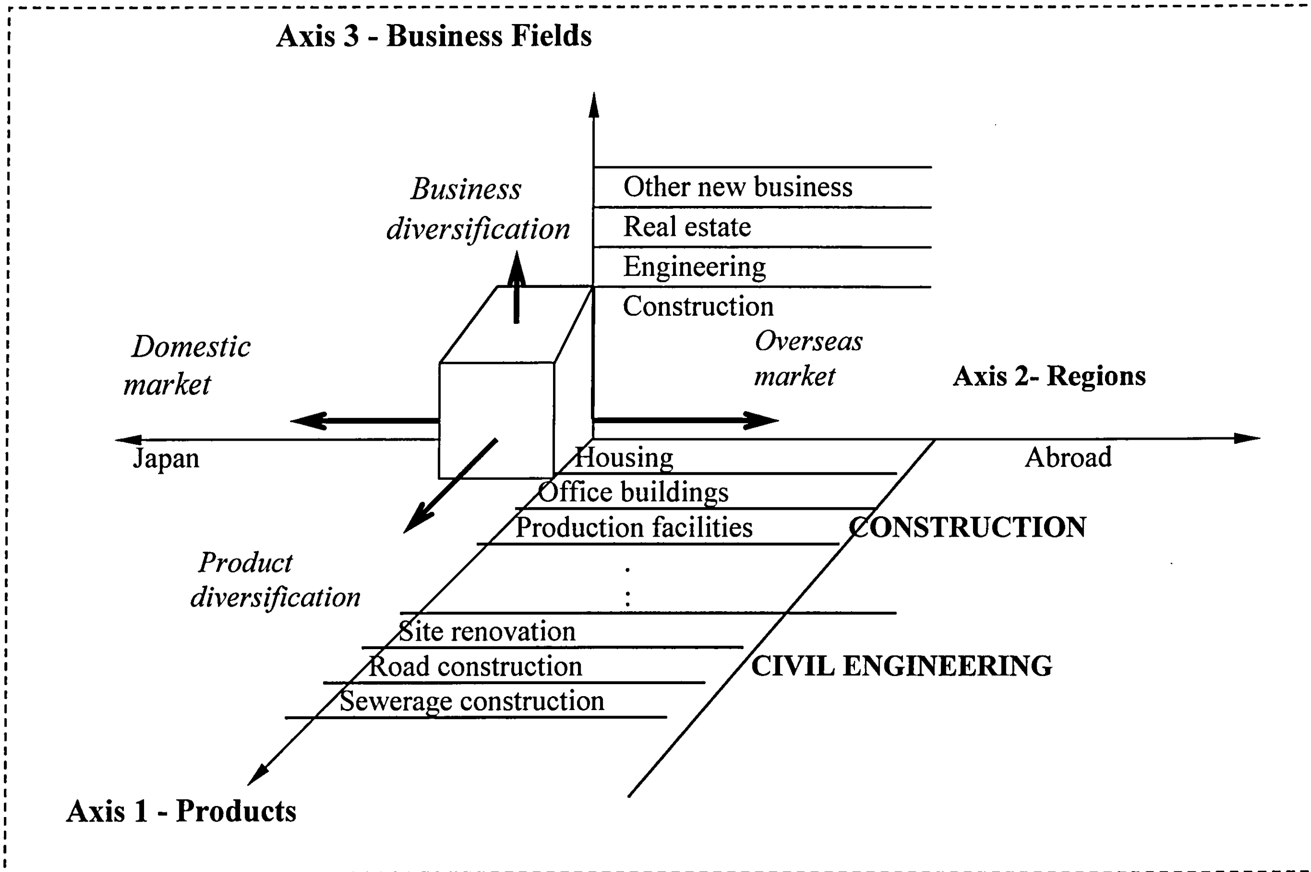

Figure 4.3: Cost Leadership Based on TQM:

Hillebrandt and Cannon (1990) describe the following means of product differentiation in construction:

- offer a range of project management methods
- ranging from construction into design
- extending into financial packaging
- extending forward into commissioning and facilities management

4.6 Strategic Implications of TQM at three levels; the industry, the firm and the Strategic Level.

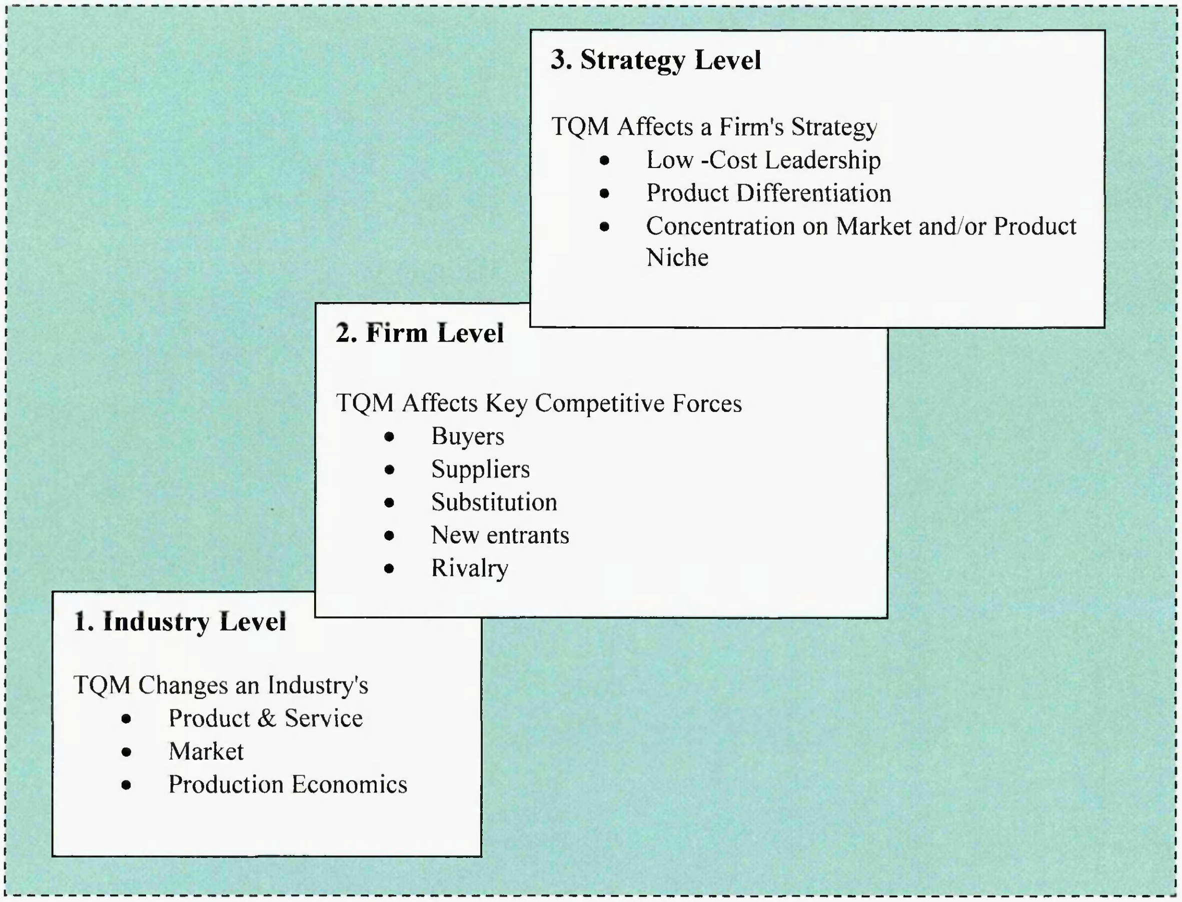

Figure 4.4 The Three - Level Impact of TQM

4.6.1 The Impact of TQM at The Industry Level

4.6.2 Products and Services

The strategic impact of TQM at industry level was not examined in depth, as the focus of this research was at the organisation level, in particular to address how the TQM affected key competitive forces as identified by Porter (1990). However, a limited literature review was conducted, and highlighted in particular the linkages between product/service and competitive strategy. The following issues are;

4.6.3 Markets

Literature reviews show that TQM and Marketing are complimentary. Sigouras (1994) raised the following questions:

1. Whether TQM can be applied to any kind of market and product, and if so, to what degree?

2. Whether we should always expect improvements at all levels from a TQM application, or should we be aware of the possibility of failure or only partial success?

4.6.4 Production Economics

According to Sigouras (1994), any TQM approach should avoid focusing on profit and/or price results, and should not expect any major changes in the market- least of all in the short-term. This is when there is Pure Competition. Sigouras identifies the primary characteristics of pure competition as:

- Many small sellers and buyers;
- No entry or exit barriers;
- Homogeneous product;
- No product differentiation among firms;
- Any retailer can sell as much as they wish at the market place; and

- No buyer or seller can separately influence market prices. Market price is determined by the forces of 'demand and supply' within the market, and buyers and sellers react to that price (or demand). Where does the Construction Industry fit in the given scenario?

4.6.5 The Impact of TQM at the Firm Level

Castle (1998) used the integrated quality system (IQS) to map the quality management system, Miyake et al (1995) used the approach of applying practices and tools derived from just-in-time, total quality control and total productive maintenance in a complementary manner, similarly this research will focus on the application of Total Quality Management Systems (TQMS) into Porter's work. Porter's (1980) framework for the analysis of competition in specific industries, shows that an industry has a high level of competitive rivalry when it is easy to enter. Both buyers and suppliers have bargaining power and finally there is a threat of substitute products/services.

Although Porter's analysis of competitive forces does not specifically address TQM, it can provide a framework for establishing the role that TQM can play in an organisation's competitive strategy. In order to achieve this objective, a series of questions were posed.

Can TQMS:

1. be used to build barriers against new entrants (CF1)?
2. change the basis of competition (CF2)?
3. be used to generate new products (CF3)?
4. be used to build in switching costs (CF4)?
5. change the balance of power in supplier relationships (CF5)?

'CF' denotes Competitive Force, see Figure 4.5.

By using this framework, management can learn how TQM changes an industry structure through the competitive forces that shape industry. The structural implications of TQM for the construction industry are addressed by the following questions:

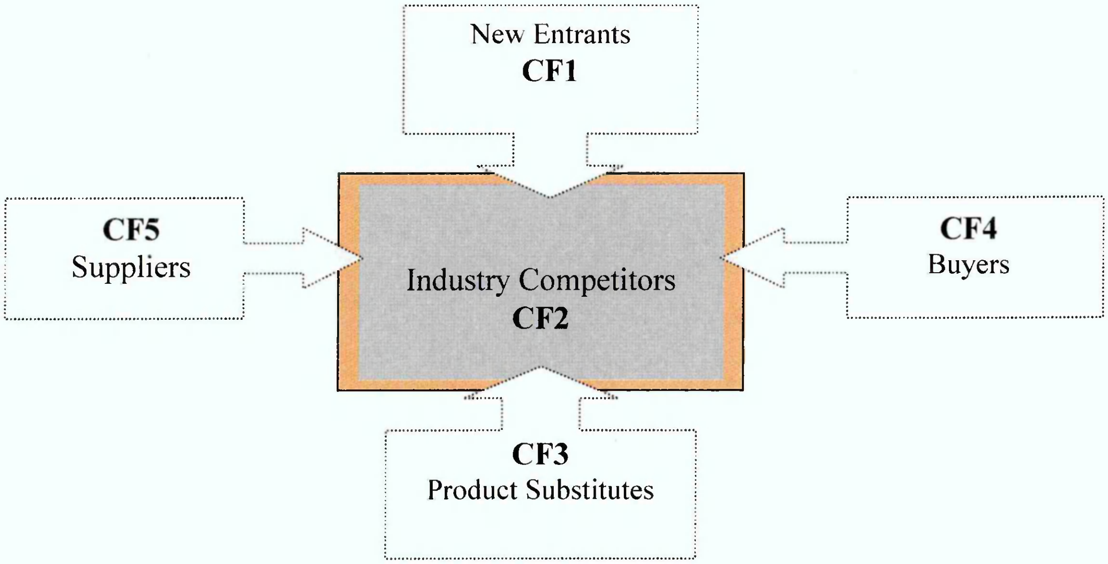

Figure - 4.5: Elements of Competitiveness in the Construction Industry (Adapted from Porter, 1980)

CF1 - Low Entry Barriers

Competitive Force 1 is characterised by low capital requirements, limited cost advantages, easy access to distribution and low expected retaliation.

CF2- Industry Competitors

Competitors within industry are numerous in each segment and there is intense rivalry.

CF3 -Moderate Threat of Substitutes

This is through other designs, off-site fabrication and similar price performance.

CF4- Moderate Buyer Power

There is moderate buyer power through concentration in specific segments, low switching costs and moderate buyer information which is highly cyclical.

Finally, **CF5 - Moderate Supplier Power** is characterised by bulk to engineered materials, moderate supplier concentration and moderate threat of forward integration.

Six of the most important barriers identified in literature are as follows:

- cost advantage of incumbents
- capital requirements
- product differentiation
- customer switching costs
- access to distribution channels
- and government policy

As Borthwick et al (1999) contend, as the markets become more competitive, these entry barriers should become less restrictive. Other barriers identified are those that relate specifically to the advent of the single market. These are physical, technical and fiscal barriers. It is not the intention of this thesis to discuss these in greater depth, but to show an awareness of the different types of barriers.

The next sub section now explores how the implementation of TQM can be used as a defensive mechanism against these potential barriers.

4.6.5.1 Barriers against New Entrants

- The following research question is posed, "Can TQMS be used to build barriers against new entrants (CF1)?"

The barriers of entry are largely dependent on the size of the organisation. SME Organisations may gain entry into the construction market. However, they are likely to face competition from other smaller firms wishing to become suppliers to large organisations. This is due to the increasing demand for a higher quality of service from large organisations. (Ghobadian and Gallear,1996). TQM could provide a barrier if clients insisted that it be a pre-requisite for entry onto tender lists.

4.6.5.2 Competitive Forces

Can TQMS change the basis of competition (CF2)?

Competition in the construction industry is no longer just between firms from the same sector, but from different sectors as well. Hasegawa (1988) noted that with the interface between construction and non-construction industries growing increasingly wider, it exposes contractors to competition from greater proliferation of outside companies. Mohrman et al (1995) established a correlation between various market conditions and the application of TQM practices. These practices included organisational approaches such as quality improvement teams; quality councils, cross-functional planning, self inspection, direct employee exposure to customers, collaboration with suppliers in quality efforts, just-in-time deliveries; and work cells.

Various improvement tools such as the use of statistical process control techniques by front-line employees, process simplification, and re-engineering; were also evidenced. Measurement systems such as customer satisfaction and cost of quality monitoring also played a vital part. These studies showed that companies experiencing foreign competition and extreme performance pressures were more likely to use most of the TQM practices, tools and systems. According to Mohrman et al (1995), this provided the evidence that competitive pressures led to the adoption of TQM. Betts and Ofori (1992) also argue that as trade barriers come down, construction enterprises in each country will face real competition from firms in other countries, even for small construction projects. The government has even acknowledged the problems of the Construction Industry by accusing them of lacking customer focus, and being ready to use any excuse to pursue so-called claims against government departments (The Guardian, 8/11/95). In the report (Construction Procurement by Government. "An Efficiency into Scrutiny") published in 1996, it calls for moves away from the usual practice of awarding tenders to the lowest bid,but rather giving it to the best designers and suppliers who could provide the best service.

4.6.5.3 Supplier Relationship

Can TQM change the balance of power in supplier relationships? (CF3)

Many companies in the manufacturing industry ensure the quality of their component delivery by requiring suppliers to adopt TQM programs. (Powell, 1995). Similarly in construction, some owners and contractors have been requesting that their suppliers (vendors) implement TQM if they wish to be considered for future work (Mathews and Burati 1989),and Ghobadian and Gallear (1996) identified that small and medium enterprises (SMEs) were often suppliers of goods and services to larger organisations. and in order for them to remain competitive, they would have to consider the application of TQM .

The thoughts of Ghobadian and Gaellear are corroborated by Moreno-Luzon (1993) who comments that if a small firm wants to become a supplier to a larger company, the increasing demand for quality by the latter creates a strong influence on the former to consider the application of TQM. Organisations should *create supplier partnerships* by choosing collaborative ventures on the basis of quality, rather than entirely on price (Gummer 1996). Companies today are not only placing demands on their organisation to become world class suppliers, they also place heavy demands on their suppliers to become world class. (Steingraber 1990). Moreno-Luzon (1993) identifies other factors influencing the spread of TQM between small and medium-sized firms as, pressure of costs, increasing competition, and more demanding customers requiring small firms to implement TQM.

Aware of the importance of quality in improving the competitiveness of the local economy, some public institutions promote and facilitate the efforts of small firms to take on this innovation. Bricknell (1996) emphasises upon communication and relationships extending beyond the organisation. A good long term relationship with a particular supplier allows you to have a strong influence on the quality of products and service that you receive, far beyond that of a conventional supplier customer relationship. Powell (1995) concluded that process improvement and supplier certification improves performance, but the performance impacts of the remaining

TQM features vary depending on the firm's stage of TQM advancement. Several studies (Motwani, 2001; Tsang and Antony, 2001; Akintoye et al, 2000) highlight the importance of suppliers in the TQM process. They argue that if what is coming down stream to you is laden with waste, in form of poor quality or erratic delivery schedules, your TQM efforts, regardless how aggressive, can only suffer. This statement typifies the way the industry operates and in which many parties are involved. If the supplier's goods are sub-standard and other contracts were to rely on them, then the corrupt elements would be embedded in the entire process. As Newcombe et al. (1993) equally agrees by stating that in an industry with low capitalisation, such as construction, the bargaining power of suppliers (and sub-contractors) is considerable. Many builders' merchants are far larger than the building firms that they supply, and the withdrawal of credit has often brought bankruptcy to building contractors.

Larson and Sinha (1995) in citing Groocock (1994) observed that buying power over the supplier, and lack of buyer trust in them, could spark supplier quality improvement efforts. He proposes that future research should look at the role of *inter*-organizational (buyer/supplier) relationships, including cooperation, trust, power, and conflict in quality/productivity improvement. According to Sigouras (1994), The TQM theory states that maintaining good relations with the supplier is critical and that the quality is defined by the customer. How true is this for the Construction Industry with it's adversely nature?

In order to explore the impact of TQM on sustained competitive advantage, the nature of competition has to be examined under the assumption that organisations have different amounts of physical, human and organisational capital. Atkinson and Naden (1989) highlights four basic factors, which successful Japanese companies seemed to use to great effect to penetrate their market and give them a competitive advantage:

- Systems
- Leadership and Commitment
- Training
- Participation

Big companies tend to subcontract many products and services, and are dependent; therefore on a network of suppliers, most will be small firms. According to Moreno-Luzon, (1993), the big companies must be assured of obtaining high quality supplies and services from these small subcontractors in order to develop their own TQM programmes.

Another school of thought is given by Fahy (1996) who contends that competitive advantage for service firms lies within the unique resources and capabilities possessed by the firm. Not all resources or capabilities are a source of competitive advantage - only those that meet the stringent conditions of value, rareness, immobility, and barriers to imitation. Powell (1995) contends that despite TQM's apparent widespread dissemination-and the claims by adherents that any firm can imitate TQM, there are powerful reasons to believe TQM is imperfectly imitable. The diffusion of innovation literature provides a useful perspective on this issue. While the resource literature focuses mainly on resource imitation from the perspective of firms seeking to protect competitive advantage, the diffusion of innovation approach takes the perspective of the potential adopter. The line of research shows that firms will not always attempt to imitate resources that produce advantages for competitors, and that diffusion of innovation depends on the following factors:

1. *perceived relative advantage*- the extent to which adopters believe the innovation is better than current practice

2. *compatibility* - the degree to which an innovation is perceived by the adopter as consistent with their needs, values, and experiences;

3. *simplicity*- the degree to which the innovation is perceived as understandable and implementable;

4. *trialability*- the degree to which an innovation can be experimented with on a limited basis;
5. *observability*- the degree to which an innovation and its benefits can be observed by the potential adopter.

Furthermore, the Construction Industry has been slow in terms of research on Innovation. Among the innovative measures there could be the usage of AHP to measure the effectiveness of TQM implementation by linking it to the performance measures. Future research could be the application of AHP to the SMEs within the UK Construction Industry. Motowa et al (1999) illustrates the need of gaining competitive advantage as a way of stimulating construction organisations as a way of exploiting innovative products and processes. Further identified were TQM mechanisms such as teamwork, leadership and information flow facilitates innovation.

4.6.5.4 Substitution (CF4)

The threat of substitute services has become more acute during the recent recession, with the traditional demarcations between design and construction being reduced by design and build and management contracting. These approaches offer clients substitutes for the traditional competitive tendering methods. (Newcombe et al. 1993)

4.6.5.5 Buying Power

Newcombe et al. (1993) notes that the bargaining power of public sector clients was considerable during the period from the Second World War until the early 1970s. The power was exhibited through fierce and often cut-throat competition, for work based on ridiculously large numbers of tenders. However, Porter (1998) views buyers as being more powerful compared to customers in local or sector context.

4.6.5.6 Rivalry (Industry Competitors)

According to Newcombe et al. (1993) competitors will be concerned with the level of rivalry between themselves *within* the construction industry. The rivalry in construction markets is likely to be based on the extent to which construction firms are 'in balance'. Balance depends on *market share* and *size* of competing firms. The construction industry is fragmented with no contractor holding a dominant position in terms of market share, although locally there may be dominant firms in a region.

4.6.5.7 The Impact of TQM at the Strategic Level

This sub section introduces the impact of TQM on strategy level. The argument for considering TQM as a form of business strategy from the content and process perspective is presented by Reed et al (1996). They posit that though both are necessary; they are not sufficient conditions for success. Tatum (1988) shows the three levels of strategy: The firm, the business unit and the functional unit.

The Figure 4.6 below illustrates the levels and major questions to be addressed.

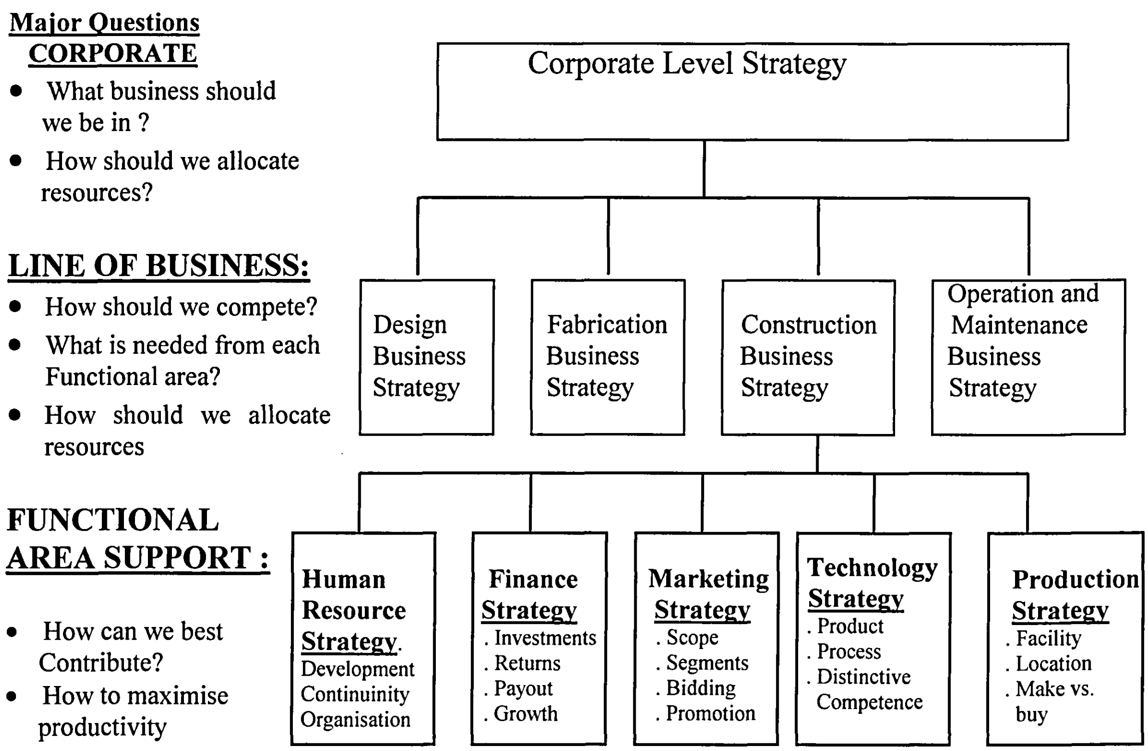

Figure 4.6: Levels of Strategy for a Diversified Architecture, Engineering, and Construction Firm

The business level strategy is strategy, concerned with how to compete in each chosen business, whereas the functional strategies describe the actions in each of the functional areas to support the line of business and corporate strategies. These are usually prepared by the person responsible, normally the functional manager. The application of TQM would have to be considered at three levels in order to appreciate the full benefits.

For example, under the functional level, the Impact of human resource strategies on TQM Implementation can be examined in greater detail.

Parsons (1983) suggests that before management can consider the long-run impact IT will have within their firm, they must understand how IT is changing the industry. The same can be said of TQM. To effectively link TQM to the strategic needs of the firm, management must anticipate the impact of TQM at the industry level before it occurs, so that the strategies can be developed to position the firm appropriately in the new industry setting.

4.7 Supporting Strategies with TQM

In order to explore the impact of TQM on sustained competitive advantage, the nature of competition has to be examined under the assumption that organisations have different amounts of physical, human and organisational capital. Studies conducted by Leonard and McAdam (2002) found TQM to be a key driver in the implementation of corporate strategy, if not in its formulation.

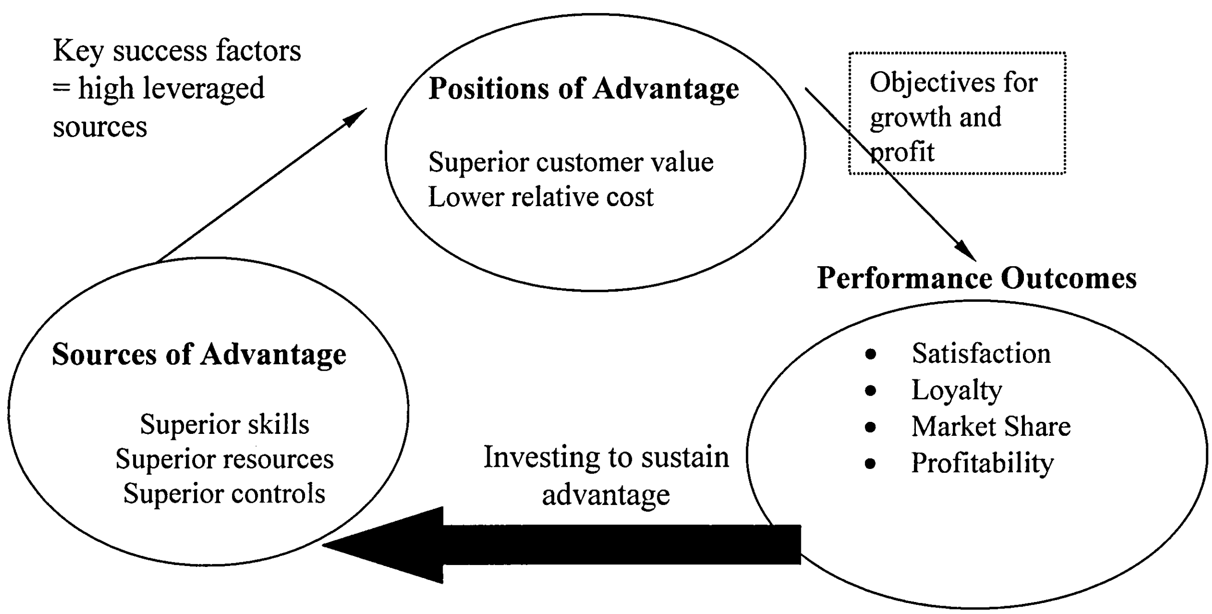

Figure 4.7: Sources of Competitive Advantage

Source: Day (1990),

4.8 Conditions necessary for competitive advantage

Fahy (1996) contends that competitive advantage for service firms lie within the unique resources and capabilities possessed by the firm. Not all resources or capabilities are a source of competitive advantage - only those that meet the stringent conditions of value, rareness, immobility, and barriers to imitation. The actual sources of competitive advantage are likely to vary depending on the nature of the service, the particular traits of the firm, the nature of the industry, and the country of origin. Fahy concludes that service firms must seek to identify the skills and resources they possess, that they meet the above criteria, and to leverage such resources to attain a competitive advantage.

Table 4.1 Methods of Assessing Advantage

Competitive-centred	Customer-focused
A Assessing sources (distinctive competencies) 1 Management judgements of strengths and weaknesses 2 Comparison of resource commitments and capabilities 3 Marketing skills audit	
B. Indicators of positional advantage 4 Competitive cost and activity comparisons (a) Value chain comparisons of relative costs (b) Cross-section experience curves	5 Customer comparisons of attributes of firms vs. competitors (a) Choice models (b) Conjoint analysis (c) Market maps
C. Identifying key success factors 6 Comparison of winning vs. losing competitors 7 Identifying high leverage phenomena (a) Management estimates of market share elasticises	
D Measure of performance 10 (a) Market share 11 Relative profitability (return on sales and return on assets)	8 Customer satisfaction surveys 9 Loyalty (customer franchise) 10 (b) Relative share of end-user segments

Source: Day and Wensley (1988)

Powell (1995) shows that under the resources view, success derives from economically valuable resources that other firms cannot imitate, and for which no equivalent substitute exists. The possible measurement methods for assessing competitive advantage as shown by Day and Wensley (1988) are in shown in Table 4.1.

4.9 Summary

This Chapter provides the rationale for Total Quality Management as a potential for competitive advantage and explores the impact of TQM at the Industry, Firm and Strategic levels, and concludes that TQM can contribute to the competitive nature of the Industry, can equally be used as a basis of supplier co-operation. The arguments presented have been backed by the market based theory of completive advantage, systems and resource-based theory of the firm. Having identified the potential of TQM for competitive advantage, the next chapter will examine the antecedents to Total Quality Management.

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Chapter Five

Organisational Antecedents to the Implementation of TQM

CHAPTER FIVE: ANTECENDENTS TO TOTAL QUALITY MANAGEMENT

5.0 Introduction

Using the Overview of the UK Construction Industry, the Implication of TQM, and Potential for TQM as a source of Competitive Advantage provided for in Chapters Three and Four respectively, the aim of this Chapter is to describe and examine the antecedents to the successful implementation of TQM within construction related SME's; Explain the steps in the implementation process and highlight the problematic issues and in particular identify the key success factors. This Chapter further presents a brief comparison of the manufacturing and construction industries. It also explores and presents various definitions of competitive benchmarking.

This Chapter is divided into the following nine sections:

Section 5.1 Embarking on TQM

Section 5.2 Explains the steps in the Implementation Process

Section 5.3 Highlights the problematic issues and advocates solutions

Section 5.4 Identifies the critical success factors

Section 5.5 Justification of the Powell Instrument

Section 5.6 Presents a comparison of Manufacturing Versus Construction

Section 5.7 Explores the definitions of competitive benchmarking and its benefits to Construction

Section 5.8 Explores the impact of organisational size to the implementation process

Section 5.9 Summaries discussion in this Chapter

5.1 Embarking on TQM

According to industry experts adapting to a TQM-oriented culture, , is often a frustrating and expensive process characterised by high front-end costs, extensive training time, possible restructuring of people and departments and a complete shift away from short-term perspectives.

Lascelles and Dale (1993) identified six levels of TQM adoption. They believed that organisations could be divided into the following levels, depending on the permanency of TQM. The six levels are:

1. Uncommitted
2. Drifters
3. Tool-pushers
4. Improvers
5. Award winners
6. World class

According to McCabe (1998), each level comprises of different behaviours manifested by an organisation on its journey to TQM. The graph (figure 5.1) depicted shows a constant level of permanency of TQM for the first three levels before an upsurge with the last two, world class and award winners only differing by their permanency of TQM. A detailed description of each level can be found in either (Lascelles and Dale, 1993:285) or the adapted version in McCabe, (1998:175)

The criticism with the research is that it is too prescriptive, as is predominantly based on characteristics which organisations would have to fall into. During early considerations for what this research would focus on, there was potential for extending Lascelles and Dale's (1993) work by devising a simple matrix based on the generation of relative indices for commitment and advancement.

This would probably lead to a new classification of nine groupings; however, the limitations have been noted with this approach as it would require a longitudinal study.

The premise of the suggested classification entails a spiral approach where the target would still remain world class, but the route undertaken would be of ascending and descending. A graphical presentation is shown in Fig 5.1.

As with every journey, it is always fraught with obstacles. The following sub section discusses some of the identified barriers to the implementation process. What is evident, is that there is commonality to the obstacles whether by industry (manufacturing v construction) or country based (UK versus China) with only cultural issues coming into play.

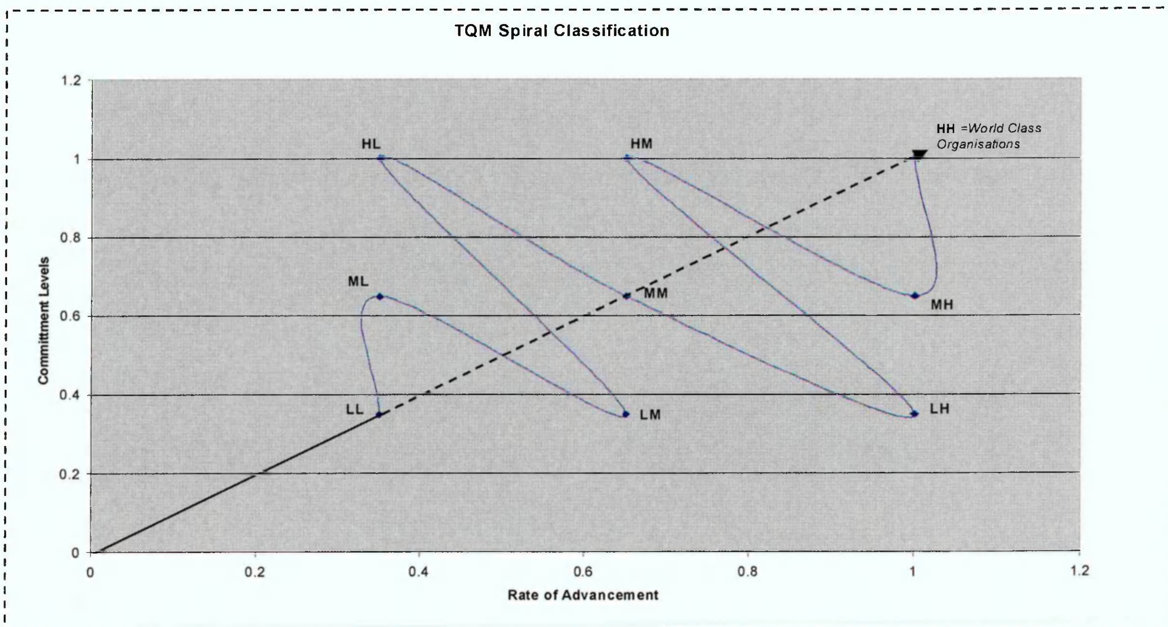

Figure 5.1 – Proposed Journey (Road-Map) to TQM

Author's interpretation to be based on the indices generated by the TQ-SMART

Some of the reasons for not embarking on TQM are included below:

> "We think TQM is now an "old hat" leading to unnecessary, prescriptive procedures, which depletes entrepreneurial activities".

"As a company we strive at every level to provide clients with a quality of service, which goes beyond what they have asked, to include areas to their advantage that they haven't considered. We provide a total package for all works on or underground which is every 'developer's problem area".

Managing Director (28 Years in employment by the organisation)

However, it is not all doom and gloom, some organisations are beginning to note and appreciate the benefits of TQM particularly in order to achieve client's requirements.

"Our group Quality Management System is designed to interpret and fulfil our client's requirement through awareness of the group's commitment to continued improvement and quality through active support and demonstration of the commitment".

Quality Manager of a TQM deploying Organisation

5.2 Steps in the Implementation Process

The literature contains several steps in the implementation process, for example, there is no specific or correct (generic) way, and some of the earlier or seminal works on the implementation are tabulated as follows:

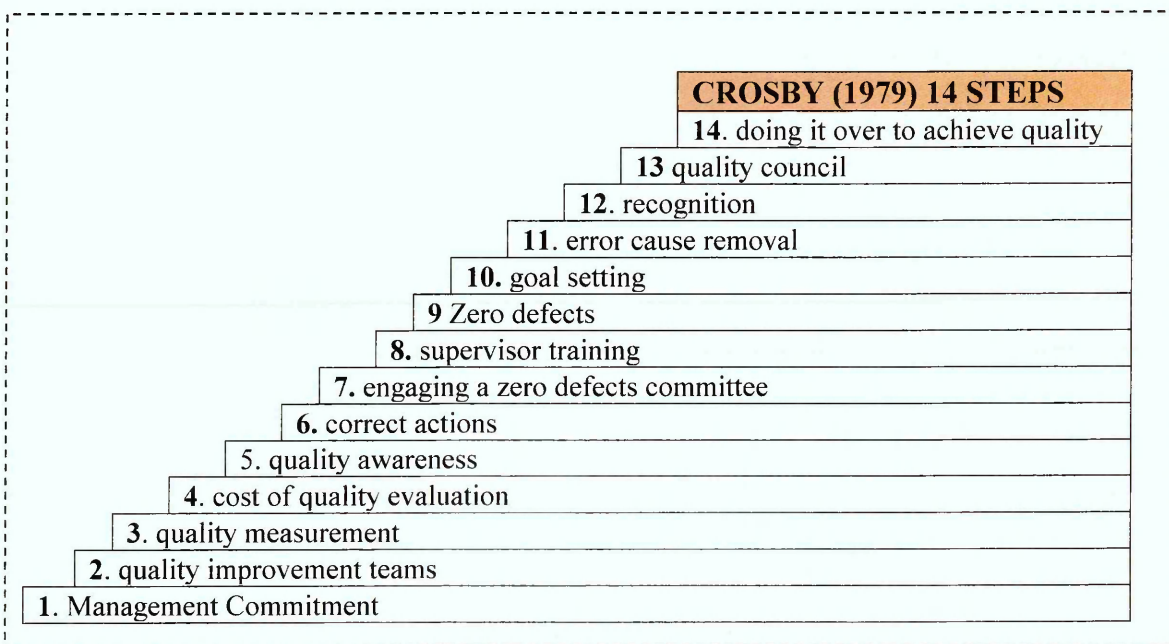

Figure 5.2: Crosby 14 Steps in the Implementation Process

5.2.1 The Deming Management Method

Deming's TQM approach is based on his prescriptive set of 14 points.

DEMINGS (1986) POINTS

14. Putting everyone to work
13. Self-improvement (education and training)
12. Taking pride in workmanship
11. Eliminating quotas
10. Eliminating slogans
9. Breaking down barriers
8. Driving out fear
7. Institute fear
6. Training on the job
5. Continuous improvement
4. Refusing to award business sole on price
3. Ceasing mass inspections
2. Adopting the philosophy
1. Constancy of purpose

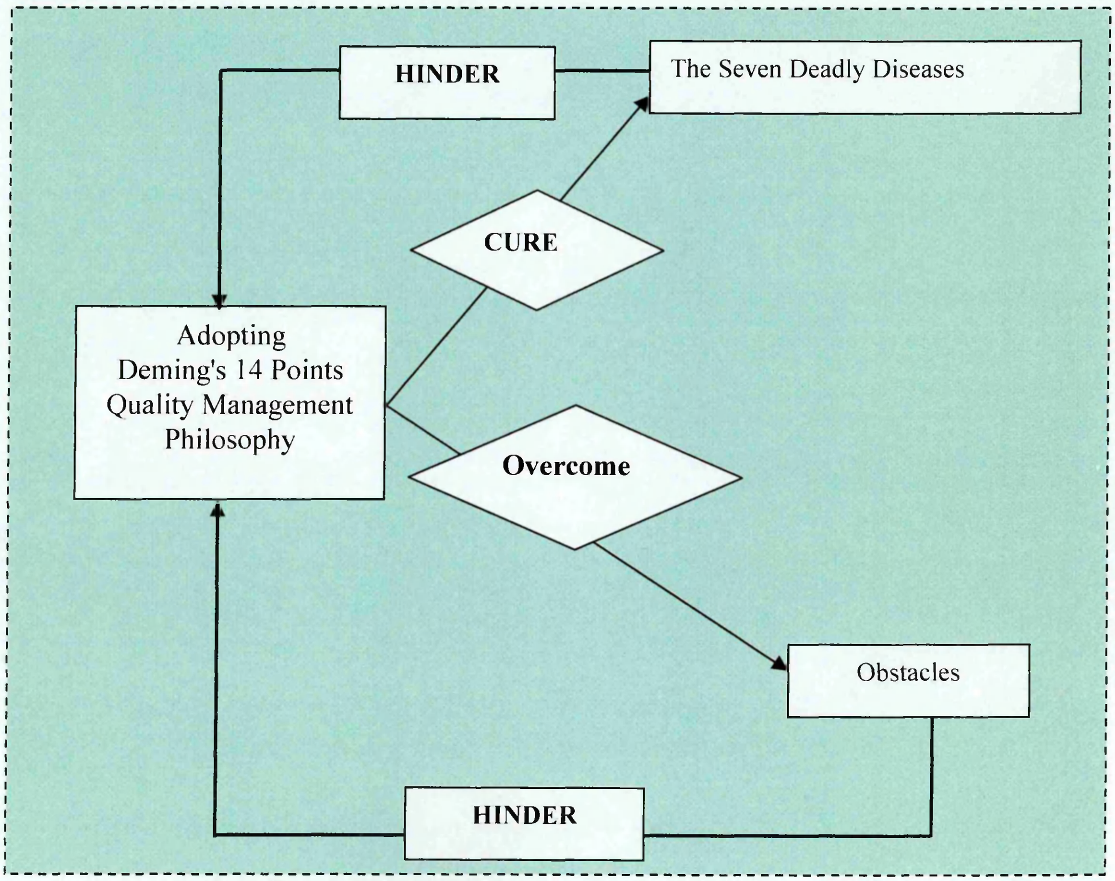

Figure 5.3 Deming's 14 points, seven deadly diseases, and obstacles

Source: Deming (1986)

Where as Juran (1989) proposed three principles namely Quality planning, quality control and quality improvement.

Ghobadian and Gallear (2001) suggest that TQM implementation plans follow a four phase implementation approach, namely, start-up (launch); transition; consolidation; and maturity/re-focusing.

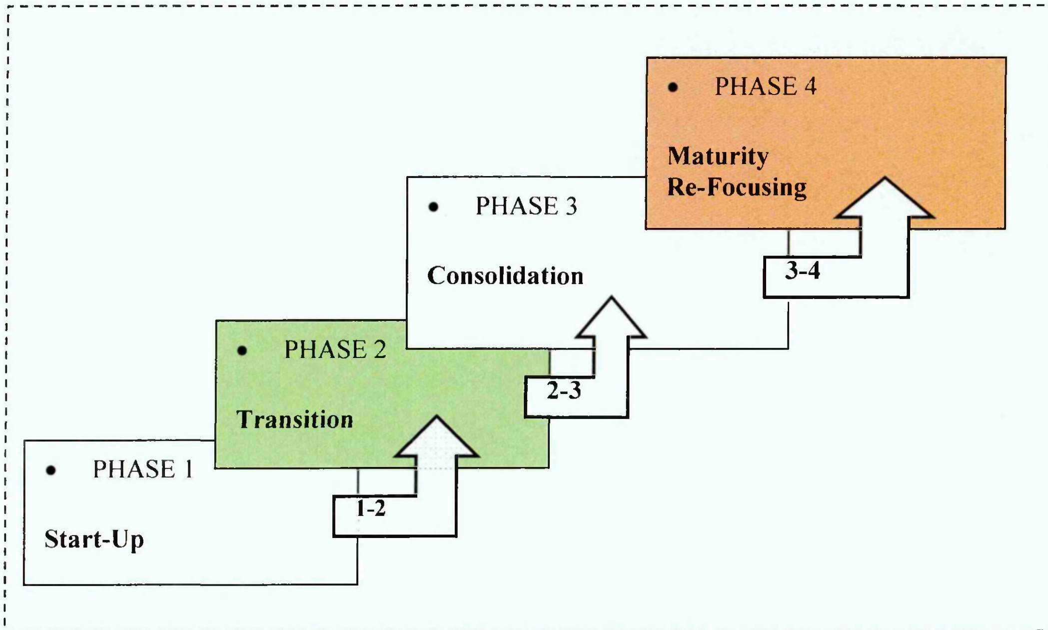

Figure 5.4 Four Phase Implementation Approach

Adapted from: Ghobadian and Gallear (2001)

5.3 Construction-Related Problematic Issues to the Implementation Process

Problems facing the implementation of TQM in the Construction Industry are well researched and documented. Earlier studies indicate that the nature of the industry in itself creates problems for the development of effective quality management systems. Grover (1987) notes that when the construction industry is stripped to the basic elements, the industry is one that designs and assembles structures made up of other industries, a task which involves formidable problems of organisation. His sentiments are shared by Pheng (1993) who states: "The nature of the construction industry is, however, unique as most building projects encompass the participation of numerous parties, including design consultants, contractors, subcontractors, building materials, manufacturers and suppliers"

Here, Pheng is advocating for the integration of all parties involved in a building project for quality to be achieved. However, the constructional industry has been reluctant to embrace TQM. (Egan, 1998, 2002)

> The Cabinet Office says that on average the 20 projects studied overran costs by 24 per cent - 500 million pounds - and these did not include the worst fiasco of all, the project to provide facilities for Trident in Scotland, which was 800 million pounds over budget. The analysis by Sir Peter Levene, Prime Minister's adviser on efficiency, finds fault with both the multi-billion pound construction industry and government departments' handling of the projects.
>
> The report, which looks at 20 building projects, backs a scathing attack on the building by Sir Michael Latham. It accuses the construction industry of lacking in customer focus, being too ready to use any excuse to pursue so called claims against government, and of being fragmented, divided by poor communications and slow to adopt modern technology.
>
> (The Guardian, 8/11/95)

The citation, though dated eight years ago, has been included to indicate the state of problems the Industry was in. Moreover, it came a year after the publication of the Latham Report, implying that the Industry was merely paying lip service.

The TQM revolution has transformed many businesses. However, the road to TQM is not without its dangers. Creating a culture of continuous improvement offers many opportunities to go astray. (Laza and Wheaton, 1990). Ashford (1989) noted that only a minority of construction defects are technical in origin. Far more arise from inadequacies in the management structure of the industry, lack of training and from the commercial pressures, which stem from the almost universal custom of awarding work, to only the lowest bidder. Burati et al (1992) cites the public construction sector and the transient craft labour force as factors need to be addressed in the US Construction Industry. "The question of the transient craft work force must be addressed before TQM can reach its fullest potential in the construction industry".

Shammas-Toma et al (1998) identified the following as obstacles to implementing TQM in the UK Construction Industry as:

- Poor coordination
- The use of one subcontractor
- The use of D&B contracts
- The use of CAD

Expanding on one of the barriers above (Lack of trained workers), the situation is made difficult because of the current problems of retaining permanent labour force in the construction industry. This is mainly related to the different skill requirements of each contract and the different locations at which work might be done (Jones and Cockerhill, 1984). Wilkinson and Witcher (1991) summarised the barriers with particular reference to the UK under four main headings;

- Short-termism
- Organisational segmentalism
- Reluctant managers
- Industrial relations

Short-termism

The ownership of industry in the UK, and the dominance of the finance function work to exaggerate measured financial performance in the short term, rather than on longer term. Term objectives such as building market share, or developing and exploiting new technology. According to recent studies by

Love et al (2002) indicate that organisations in the construction industry have eschewed implementing TQM practices because short-term benefits are minimal.

Organisational segmentalism

This refers to organisations' tendency to specialise in segments, and distance themselves from each other. Therefore, proving to be a major problem when it comes to the issues of inter-unit, departmental and plant quality in TQM implementation.

Reluctant Managers

The manager's lack of understanding of the principles of TQM is one of the major obstacles to the implementation, or adoption of Quality Management practices. Scase and Geoffee's (1989) Survey of middle manager opinion within the UK reported that many managers felt they had been subject to greater demands to work harder under tighter monitored circumstances. Terziovski et al (1999) found similar experiences in the Australian sector.

Industrial relations

Impact of trade unions were considered to be unimportant as factors in the implementation of TQM according to Develin and Partners (1989) and citied in Wilkinson and Witcher (1991).

Laza and Wheaton (1990) identified the following as the common TQM pitfalls:

- Oversimplification and underestimation of the difficulty of bringing about cultural change.

- Failure to recognise that every company, and every environment, is different.
- Lack of project management and/or the management of TQM implementation as a project.
- Conducting mass training before establishing support systems for TQM.
- Overemphasising technical tools at the expense of leadership and management issues.
- Applying tools before needs are determined and direction is established.
- Failure to provide the structure to move the program to supplier or subcontractor organisations.

Drawing similarities from the US Industry, Schaffer and Thomson (1992) identified the following six factors that made TQM programs especially difficult for U.S. firms to imitate:

- Process (rather than results) orientation,
- TQM is too large-scale and diffused
- Bad results are excused for the sake of the program success
- Delusional measurements of success
- TQM is staff- and consultant-driven, and
- TQM is biased to orthodoxy, not cause and effect.

Masters (1996) further highlighted the following 8 distinct barriers that plague organisations as:

1. lack of management commitment
2. inability to change organisational culture
3. improper planning
4. lack of continuous training and education
5. incompatible organisational structure and isolated individuals and departments
6. paying inadequate attention to internal and external customers,
7. inadequate use of empowerment and teamwork, and

8. ineffective measurement techniques and lack of access to data and results

Corrigan (1994) shows a different view as to why TQM efforts fail. He lists three prime causes of failure as:

- lack of constancy of purpose
- lack of adequate leadership, and
- failure of pilot improvement teams.

He further argues that the failure is due to the presence of the following traits:

- over delegation of TQM responsibility
- great initial enthusiasm quickly followed by impatience
- an unwillingness to change their own behaviour, and
- lack of personal participation in the TQM effort.

The Construction Industry Institute (CII) in the U.S., conducted research which identified the problems with quality in the construction industry and found deviations (rework, repair), not including impact costs, such as schedule delays, which were costing owners over 12% of the total project cost (Biggar 1990). This was a conservative percentage, as the projects were evaluated after completion, and most did not even have formal programs to track all rework. This meant that for the $140 billion U.S. construction industry, they wasted in excess of $16 billion annually.

Whelan and Rahim (1994) offered a different perspective and identified the implementation and development barriers under the following subheadings:

- Poor planning
- Lack of management commitment
- Resistance of the workforce
- Lack of appropriate training
- Teamwork complacency

- Use of an off-the-self program
- Failure to change organisational philosophy
- Lack of resources provided
- Lack of effective measurement of quality improvement.

From the various reasons put forward as barriers, the common theme emerging is the lack of management commitment, poor training, and emphasis on the usage of SPC than support systems for TQM. More recent research by Taylor and Wright (2003) indicates that the influence of lack of management understanding of TQM can affect the implementation outcomes. Furthermore, Quality Managers within the construction industry who are not intent on pursuing TQM are prone to frustration. One manager had the following comment in response to the definition of TQM commented:

> "In our area of work TQM tends to be overwhelmed by everyday problems arising out of the traditional construction industry difficulties. It is an achievement to complete a scheme on time, and to our client's reasonable satisfaction so quality as a definable factor is, at best ephemeral
>
> Given that the industry operates in an essentially under-trained/under capitalised way for consultants who are similarly limited and that our clients demand Rolls Royce quality for sub-ford prices, TQM/EFQM and similar concepts have more in common with deck chairs on RMS Titanic!
>
> Our industry will remain mixed in the dark ages until we take ourselves seriously and change accordingly so that we can train our workforce, employ sufficient supervisors and insist on competent designs and specifications".

The above comment captures some of the antecedents to the successful implementation of TQM. Some major issues relate to training as being a major obstacle. It acknowledges the superiority of the manufacturing industry by referring to "Rolls Royce" which is normally construed as a symbol of excellence within the manufacturing industry. The aspect of having competent designs and implications are equally covered in detail under the Juran's Triple role concept. The argument being that if the workforce is not trained, then its difficult for them to understand the drawings, let alone the interpretation will be lost as desired by the engineers. The result of which are products not conforming to specifications.

Fienberg (1998) identified the resistance of TQM initiatives by most managers as the following three opposing principles:

- Managers know better
- The customer is not always right
- Not everything is a process (in the TQM sense of the word)

5.4 Identification of the Key Success Factors

Literature review identified numerous studies dealing with the identification of key or critical success factors for the implementation of TQM. Some of the factors are industry specific, in particular among the early writings, the TQM success factors were done within the manufacturing environment. Saraph et al (1989) derived eight factors from interviewing 162 managers; others were award based, for example Black and Porter (1996), who derived ten factors with 106 elements. The source of these factors being the Malcolm Baldrige National Quality Award model (MBNQA). Other work on critical success factors are listed in Table 5.1.

During the 1980's, when Japanese were prominent in the quest for quality improvement techniques, Atkinson and Naden (1989) identified the following eight lessons to be learnt from the Japanese about the success of TQM :

- Education
- Fool proofing
- Quality Circles
- Communication
- Automation

- Measure and Display
- Quality is not just a Manufacturing Concept
- Long Term planning

On a country scale, DeCieri et al. (1991) carried out an empirical study of TQM in Australian Manufacturing companies and based on their observations, they identified the following to be critical factors for TQM:

- Key people such as facilitators need to be appointed on a full-time and long-term basis;
- Senior management must understand TQM and the processes involved.
- Continuous improvements at the workplace are needed.
- A demonstrable constancy of purpose in the elimination of waste and elimination of poor decision-making processes is needed.
- Change must be demonstrated, or dissatisfaction will affect the performance of employees
- Good communication is important. Consultation is an important factor throughout the process of TQM implementation;
- Critical measurements which affect the organisation must be installed and utilised;
- Worker involvement and commitment are fundamental to TQM implementation.

Zhang et al (2000) developed a measuring instrument for the Chinese manufacturing industries whereas Antony et al (2002) advocate the following potential benefits of TQM:

- Improved employee involvement
- Improved communication
- Increased productivity
- Improved quality and less rework
- Improved customer satisfaction

- Reduced costs of poor quality and Improved competitive advantage

However, they emphasise that this is dependent upon TQM being fully adopted and practised effectively. Antony et al (2002) further contend that this results in strengthening the organisational business performance and competitive advantage. The only limitation in this research is that they did not specify as to whether the competitive advantage would be sustainable. The research equally tests the potential advocated benefits of TQM to be gained by the SMEs in the UK Construction Industry, the results of which are presented and discussed in Chapter six.

In order to learn how service quality might be achieved, Ghobadian et al (1994) present the four requirements as follows:

- market and customer focus
- empowerment of frontline staff
- well-trained and motivated staff
- a clear "service quality" vision

- All the four requirements are included in the Powell (1995) instrument as customer focussed, employee empowerment, training and adopting a quality philosophy. Other critical success factors are summarised in table 5.2. Some findings of critical success factors are summarised in the following table:

Table 5.1: Critical Success factors for TQM

Author (Purpose and source of factors)	**Critical success factors for TQM Implementation**
Saraph et al (1989) **Purpose**: To develop an instrument for studying critical success factors of Quality Management in Minneapolis, USA. **Source**: from concepts and prescriptions of quality gurus **Industry**: Manufacturing and Service	1. Top management leadership 2. Role of the quality department 3. Training 4. Product design 5. Supplier quality management 6. Process management 7. Quality data reporting 8. Employee relations
Black and Porter (1996) **Purpose**: To develop critical success factors for the Europe **Source:** Malcolm Baldrige National Award Model (MBNQA) **Industry**: Manufacturing	1. People and customer management 2. Supplier partnership 3. Communication of improvement information 4. Customer satisfaction orientation 5. External interface management 6. Strategic quality management 7. Teamwork structures for improvement 8. Operational quality planning 9. Quality improvement measurement systems 10. Corporate quality culture
Tamimi (1998) **Purpose**: to analyse the critical TQM success factors. **Source:** Deming's 14 points **Industry:** Manufacturing	1. Top management commitment 2. Supervisory leadership 3. Education 4. Cross function communications to improve quality 5. Supplier management 6. Quality training 7. Product/service innovation 8. Providing assurance to employees
Joseph et al (1999) **Purpose**: to analyse the critical TQM success factors using second order analysis in Pennsylvania, USA Source – Saraph et al (1989) research **Industry** : Indian Manufacturing	1. Organisational commitment 2. Human resources management 3. Supplier integration 4. Quality policy 5. Product design 6. Role of quality department 7. Quality data reporting 8. Technology utilisation 9. Operating procedures and 10. Training

5.5 Justification for Selection of Measuring Instruments

A comparison between the Powell (1995) instrument as refined in this study and other empirical quality measurement instruments indicate that all empirical studies have gaps in terms of coverage of the constructs. According to Behara and Gundersen (2001), these gaps highlight the fact that Quality Management theory building research is in the mapping/relation building stage.

Comparisons with Other Quality Measurement (QM) Instruments. Comparisons of the various instruments were made on the following criteria:

- Objective of the Instrument
- Industry of Application

  Manufacturing, Service or Construction
- Level

  Plant or Individual/ Business Unit
- Methodological shortcoming
  - a lack of identification and validation of the Quality Management constructs
  - a lack of the analysis of relationships among constructs
- Operationalization of TQM Constructs
- Results and Future Research

The constructs developed in this study are compared with five other major Quality Measurement instruments. The comparison of Powell (1995) is made with the following instruments;

- Saraph et al (1989) - 8 constructs (78 items)
- Flynn et al (1994) - 10 constructs
- Ahire et al (1996) - 12 Factors (100 items)
- Black and Porter (1996) - 10 Factors
- EFQM - 5 Enablers and 4 Results

- Samson and Terziovski (1999) used 6 constructs

Various researchers have acknowledged that developing new constructs or scales of measurement is normally a complex task. It is recommended wherever possible to use pre-tested constructs from past empirical studies to ensure their validity and reliability. Hyrkas et al (2003) identify that the production of a brand new instrument is a time consuming process in which the bulk is dedicated to the conceptualisation of the instrument and selection and reduction of items.

According to Hensley (1999) and citied by Koste et al (2004), rigorous scale development is a time-consuming endeavour, as evidenced by the fact that between 1989 and 1996, Hensley could only find six studies in the operations management literature that utilised and described a formalized, complete scale development process using questionnaire data.

For example Motwani et al (1994, 1997) used the Saraph et al (1989) Instrument to forecast quality of Indian Manufacturing Organisations. However, as the instrument was designed for both Manufacturing and Service organisations, no refinements were done by Motwani et al (1994).

Table 5.2: Comparison of Previous Studies on Development of Measurement Instruments

Study	Purpose (Industry)	Source and Scales Used Sample
1. Saraph et al (1989)	Develop an instrument for measuring critical factors of quality management (US Manufacturing and Services)	162 General Managers and Quality Managers of 89 divisions of 20 organisations - 8 factors with 66 items
2. Porter and Parker (1993)	Manufacturing	Balridge Award Criteria
3. Flynn et al (1994)	Develop an instrument based on empirical and practitioner literature (Manufacturing)	7 major dimensions with 48 items 42 manufacturing plants.
4. Ahire et al (1996)	Identify constructs of TQM and develop scales for measuring these constructs. (US Manufacturing)	12 factors with 50 items 371 responses from different plants in automobile industry
5. Black and Porter (1996)	Identify a set of critical factors of TQM (Manufacturing & Services)	MBNQA
6. Powell (1995)	Manufacturing & Services	54 US manufacturing and service firms
7. Motwani (2001)	Measuring Critical Success Factors of TQM	

Firstly the reason that this model sets out to determine whether TQM was the source of competitive advantage, and secondly, as argued by Motwani 2001, this model encompasses the major constructs of TQM which are omitted in other instruments. Furthermore, it covers most of the requirements as envisaged by the Latham (1994) and Egan (1998; 2002) reports in improving the efficiency and effectiveness of the Construction Industry.

More importantly, the instrument also addresses the nine key concepts considered to be central to running a Total Quality project by the European Construction Institute (1996). The concepts are Teamwork, Leadership, Communication, Training, Empowerment, Alliancing, Benchmarking, Recognition and Reward, and Culture. Some of the concepts used in this study are still addressed. For example, the concept of Culture advocated by the ECI (1996) is addressed through the construct of "Open Organisation", whose variables emphasise a more trusting organisation culture. The concept of Teamwork can be found in the "Training" construct where the fourth variable seeks employee training in teamwork. Also the "Open Organisation" Construct advocates for the use of empowered teams.

The Alliancing Concept which describes the business relationship between Customers, Contractors and Suppliers working together on a project is addressed through the "Customer Focus" and "Supplier Focus" Constructs. For example the Customer Focus construct calls for increasing the organisations direct personal contacts with customers (Variable No. 7) and the Supplier Focus advocates the working more closely with suppliers.

Finally, the model advocated by Reed et al (1996) in exploring the firm orientation, TQM content and performance are best captured by the Powell Instrument, for instance the issue of Customer Orientation through market advantage.

5.5.1 Comparison with Other Quality Management (QM) Instruments

According to Filippini (1997), in order to support theory development, more attention should be dedicated to comparisons between studies and accumulation of Knowledge. This study achieves this requirement by replicating the Powell (1995) Instrument and comparing the results of this research to different studies which are described in this sub-section. In this sub section, a comparison of the TQ-SMART and Powell (1995) instruments with four other Quality Management instruments are presented: The Saraph et al (1989) instrument, Flynn et al (1994), Ahire et al (1996) and the Black and Porter (1996).

For the purpose of this study, the instrument developed by Powell (1995) to evaluate Quality Management practices in manufacturing or service organisations was used by refining it through the dropping of items specifically related to Manufacturing. These studies represent the various approaches taken in Quality Management theory development.

5.5.2 Rationale of Selecting These Instruments for Comparison

From the industry point of view, none of the instruments examined included construction in their samples, they all included either manufacturing or service industries only. Of all the instruments only the Saraph et al (1989) and Powell (1995) included both Manufacturing and Services. The omitted construction is identified as the motivation for this research, though it is acknowledged that further work by Sharma and Gadenne (2002) did include construction in their sample.

The following sub section presents a brief description of the Instruments examined in this study, and a flowchart showing the various options in selection of the instruments and their justification for selection is presented.

5.5.2.1 Saraph et al (1989) Instrument (Plant)

Based on the theoretical work of quality gurus, including Deming, Juran, Crosby and Ishikawa, none of the service organisations included construction. Moreover, organisations with less than 1000 employees were excluded as the Quality Management Systems were precluded to be less advanced. One of the main limitations of the study was that it did not consider issues related to Customer Focus/Satisfaction, and Usage of Statistical Process Control (SPC). In terms of scale construction and reliability, the undimensionality of scale was not described, nor correlation analysis, the split-halves test and the comparison of oblique to orthogonal rotation.. The major strength of the instrument is that it had a high level of external validity. This was tested in 20 service and manufacturing firms. The reason for non inclusion of Customer Focus can be attributed to the fact that it was conducted in the early phase of Quality Management efforts in organisations, and as such was internally focused on the organisation and on its suppliers.

5.5.2.2 Flynn et al (1994) Instrument (Plant)

This instrument was based on practitioner and empirical literature which reports on practices in actual use in US and Japan, and was built on the Saraph et al (1994) study. The major omission of this instrument is that it excluded employee empowerment and benchmarking scales found in Powell's (1995) and Ahire et al (1996) instruments.

The following were not described; undimensionality of scale, split-halves, comparing oblique to orthogonal rotation and the Werts-Linn Jorsekog method. This instrument did however employ correlation analysis and deleted items with < 0.30. From the analysis point of view, this study used exploratory factor analysis (EFA) to analyse data from 42 manufacturing plants from three industries and included multiple responses from each facility.

5.5.2.3 Ahire et al (1996) Instrument (plant)

Ahire et al (1996) made a comparison of the Saraph et al and Flynn et al instruments. They identified, validated and tested 12 constructs based on literature within the manufacturing environment. This was based on a thorough review of the conceptualisation and empirical literature on TQM. Interestingly enough, both Ahire and the Black-Porter Instruments were published at the same time and in the same journal. In terms of analysis, this study undertook a confirmatory factor approach to the refinement and validation. The focus was on a single industry based on a total of 371 responses from different plants in the automobile parts industry.

5.5.2.4 Black and Porter (1996) Instrument (Business Unit)

This instrument had the added advantage of using the split-halves test and comparing oblique rotation in the Principal Component Analysis. However, the source and scale of items were drawn from the MBNQA, which is the assessment framework for identifying leaders in Quality Management within the United States, hence deemed inappropriate for this study. Furthermore, this research did not indicate the manufacturing or service focus of the 61 organisations that formed the basis of analysis.

5.5.2.5 This Instrument (TQ- SMART) and Powell (1995)

Powell (1995) used the TQM literature as the main literature base. However, one of the weaknesses of the Powell (1995) instrument is that the sample size was too small to permit generalisation. In comparing the four instruments, Powell (1995) developed a number of constructs and measures related to continuous improvement and organisation culture which addressed the issues raised in the Egan and Latham Reports. On the other hand, Flynn et al (1994), Black and Porter (1996); and Ahire et al (1996) developed constructs commonly associated with TQM by the Baldrige Award which is more US based, as opposed to the Powell Instrument. Only the Ahire et al (1996) and Powell (1995) addressed the benchmarking concept.

5.5.2.6 Comparison of Powell (1995) with the Silvestro (1998) Instrument

Silvestro (1998) further developed a TQM generic model derived from the manufacturing literature and enhanced it in the light of the service management literature. The model had six core precepts, which were deemed conceptually central to TQM. These are Customer Orientation, Leadership, Empowerment, Continuous Improvement, Elimination of Waste and Quality

Measurement, which were then compared to the TQM approaches. On closer examination, the six precepts are included in the proposed re-development of the Powell (1995), instrument. The following Table 5.3 presents a comparison of Silvestro's six precepts to the constructs that are included in the model that is the basis of this research:

Table 5.3: Comparison of the Silvestro and Powell Instruments

Silvestro (1998) Generic Model	Powell (1995) as Used in this study
1. Customer Orientation	1. Customer Focus[a]
2. Leadership	2. Executive Commitment
	3. Supplier Focus[b]
3. Empowerment	4. Employee Empowerment 5. Open Organisation
4. Continuous Improvement	5. Measurement 6. Training
5. Elimination of Waste	7. Zero Defects
6. Quality Measurement	8. Benchmarking
	10. Adopting a Quality Philosophy

What is notable from the above, that although the proposed redeveloped model will have 10 dimensions as compared to Silvestro's, some of the omissions are actually included within the dimensions.

For example, while Powell's supplier focussed dimension advocates for working more closely with suppliers and requesting them to meet stricter quality specifications and a requirement to adopt a quality program, the equivalent of Silvetro's model can be found under the customer orientation dimension.

This calls for multiple sourcing where suppliers are selected primarily on the basis of cost. This is similar to supplier partnership in the traditional TQM approach. Evidence of this can be found in Egan's (1998) argument for closer collaboration with suppliers, in order to improve the effectiveness of the industry.

The customer-focus dimension was originally named closer to suppliers. The same applies to Supplier Focus, which was renamed for the purpose of this study from its original name of Closer to Suppliers. As with the other limitations identified when conducting studies within the service industries, Silvestro's (1998) model was tested in the professional and mass services. Furthermore, no internal consistency and validity were ever tested on the model. It relied on the computation of mean scores along the six dimensions as a measure of TQM awareness. This research has shown that this is not the true representation of the scores as they portray an inaccurate picture. On the other hand, the TQMI index, which is explained in detail in the next Chapter, indicates a considerable reduction in the scores achieved as compared to the Silvestro method of scoring. Therefore, the TQ-SMART presents a more accurate way of presenting the scoring and will enable management to make accurate decisions.

5.5.3 Rationale for Selection of Existing Measures

There are various schools of thought as to which route to take. While option one might be desirable where a new concept is being studied, it has its own negatives. For example, developing new constructs or scales of measurement is a complex task (Prajogo and Sohal, 2003). In support of Option two, Tata et al (1999) notes that wherever possible, use pre tested constructs from past empirical studies to ensure their validity and reliability. Frohlich (2002) notes that the use of existing scales reduces the survey's length and makes it easier for managers to complete the instrument.

Furthermore, in order to empirically examine the relationship between TQM implementation and quality performance, a reliable and valid measuring instrument of Quality Management practices is normally required.

Any revisions to the authority's instrument must be identified and justified. However, it is acknowledged that an old instrument in a new application is an original investigation. According to Phillips (1982), a new or partly new instrument is not an absolute necessity for PhD research. In this case the instrument is used as a means to justifying the end. The flowchart shown in Figure 5.5 highlights two approaches for developing and validating an instrument.

The development draws on empirical data collected to explore the dimensions of the domain under investigation or theoretical knowledge of this area. Of the two options available, this study opted for the second option, and the rationale for that is provided in the next section. One of the rules for developing an instrument is always more economical to search literature to find an instrument that may be suitable for the study Fagarasanu and Kumar, (2002), Sousa and Voss (2002). Powell (1995) conclude that conventional tools of benchmarking and process management had less effect on performance than its more tacit features such as culture and employee empowerment . One of the weaknesses was that it relied on self-report data from Quality Managers to measure both independent and dependent variables. However, as observed (noted) by Nilison (2000); Coyle and Morrow (2003), this issue is of less concern to small organisations.

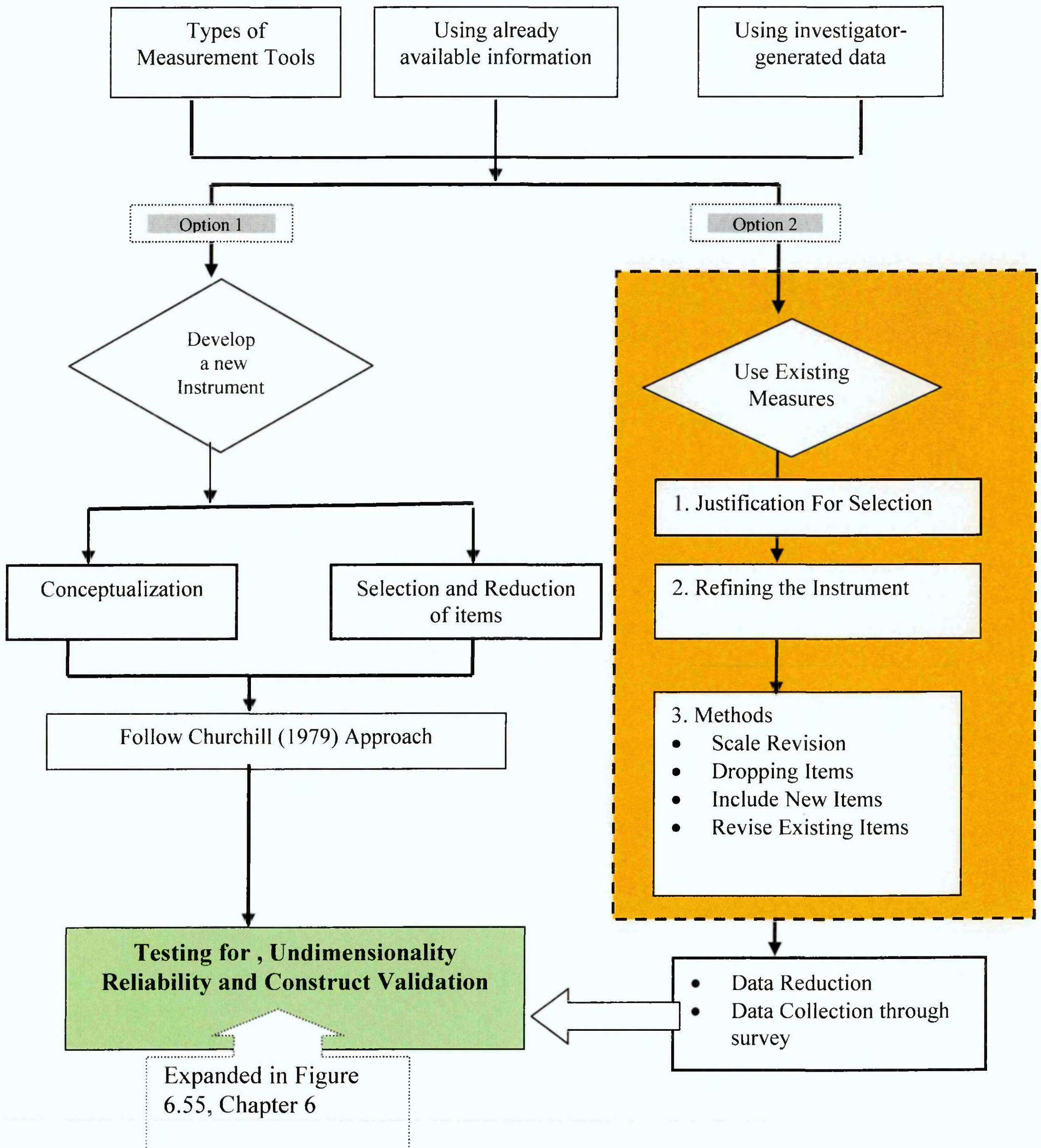

Figure 5.5: Flowchart Comparison of developing a new instrument to using an existing one

5.5.4 Summary of Comparison

The above sub sections compares the implementation construct used in this study compared to other instruments by Ahire et al (1996) and Saraph et al (1989). Whereas Powell (1995) used 12 constructs, this research used 10 constructs, excluding Flexible Manufacturing and Process Improvement from those used by Powell (1995), as these were more manufacturing oriented. It also renamed the "closer to customers" as "customer focus", and "closer to suppliers" as "supplier focus". In terms of a standardised TQM research, Grandzol and Greshon (1998) proposed the seven constructs used by Anderson et al (1994) as adequate for the definition of TQM.

These seven are: leadership, process management, employee fulfilment, customer focus, learning, continuous improvement and cooperation. They argue that the seven constructs either explicitly or implicitly summarise the appropriate operational constructs that best define TQM. However, it can be argued that the constructs used in this study as suggested by Powell (1995), adequately covers all seven constructs.

The rationale for not using the Saraph et al (1989) instrument in this study is that it omitted the most important constructs in TQM being mainly customer focus, satisfaction and usage of SPC. The Flynn et al (1994) instrument was equally considered, but on close examination this instrument excluded employee empowerment and benchmarking scales, which are both considered crucial in the TQM Implementation. On the other hand Powell (1995) included the omissions of Saraph et al (1989) and Flynn et al (1994).

As Motwani (2001) observed, Powell's Instrument is very comprehensive and posses higher validity than the non-empirical TQM studies. Furthermore, the construct used in this study spans the entire range of activities deemed critical by TQM authors. Ahire et al (1996) was only tested and validated in the manufacturing industry.

Apart from the above-mentioned studies, this author is aware of other studies that have published empirically validated scales for TQM such as Motwani (2001), Zeitz et al, 1997; Agus and Abdullah (2000).

5.6 Impact of Organisational Culture

The importance of an organisation's culture as a basis for the achievement of quality and performance outcomes has been highlighted by various researchers. Mallak et al (1997) opines that an organisation's outcomes concerning quality and performance are the result of many complex technical, political, social and behavioural processes operating inside and outside the organisation. Similarly, this research would address cultural issues affecting construction related organisations. Kolb et al (1991) defines organisational culture as:

> "Organisation Culture is the pattern of basic assumptions that a given group has invented, discovered or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems".

Therefore, though under one construct of Open Organisation. the UK Constructional related SMEs will be analysed in the following areas:

(i) Pattern of Basic Assumptions
(ii) A Given Group
(iii) Invented, Discovered, or Developed
(iv) Problems of External Adaptation and Internal Integration
(v) Assumptions That Work Well Enough To Be Considered Valid
(vi) Taught to New Members
(vii) Perceive, Think, and Feel

The assessment of organisational culture will be based on semi-hard data, (directly or indirectly quantifiable) as it has the advantage of reliability and stability of the instrument over time, thus allowing 'longitudinal 'research (Hofstede 1980). TQM practices require a shared mindset (culture) that emphasises customer satisfaction, shared leadership, and getting it right first time (Abraham et al, 1997). TQM directly seeks to alter the culture or "the pattern of basic assumption which given groups have invented, discovered or developed in learning to cope with problems of external adaptation and internal integration" (Schein, 1984). The need for change can be achieved by breaking the framework of the old culture by challenging traditional values, shaking out complacency, apathy and fear (Hames, 1991).

5.7 World Class manufacturing v Construction

The aim of World Class Manufacturing (WCM), is achieving a global competitive position as shown in Figure 5.6. It is attained through superior manufacturing system performance, as indicated by the five manufacturing performance measures, each of which directly reflects a competitive attribute. The following are; High Quality, Low Costs, On-Time Delivery, Volume Flexibility, and Product Line Flexibility Source: (Flynn and Flynn, 1996)

Compared with industrial operations, quality is more crudely controlled in construction, production is less predictable, waste is very high (some of it inherent, but not all), labour costs have advanced more, and productivity has increased very little since the initial mechanisation of two or three decades ago. The low cost measures advocated for by the manufacturing environment are slowly eroding within the UK construction industry due to the way goods are procured.

While the traditional approach focussed on competitive tendering, led to the "lowest bid" being accepted, the evolving nature of the industry and the changing demands of the clients have led to the development of new procurement methods where price alone is not the deciding factor. These calls for the concept of transferability of ideals from the manufacturing settings to construction need to be treated with caution. Furthermore, despite the well documented differences between manufacturing and construction, very little research has been conducted on how product versus service organisations research has been conducted on how product versus service organisations differ in respect to the impact of quality practices on performance. (Nilsson et al, 2001)

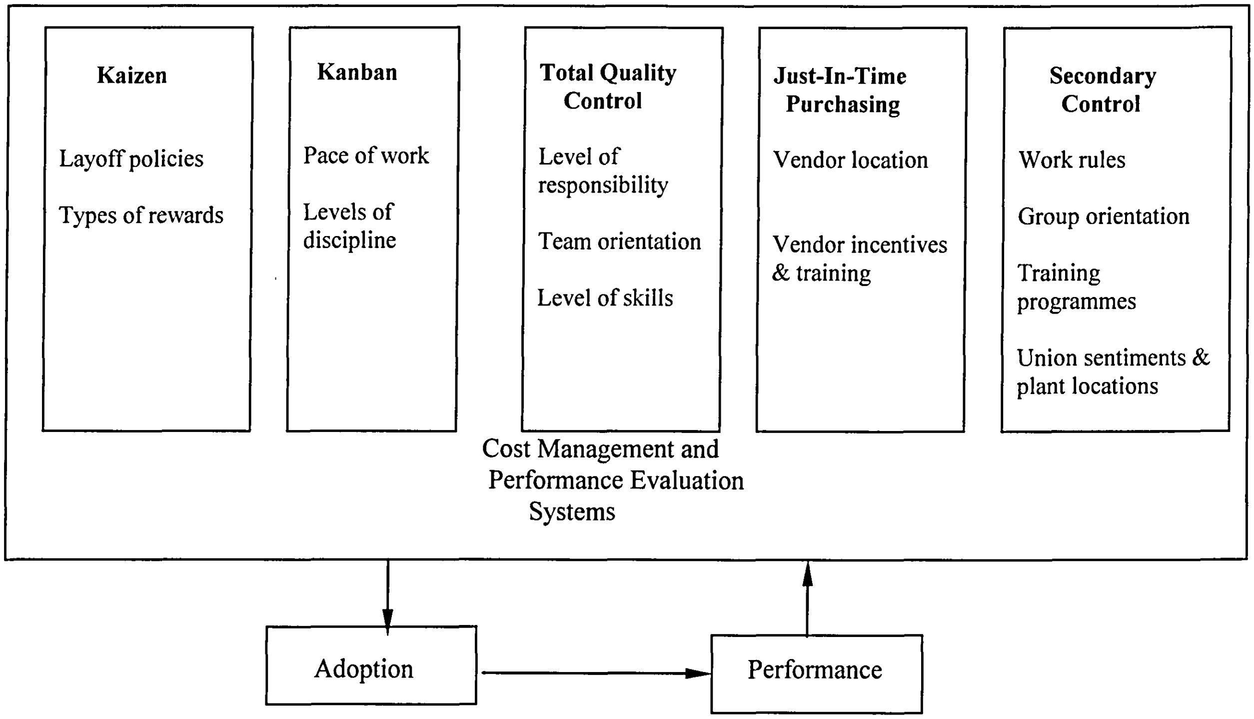

Figure 5.6: A Framework for Successful Adoption and Performance of Japanese Manufacturing Practices in the United States
Source: Young (1992)

Ashford (1989) observes that Quality Management as practised in factories, can be transplanted unchanged into the construction industry. However, he cautions that the differences between factory (manufacturing) and the construction site cannot be ignored. The differences observed are :-

- The susceptibility to weather
- the mobility of labour
- the fact that every job is a prototype

The manufacturing process usually begins with the delivery of materials. Materials are supplied to manufacturing facilities by vendors who rely on a competitive bidding process in order to supply the manufacturer. Flynn and

Flynn (1996) argue that WCM's use of 'Just-in-Time' (JIT), which focuses on improving material flows through the production system by exposing problems in the manufacturing process and solving them, ultimately has benefits beyond the production system. When material flows are improved, inventories are reduced. Rounds et al. (1984) dispute that although there are significant differences between construction and manufacturing, quality control systems in the two disciplines have evolved in a similar manner.

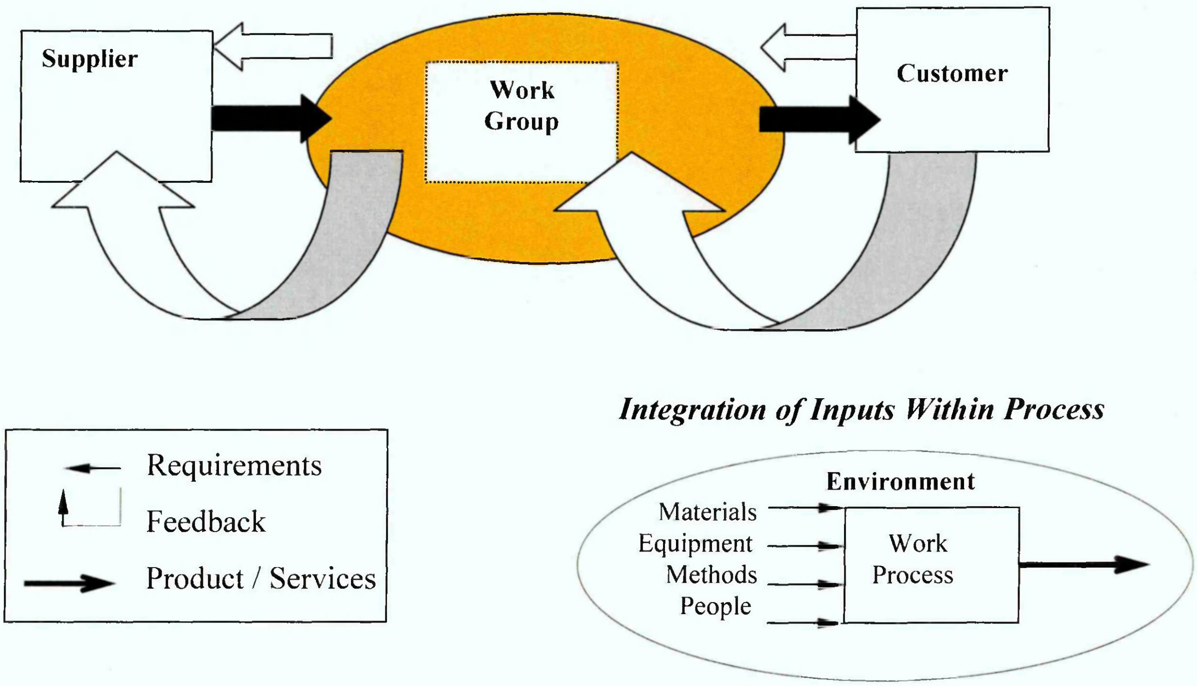

Figure 5.7: Process model for manufacturing and non-manufacturing

Adapted from: Scherkenbach (1986)

Figure 5.7 indicates, the work involves the sequential integration of people, materials, methods, and equipment to add value for customers.

The generally accepted definition of quality is that of "conformance to the established requirements." In the construction industry, these established requirements are usually derived from customer contracts, engineering specifications and drawings, nationally recognised codes and standards, and self-imposed requirements. TQM comes into the picture by ensuring that these requirements are satisfactorily being implemented.

According to Paulson (1988), construction operations are dispersed on sites, dependent on unique and often dynamic designs, subject to variable working conditions, and constantly reconfigured. This makes the TQM very different from manufacturing. Further comparisons of manufacturing versus construction, can be found in the work of Nilsson et al (2001), who present the argument of product versus quality. These findings relate to the adopted two perspectives of output and process. The main argument of this thesis is the usage of the Powell (1995) instrument to the construction environment. Even though the main emphasis has been on the service industry, a distinction between the two industries should be made. Accordingly, Huq and Stolen (1998) advocate the implementation of TQM concepts differently in the service and manufacturing industries. They contend that certain environmental differences between these industries must be taken into account. Among the difference, service employees must exercise greater judgement than their counterparts in the manufacturing firms, in particular when providing service to customers. Another aspect is that due to its highly customised output, service organisations must approach quality differently as opposed to manufacturing organisations that can utilise tools and process control techniques.

In highlighting the differences between Manufacturing and Service Sectors, Ghobadian et al (1994) identified the following as being the salient differences as inseparability of production and consumption

In service industries, the marketer usually creates or performs the service at the same time as the full or partial consumption of the service takes place. While this might be true of service industries like the Fast Food (McDonald), or Airlines, where the above assertions are visible, the Construction Industry presents a different scenario, in particular for the construction or contracting side of the process, the customer will only occupy the building after the process is completed.

It is for this reason that construction should not fully be considered as a service industry, particularly when comparing the instruments used for measuring service quality. This research posits that, instruments developed for measuring service quality cannot fully measure the advancement of quality initiatives within the SMEs.

- Intangibility of services

The fact that many of the services are essentially intangible, this made it difficult for the producer to describe the service, and for the consumer to ascertain its likely virtues. The main cornerstone of this difference is that the consumer cannot see, feel, hear, smell, or touch the product before it is purchased. Again, construction might apply things differently, for example with the advent of new procurement methods, customers can be involved in the process of producing the product. See the Juran (1988) triple concept role which states that every part involved in the construction process could adopt the roles of supplier, designer and customer, and this involves the client as well. The concept is explained in detail in section 5.7.2

- Perishability of services

Services are perishable and cannot be stored in one time period for consumption at a later date. This assertion while it might hold for certain services, it can be applied to the construction processes end result such as buildings where the final check can be made, albeit post defects.

- Heterogeneity of services

Most of the examples drawn for this comparison were from the airlines. However, this might hold true for construction, where it is often difficult to reproduce a service consistently and exactly.

It must be noted that the above differences were specifically intended for manufactured and service goods. However, when the construction industry is referred to, then the goods in terms of the industry imply finished products such as buildings, bridges and other infrastructure. The point of the arguments presented in the aforementioned clarification was to bring to light where Construction Industry might qualify to be described as partial and not as a full service industry.

5.7.1 Quality problems in manufacturing and their solutions

Although the manufacturing industry has been successful in implementing TQM, it is not exempt from quality problems. Ho (1995) gives the reason for picking the manufacturing industry to illustrate the problems of quality. This is because it encompasses most business functions encountered in other sector and industries, like the service sector, public sector, education and training. Furthermore, many of the proposed constructs for quality have been developed only for manufacturing companies, Ahrie et al (1996) and Samson and Terziovski (1999).

In Japan, Kaizen, continuous improvement is a pervasive concept linked to all Japanese manufacturing practices. Imai (1986) described Kaizen as the driving force behind Japan's manufacturing success in eliminating worker complacency. The competitive advantage of a World Class Manufacturer is built on outstanding performance on several competitive dimensions, as well as continuous improvement among them. This gives it the ability to repeatedly gain temporary advantages that yield a sustainable competitive advantage (D'Aveni, 1994) as cited in Flynn and Flynn (1996).

Silvestro (1998) identified the following key concepts and practices as being more problematic in manufacturing than service:

- the traditional engineering of quality in terms of adherence to specification resulting in an inwardly focussed perception of quality
- the concept of acceptable levels generating complacency about quality
- functions and departments creating a barrier to process ownership; and
- quality control through inspection and detection rather than prevention

(Silvestro, 1998. pp 320-321)

5.7.2 Construction as a process

Every party in a process has three roles: suppliers, processor, and customer. Juran (1988) defines this as the "triple role" concept. These three roles are carried out at every level of the construction process-corporate division, department, and individual.

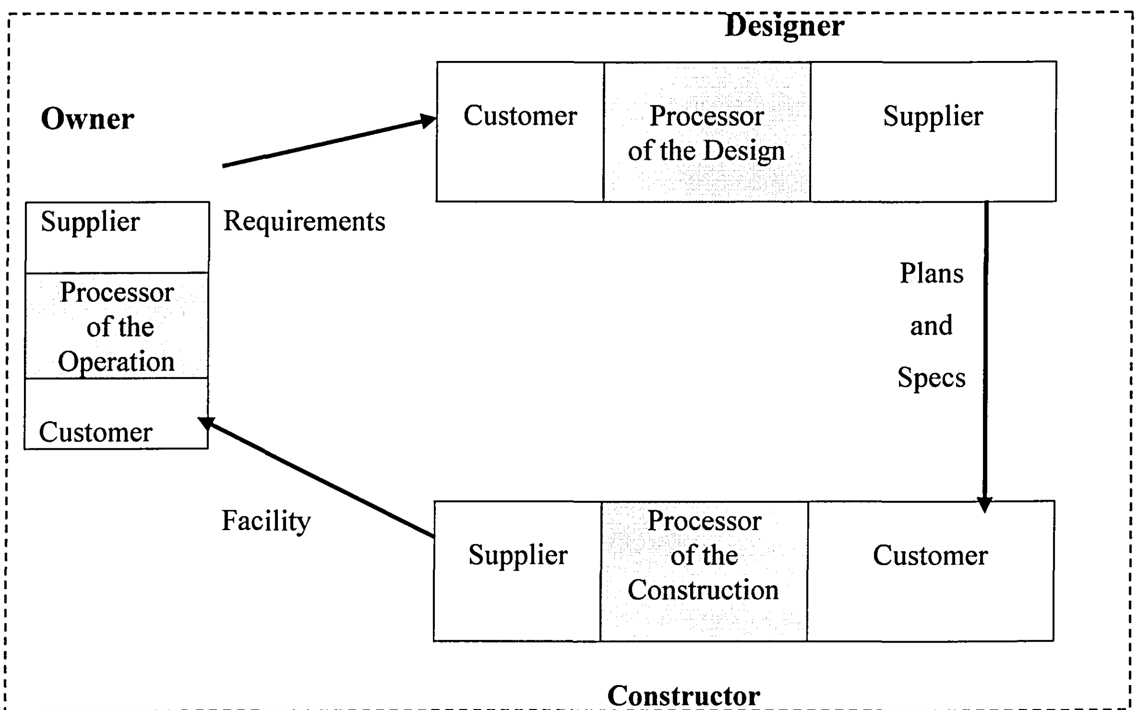

Figure 5.8: Juran's Triple Role Concept Applied to Construction

Figure 5.8 illustrates Juran's concept. The designer is a customer of the owner. The former processes the design and supplies plans and specifications to the constructor. The constructor is the designer's customer, who uses the designer's plans and specifications, processes the construction, and supplies the completed facility to the owner. The owner supplies the requirements to the designer who receives the facility from the constructor, and processes the facility's operation. The roles of the three parties have not traditionally been viewed this way, but this clearly illustrates that construction is a process, and that TQM principles that have been applied to other processes are potentially adaptable to the construction industry. As Al-Momani (2000) notes, every element in the construction process can be portrayed as a customer, whether he is an owner, designer or a contractor. The TQM view implies that if customers are to be kept satisfied, the process must constantly be improving.

Customer satisfaction at each stage of the construction process implies that the goals of the construction process are met.

"The construction process is long, involved and often cumbersome and inefficient. Its success depends on having the right relationships between the parties to the process" (Hillebrandt, 1984)

Hillebrandt further attempts to highlight the problems facing the industry. "In view of the large number of participants in the construction process, the complexity of the relationships and the large number of functions to be performed, it is not surprising that there has been concern in the industry itself and in government that the process does not always work smoothly." Newcombe's analysis suggests that the principal functions performed in the manufacturing industries can be mirrored in the construction industry although he uses different titles for various functions. Propositions relating to how each of these factors can lead to successful adoption and performance of Japanese practices in the U.S. manufacturing environments have been developed by Young (1992).

5.8 Competitive Benchmarking

The benefits of benchmarking in the quest for quality have resulted in its use by organisations around the world (Boone and Wilkins 1995). One of the objectives of this research is to investigate the models or 'benchmarks' that reflect the successful application of TQM to the construction industry.

A case study is further described in Chapter six, of one construction organisation that has made a serious commitment to the philosophy and principles of TQM and is reaping significant benefits from that effort. Zairi (1992) provides the linkages between TQM and benchmarking. Whereas TQM could be described as meeting internal and external customer requirements, benchmarking is establishing objectives based on industry best practice. From the performance aspect, TQM relies on the performance of teams, whereas benchmarking is based on performance management.

According to Yasin (2000), benchmarking has an external dimension whereby the organisation searches its industry and other domains in an attempt to identify external and competitive benchmarks and practices, which may then be implemented into its operating environment. Furthermore, Authors such as McCabe (2001) and Lema and Price (1995) explored the benefits and applicability of benchmarking in the Construction Industry. According to Zairi (1992), caution must be exercised in deciding on which factors to consider when measuring customer satisfaction. McCabe (1998, p. 103) in citing Zairi (1996: p. 189) provides the following required principles into benchmarking customer satisfaction levels:

- The metrics that are used to monitor the customer's satisfaction are accurate.
- These metrics should be sensitive (they clearly indicate a casual relationship).
- The results should be capable of comparison with direct competitors.

- The process must be regular and continuous.
- Whatever method is used, it should be simple, and the results easily communicated to those who are affected.

5.8.1 Definition of Benchmarking

The consortium for excellence in Higher Education (2003) provides the following definition of performance or competitive benchmarking as a process, whereby organisations use performance to compare themselves against similar organisations. McCabe (2001) in citing McGeorge and Palmer (1995) define benchmarking as a process of continuous improvement based on the comparison of an organisation's processes or products with those identified as best practice. Another definition of benchmarking is provided by Lema and Price (1995) who define it as a process of continuous measuring and comparing an organisation's business process against business leaders anywhere in the world to gain information which will help organisations to take action to improve its performance.

The common denominator from the definitions is that it involves an examination of processes through the usage of metrics (methodology). As acknowledged in literature, there are different types of benchmarking and their inter-relationship can be illustrated in Figure 5.9.

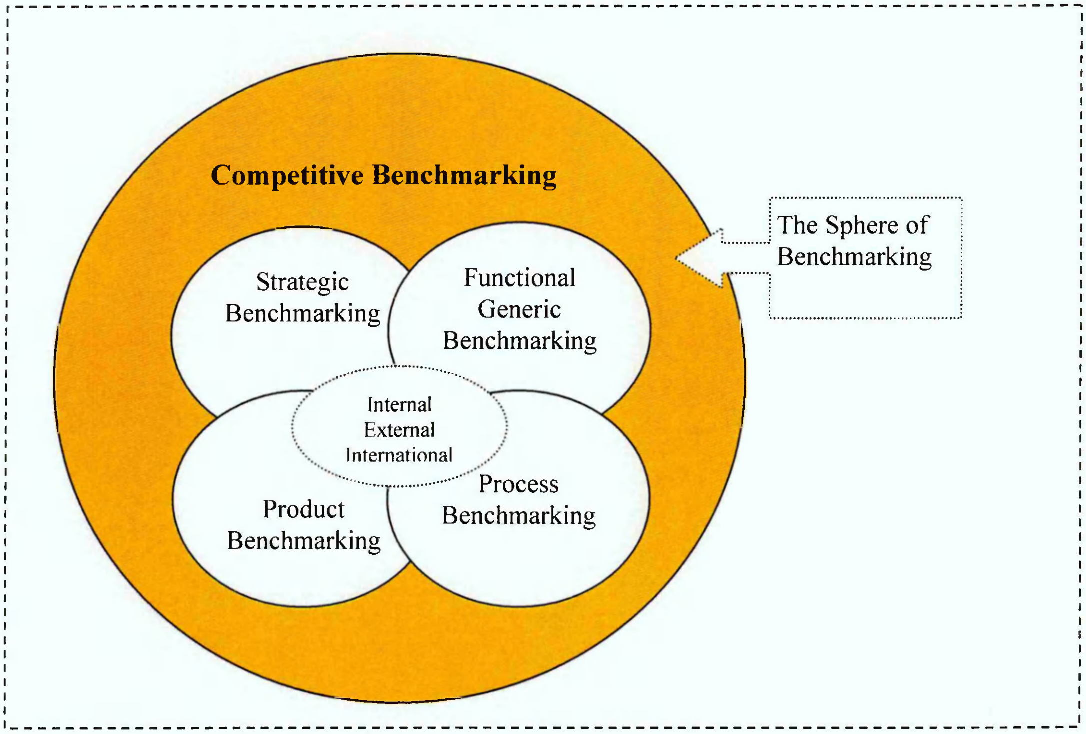

Figure 5.9: The Relationship between the different types of Benchmarking

Source: Adapted from Consortium for Excellence in Higher Education (Pupius, 2003)

The above Figure highlights the different types of benchmarking, and includes the three main ways of carrying out benchmarking according to McCabe (2001) as follows:

- Internal
- Competitive
- Functional or generic

(McCabe, 2001: 29)

A recent study conducted by McAdam and Kelly (2002) among the SME's in the manufacturing environment found that the benchmarking teams from each organisation were convinced of the value of exchanging ideas and seeing them work. Secondly a positive approach by increasing the company's team learning and development and being exposed to best practice. Despite the highlighted advantages and the fact that many organisations do recognise that continuously searching for and applying the best practice is the only way to continue to be the best, Kumar and Chandra (2001) found that many of the organisations are still struggling to achieve benchmarking effectiveness.

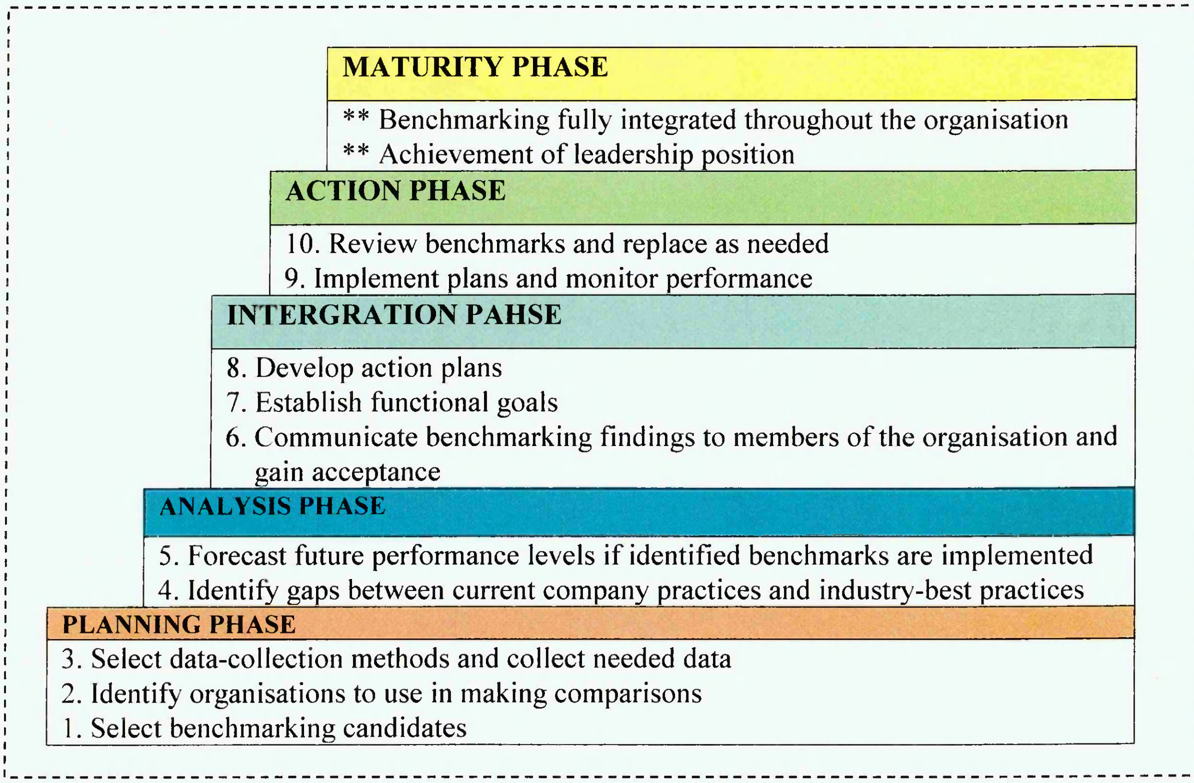

Figure 5.10: Steps in the Benchmarking Process
Source: Adapted from Camp (1989)

Planning: This involves answering the who, what, and how questions regarding the benchmarking investigation.

Analysis: In this stage, managers develop an understanding of current company practices and how they compare with firms being benchmarked. This comparison is conducted for each activity to be analysed to discover strengths and weaknesses present in the current operations.

Integration: Communicating the results of this comparison to the members of the organisation. Plans are then developed to integrate superior practices in the firms operations.

Action: The action phase of the benchmarking sequence is devoted to converting these findings into operational plans and then implementing them.

Testing and monitoring of newly implemented processes are used to ensure effective blending of current and new approaches.

Maturity

Superiority is achieved when the best industry practices are incorporated into all business processes. According to Boone and Wilkins (1995), "Successful benchmarking should enhance customer satisfaction through employee involvement, management from the top, problem-prevention, and minimising product defect". The aim is to achieve a competitive advantage in today's global marketplace. Although customer satisfaction is the ultimate goal of TQM, other objectives are also present. A fundamental premise of the TQM concept is that once goals have been established, it is necessary to examine all the factors involved in achieving total quality and describe how these goals will be accomplished. One such method is benchmarking. (Boone and Wilkins 1995)

Karlof and Ostblom (1995) describe the five stages of process of benchmarking as follows

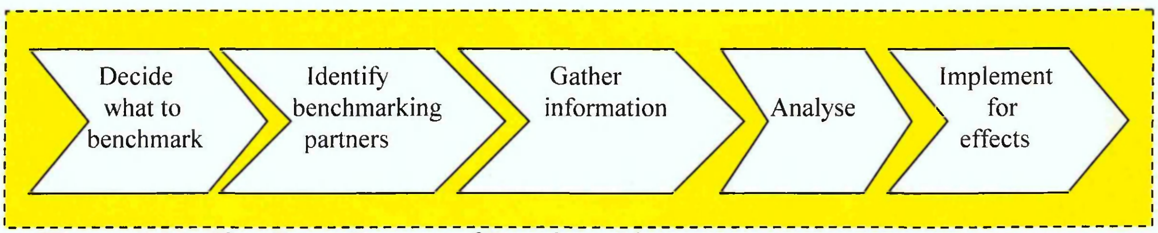

Figure 5.11: Five Stage Process of Benchmarking

5.8.2 Benchmarking Benefits to Construction

Most of the success stories of benchmarking can be found in the manufacturing literature. Among the successful initiative is Xerox, from the automobile industry are Nissan/Infinite case (Yasin, 2002). According to the authors, organisations can gain both operationally and strategically when they utilise differing facets of benchmarking. Fong et al (1998) found that benchmarking can provide a means to sustain a continuous superior performance. According to (Boone and Wilkins, 1995), the following are the benefits of benchmarking; Customer Satisfaction, Employee Involvement, Management from the Front, Problem Prevention and Zero Defects.

5.9 Assertions and Contradictions of the Organisation Size-TQM Implementation Literature

5.9.1 Impact of Organisational Size

According to Taylor (1997), few studies have being written about the influence of organisation size on TQM outcomes. Furthermore, support for organisation size in making an indirect contribution to the implementation of TQM is somewhat mixed in both manufacturing and service industries. While some studies find support for a correlation between organisation size and TQM implementation, in contrast several studies have failed to find support for a direct relationship between organisation size and implementation of TQM. For example Brah et al (2002), found Organisation size, adoption of TQM, and TQM maturity affected the rigor of TQM implementation. They further found that TQM implementation correlates with quality performance.

Other studies that support this, are by Powell (1995), Martines-Lorente et al (1998); Goldschmidt and Chung (2001); and Hendricks and Singhal, (2001). In contrast Benson et al (1991) found no relationship between organisation size and TQM implementation, Ahire and Golhar (1996) reported no operational differences in TQM implementation owing to organisation size with expectation of customer focus and SPC usage and more recently, Yeung et al (2003) found firm size not an important factor to organisation performance. In addition, most of the studies conducted are in large organisations and the impact of organisation size on TQM implementation remains unexplored.

The research question raised in this chapter is whether Organisation Size impedes TQM implementation. Some of the differences between large and SMEs were tabulated, and using the case methodology in the next Chapter, some of the barriers specifically related to SMEs identified in literature will be explored among the three cases to be studied. This research redresses the imbalance by specifically conducting the MANOVA analysis on the UK Construction related SMEs.

Hendricks and Singhal (2001) observe that inertia can be caused by 'constraints on Action'.

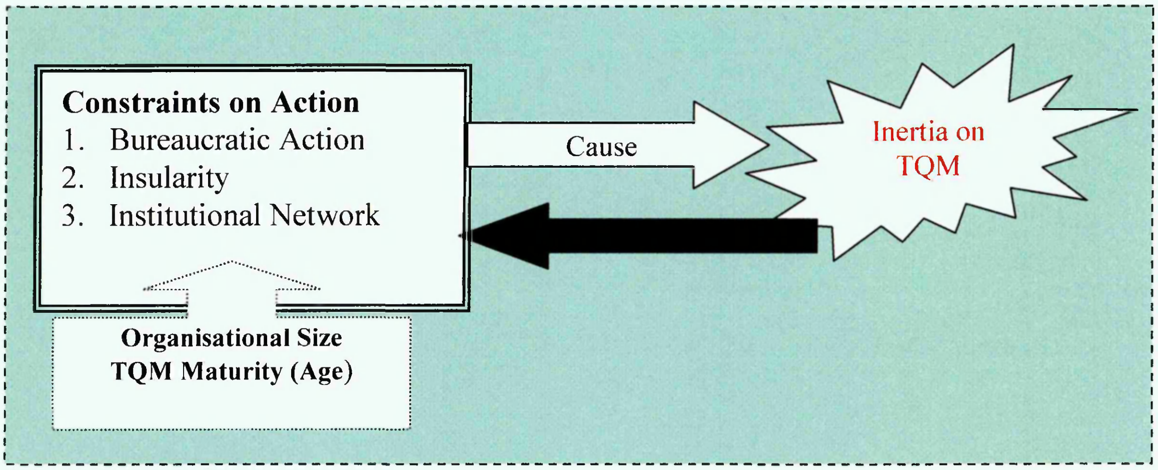

Figure 5.12: Impact of Organisation Size, Age on TQM

In order to address how the research contributes to the application and development of TQM within SMEs, the following factors were taken into consideration; Industry effects and organisation size. Measurement model fit indices were carried out based on the size of the organisation. TQM deploying organisations were classified in two groups depending on the number of employees as follows:

- Macro – less than 10 employees
- Small – more than 10 and less than 99
- Medium - 100 to 499

Included are arguments for lack of clear evidence of what should be the cut off of small organisations. The final analysis excluded the Macro group as none of the respondent fell into that category.

Analysis

A series of propositions were addressed in order to satisfy the deficiencies highlighted

- 5.1 The levels of model constructs are not affected by competition within the industry, bargaining powers of the suppliers etc.- denoted as path A in Figure 2.3 (Chapter Two)

- 5.2 The levels of model constructs are not affected by organisation size denoted as path **B** in Figure 2.3

These propositions were translated into the following hypothesis:
H_{7-1}: Medium-sized TQM deploying UK construction related organisations exhibit a high level of advancement of the ten TQM constructs than small TQM deploying UK construction related organisations.

H_{7-2}: Medium-sized TQM deploying UK construction related organisations perform better in each of the four measures of TQM and organisation performance than small TQM deploying UK construction related organisations.

H_{7-3}: Medium-sized TQM deploying UK construction related organisations exhibit a high level of advancement of the ten TQM constructs than medium non-TQM deploying UK construction related organisations.

H_{7-4}: Small-sized TQM deploying UK construction related organisations exhibit a high level of advancement of the ten TQM constructs than small non-TQM deploying UK construction related organisations.

5.10 Summary

Antecedents to TQM practices in constructional related SME's have been conducted through an extensive literature review and employed case studies which are elaborated in detail in Chapter six. The result of the literature review concludes that the main barriers to the implementation process are mainly due to lack of management commitment and inadequate training among others. As noted by Nilsson et al (2001), a quality concept is essentially a business philosophy, a company ideal or a policy statement. As such, it is advantageous for organisations to focus more on behaviours than philosophical notions as it is easier to operationalise the different quality constructs.

Having highlighted the differences between manufactured and service goods, some of obstacles to service quality improvements as identified by Ghobadian et al (1994) are as follows;

- lack of visibility
- difficulties in assigning specific service quality
- time required to improve service quality
- delivery uncertainties

The main purpose in highlighting the obstacles to attaining service quality improvements is to identify which might be applicable to the construction setting. As the focus of the study is to refine the developed instrument, originally tested in the manufacturing and service setting, it is imperative to be aware of the various obstacles the instrument might have been designed to overcome. The advocated solutions to these service quality problems are presented in the earlier sub chapter on identification of critical success factors.

This Chapter concludes the literature review which commenced with Chapter three's overview of the construction industry and implications of TQM, in particular, focussing on the utilisation of TQM within SME's. Chapter four elaborated on TQM as a potential competitive advantage by examining the strategic implications of TQM at the three levels namely the Industry, firm and strategy. This is linked into these present Chapters which explored the antecedents to the successful implementation of TQM. The next Chapter now presents the data collection, results and analysis of the descriptive statistics. The grounded theory approach is adopted for the evaluation of case studies.

This Chapter examined the antecedent to TQM. Following on from the issues which were explored in Chapter three, various authors have been citied in terms of the critical success factors. The next Chapter now presents the data analysis using the AMOS Software, SPSS package and the qualitative approach through case study.

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Chapter Six

Data Collection & Synthesis

CHAPTER SIX: DATA COLLECTION & SYNTHESIS

6.1 Introduction

The aim of this Chapter is to present the findings of the statistical analysis using the SPSS and AMOS software package, and the qualitative analysis through case studies. Formal correlation analysis and path analytical techniques are explored. Comparisons between TQM and non-TQM deploying organisations on the assessment of TQM principles are presented. The ten constructs of TQM Implementation as stated in part two of the questionnaire and the 15 items four-factor TQM performance indicators are presented. This includes results of the hypothesis testing as formulated in Chapter 2. The results of the analysis are presented in Tables 6.1 to 6.44 and illustrated in Figures 6.1 through 6.79 and in Chapter 7, Tables 7.1 to 7.23 others are in the appendices E and D. The Chapter is sub divided into fifteen sections and structured as follows;

- first, the introduction is provided,
- second, the methods in the data analysis are explored,
- third, present the descriptive statistics of the demographics and explore the descriptive statistics of the TQM deployment constructs.

Figure 6.11 captures the entire survey document and highlights the detailed order of presentation. Also this Chapter in section 6.4 reports on the impact of organisation size, presence of unions and TQM maturity on the total quality management practices on business and organisational performance. This is followed by sections 6.5 and 6.6 which discuss the descriptive statistics for the TQM deployment constructs and the correlation matrix. Section 6.7 explores the advocated benefits of the implementation process. Descriptive statistics and Reliability analysis of the business and organisational performance indicators (BOPI), and the assessment of the competitive environment are presented in sections 6.8 and 6.9 respectively. The results of the Confirmatory Factor Analysis and justification, empirical validation of the measurement instrument are examined in section 6.10. Finally sections 6.11

through to 6.15 presents the case study methodology, with the associated cross case analysis and discussion of the triangulation approach. Chapter Six concludes with the summary and sets the groundwork for the model re-development and validation in Chapter Seven.

6.2 Data Analysis

A total of ten dimensions of total quality management practices in UK constructional related SME's were perceptualised and measured using the five-point Likert scale (1=have not begun, 5=highly advanced in Implementation). Performance of TQM success was measured by the three-point Likert scale (1 = Not at all, 3 = hardly and 5 = greatly). The *Statistical Packages for the Social Sciences (SPSS)* was used for the analysis. Two levels of data analysis are conducted: a macro-level analysis of aggregate, surface characteristics of the respondents and a micro-level analysis of deeper, fined data methods.

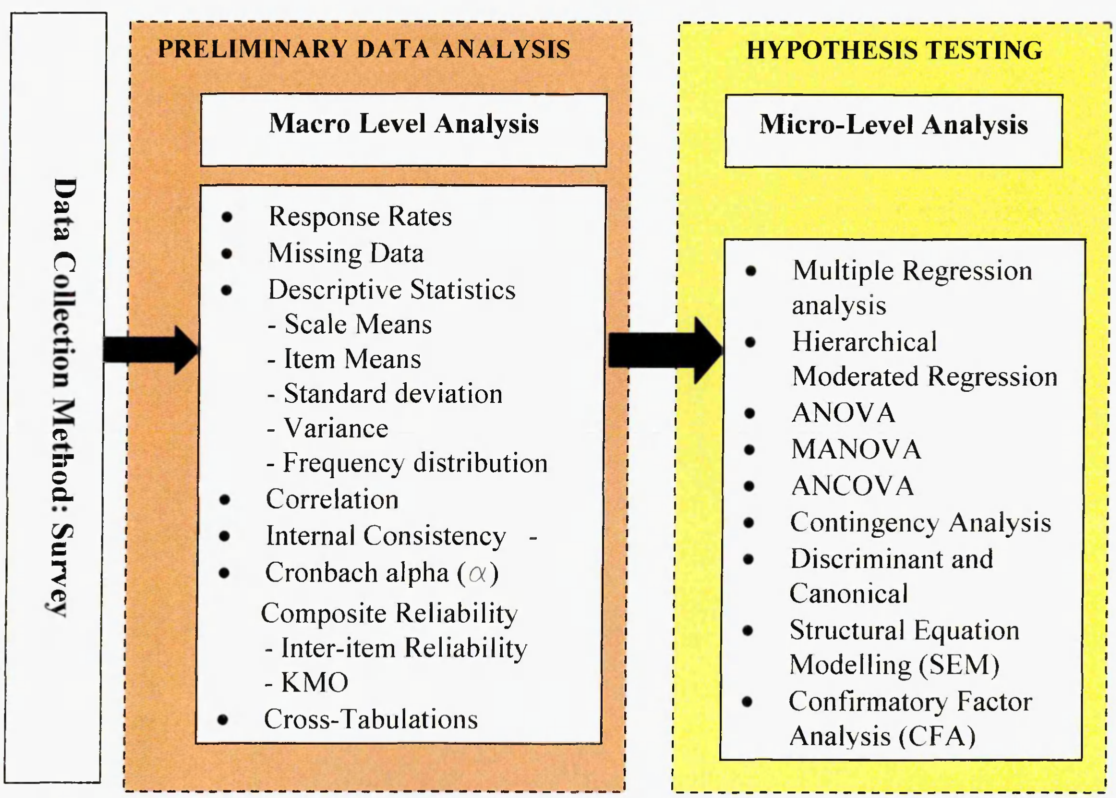


Figure. 6.1. Data Analysis Map
Source: Adapted from Boyer et al (2002)

As shown in Figure 6.1, the macro-level is concerned with the aggregate measures of the descriptive statistics, where as in the micro-level, there is the evaluation of the measurement and structural model, TQ-SMART, using fine grained methods such as structural equation modelling (SEM)

According to Forza (2002), Data analysis can be schematically divided into two phases: preliminary and hypothesis testing. Boyer et al (2002) described these phases as macro-level and micro-level analysis. This study adopted both approaches and a summary of the data analysis techniques utilised in the survey part of the research is shown in Figure 6.1. Data was further subjected to tests to determine whether it met the parametric or non-parametric criteria. A full description of the conditions is highlighted in Chapter 3. The methods involved in the macro and micro level of analysis are presented in the following sub-section which is followed by the presentation of the results of data analysis.

6.2.1 Mean Scores and Correlation Analysis

For the two ordinal variables, the following methods are used in order to determine whether each scale is measuring a single ideal; each individual variable was paired with the summed score for that category. The results are shown in the appendices

- Spearman rank order correlation (rho)
- Kendall rank order correlation (tau)
- Kendall's coefficient of concordance (*W*)

The Spearman rank order correlation involved the pairing of each individual variable with the summated score for that category.

The Kendall's coefficient of concordance was used to assess the degree of consensus or measure of agreement of respondents within a group on the ranking of the importance of the TQM constructs or critical success factors as commonly known in literature. The analysis procedure has been used by other similar survey studies such as Anderson and Sohal (1999) and Chan et al (2003). Correlation analysis is used to provide a summary between pairs of variables such as TQM and Business and Organisation Performance.

For the variables measured at an interval (i.e a five-point weighting scale where 1= not advanced and 5 = highly advanced), the Pearson Product Moment Correlation was computed to test the correlations between the TQM constructs and TQM performance. Based on the simple formulation of N*(N-1)/2, where N is the number of variables, the data generated 561 pairs which are shown in the appendix.

6.2.2 Reliability Analysis

The following measures are used in the thesis for the reliability test. A brief description is provided and the results of the analysis can be found in the subsequent sub sections and the appendices D.

- Cronbach Alpha (α)
- Kaiser-Meyer-Olkin (KMO) Sampling measure of adequacy (SMA)
- Barletts Measure

The degree to which multiple indicators share in their measure of a construct (Field, 2000) was conducted using Cronbach's alpha coefficient. This was calculated for each of the variables and summated score for the construct.

To supplement the stability, the Kaiser-Meyer-Olkin (KMO) sampling measure of adequacy and the Barlett's test of Sphericity were conducted. The KMO Statistic varies between 0 and 1, and is defined as an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients and for the original matrix. It is recommended that the value of KMO should be greater than 0.5 if the sample is to be adequate (Field 2000). The findings from the survey have a KMO value of 0.788 and indicate that the sample was adequate and that 'factor analysis' is appropriate for this data

Barlett's measure tests the null hypothesis that the original correlation matrix is an identity matrix. The result of the test was 2122.876 with an associated significance level of 0.0000. All the results suggested that the data collected was adequate for factor analysis. The KMO for individual variables are shown in the Appendix D (Table D28), the small value of the significance level ($p < 0.001$) indicates that a factor analysis may be used.

6.2.3 Confirmatory Factor Analysis

Confirmatory Factor Analysis is used to check the construct validity using convergent validity and scale undimensionality. The rationale behind the usage of confirmatory factor analysis according to Gumus and Koleoglu (2002) is to serve three main purposes. The first is to minimise variables under a minimal number of factors, after computing their correlations. The second is to limit the structure of variables under factor, and the final purpose is that it is a hypothesis test for the certain factors computed for values.

Confirmatory Factor Analysis (CFA) is used to determine whether the patterns of variance and covariance in the data are consistent with a specified structural model. The three approaches for SEM Construction and development are; strictly confirmatory, model generation and model comparison.

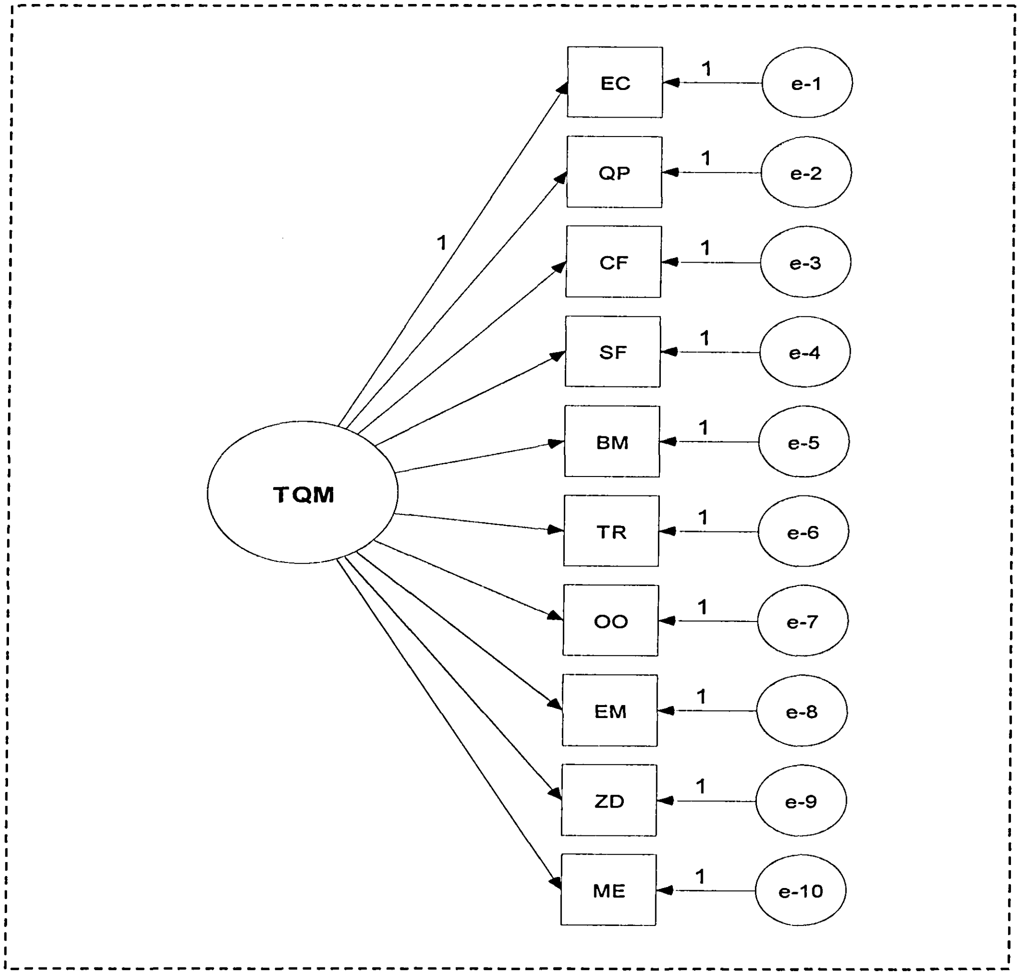
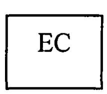
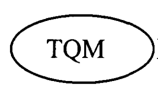


Figure 6.2: Model of the Second-Order Confirmatory Factor Analysis

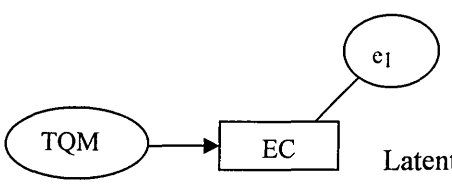
Path Diagram Symbol Notation or explanation of the labels



Observed variable or indicator



Latent variable or factor



Latent variable measured by indicator with error term

In Figure 6.2, the ten model constructs are shown in the boxes. e_1 to e_{10} and represent the measurement error of the observed variables. The arrows depict linear relationships. To cope with identifiably, the TQM→EC path is restricted to 1 as conventionally accepted.

Another valid reason for the use of CFA is that it is ideal when the researcher has hypothesized the structure (i.e. which questions go with which construct) and wishes to test data for the predetermined structure (Spector, 1992).

Joreskog and Sorbon (1989) state the four steps that characterize CFA as follows: Model Specification, Model Data Fit, Model Comparison, and Model Re-specification. The main steps in applying Confirmatory Factor Analysis in Structural Equation Modelling are summarised as a flow diagram shown in Figure 6.3

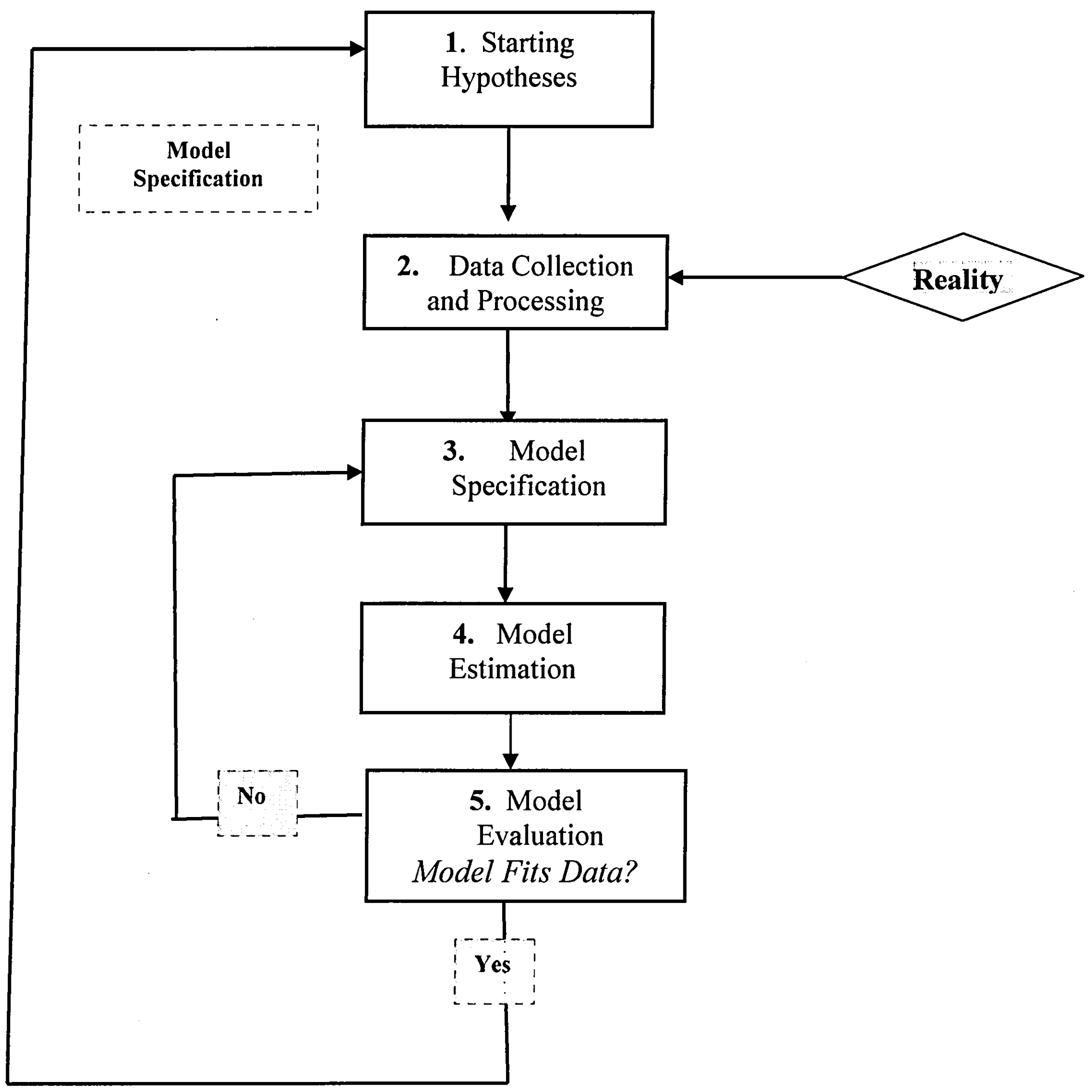


Figure 6.3: The Confirmatory Factor Analysis Process Using Structural Equation Modelling (SEM)

The issues in applying CFA in each of the steps of Figure 6.3 are addressed in the following

1. Model Specification

Proposing alternative models of factor structure such as logic, theory or previous studies based on a review of the literature research. This led to the following models of comparison:

- Soft versus Hard Factors as illustrated in Figure 6.68
- Ten Factor Model as illustrated in Figures 6.2 and 6.10

The method is based on logic, theory or previous studies. In this study, this stage involves the refinement of the Powell (1995) instrument developed for assessing the quality levels in manufacturing and service organisations

2. Model Data Fit

This step can be described as assessing the degree to which data and proposed models meets the assumptions of Structural Equation Modelling. The method used is through the goodness of fit criteria and should be evaluated at several levels. Firstly for the overall model and secondly for the measurement & structural models separately.

3. Model Comparison

This involves comparing fit indices for alternative models that subjectively indicate whether the data fit the theoretical model. The method used is a multiple trait method and assessing convergent validity –(CFA) method.

4. Model Re-Specification

This usually occurs when the model fit indices suggest a poor fit. By using Modification Indices, the model can be respecified. This involves the researcher making a decision regarding how to delete, add, or modify paths in the model, and then subsequently returns to the analysis.

6.2.4 Assessment of Fit Criteria

This study used SEM in order to provide additional assessment of the instrument used in the study of Powell (1995), but to a greater extent and based more on the construction environment as opposed to the manufacturing and service environment. The main steps in applying SEM are summarised as a flow diagram shown in Figure 6.4. Issues in applying SEM in each of the steps of Figure 6.4 are addressed in more detail in sub section 6.2.18. Li et al (2003) defines the Goodness-of-fit criteria as how the model fit determines the degree to which the structural equation models fit the sample data. Other fit indices to be used in step are Chi-square (χ^2). Normed Fit Index (NFI) and Bentler and Tucker. A detailed list of available assessment methods for fit is shown in Chapter 7. As illustrated in Figure 6.4, the structural equation modelling consists of two parts, the measurement and structural model.

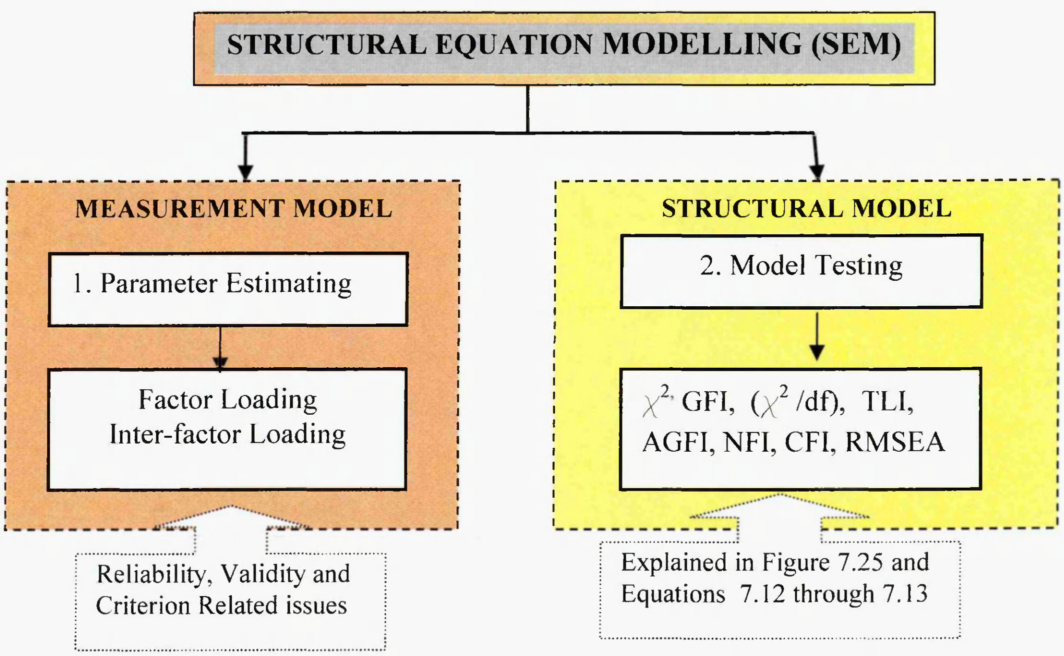


Figure 6.4: Basic Components of Structural Equation Modelling (Author's Interpretation)

Parameter Estimating generates the unstandardized estimates which could be unanalysed association between factors or measurement errors. The factor loadings are interpreted as unstandardized regression coefficients that estimate the direct effects of the factors on the indicators (Kline, 1985). The parameters that will be calculated first are the weighted mean, and variance for each composite measure. Then the maximised reliability coefficients, in the form suggested by Werts et al (1978).

Model Testing: This involves the demonstration of re-specification, through the modification of an initial CFA model with mediocre or poor fit to the data. Several models are tested ranging from testing for a single factor, where TQM is hypothesised as one factor to a multifactor model (i.e. the ten factor, three factor mechanistic model and seven factor organismic models.)

6.2.5 Multiple Regression Analysis

The purpose of this analysis was to determine the independent variables (Factors 1-10) which are related to the dependent variables of performance measures. This is achieved by using a stepwise regression analysis procedure. The results for the 10 construct regression model showing the unstandardized coefficient (B), std error, Standardardized coefficients (Beta), 't' and significance values are shown in the appendix D. The study initially used multiple regressions in the analysis of the relations between variables.

The main stages in applying multiple regression analysis are summarised as a flow diagram shown in Figure 6.5.

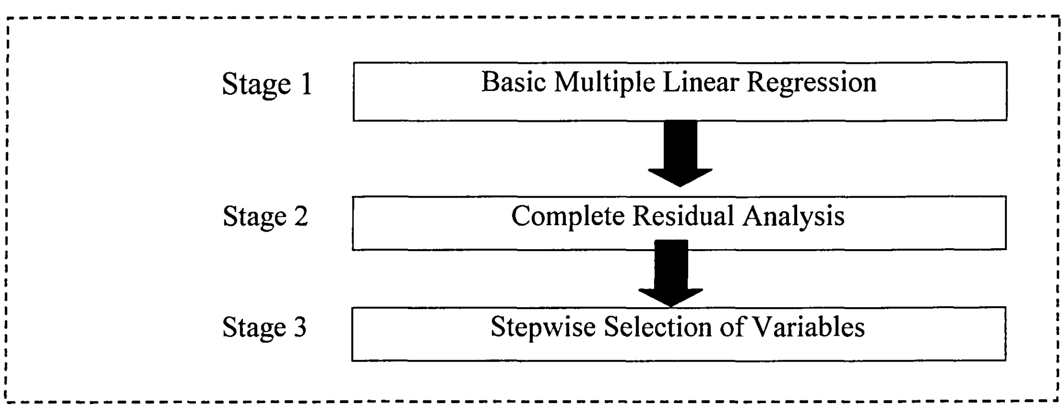


Figure 6.5 Stages in the Regression Process

Issues in applying regression analysis in each of the stages of Figure 6.5 are addressed in the following; **Stage 1** was the basic multiple linear regression using each dependent variable with all independents. In this case all the ten TQM constructs were entered as independent variables with each of the fifteen dependent variables (performance measurement variables), the results of which are the t-values and Beta (β) which are reported in the appendix D. **Stage 2** involved a complete residual analysis which was conducted to determine the prior assumptions of linearity and homoscedascity where valid. The primary method used to test the distribution normality of residuals was the Chi-square (χ^2) goodness of fit. The chi-square (χ^2) tests conducted on the residuals of each regression indicated the acceptance of normality for the dependent variables. The standardised estimates allow the evaluation of the relative contributions of each predictor (the ten deployment constructs) to each outcome variables. Finally **stage 3** involved the stepwise selection of variables.

6.2.6 Analysis of Variance (ANOVA)

To find out how much variation exists among the constructional related SME's concerning the implementation of TQM, both the Kruskal Wallis test (K-W) and the one way variance test (ANOVA) were employed to state the similarities or dissimilarities among the SMEs. The results of the descriptive statistics such as the mean and standard deviations are presented in Appendix D (Tables D4 and D5) for both the TQM and Non TQM deployment constructs and the various measures for the business and organisational performance. The preliminary results for the Analysis of Variance (ANOVA) was used to test the TQ-SMART measuring instrument and revealed a significant difference of variance between the measures (F =10.4659, p =.0000). ANOVA has been used to test the hypothesis, in order to identify if differences of averages between

- TQM and non-TQM organisations
- experienced and less experienced
- small-sized and medium-sized, were significant.

6.2.7 Multivariate Analysis of Variance (MANOVA) & Multivariate Analysis of Covariance (MANCOVA)

MANOVA and MANCOVA are used in order to assess group differences across the 15 dependent business and organisation performance indicators simultaneously. In order to address the analysis of the time lag between inception and improvement, a sub group analysis of the measurement model fit indices was carried out based on the TQM duration. TQM deploying organisations were classified in two groups depending on the number of years TQM was in place. The classification as used by Ahire and Dreyfus (2000) is as follows;

Table 6.1: Classification of Organisations based on TQM Maturity

Classification	No. of years TQM in place
Recent TQM Implementers	up to 3
Experienced TQM Implementers	more than 3

Other studies to have used the three year cut off point are Dawson and Patrickson, (1991) and Ahire (1996). The results of the MANOVA such as the four indices of multivariate tests of significance namely; Pillai's trace, Wilk's lambda, Hotelling's trace, and Roy's largest root are presented in Appendix ??. Furthermore, according to Hair et al (1992) as citied in Terziovski and Samson (1999), the Pillai's criterion or Wilk's Lambda are the best statistical measures to assess whether an overall significance difference is found between groups. The implications based on the results are discussed in this Chapter. One of the objectives of this study is to determine if there are any differences in quality management implementation and quality outcomes across UK Construction related SMEs, and if so, how and why they differ. One approach taken is to investigate organisation size as a context factor and establish whether organisation size may impede successful TQM implementation. The following sub section (6.2.7.1) describes the data analysis to be employed.

6.2.7.1 Analysis of the Impact of Organisational size on TQM Implementation and Outcomes

In order to address how the research contributes to the application and development of TQM within SMEs, the following factors were taken into consideration: Industry effects and impact of organisation size. Measurement model fit indices were carried out based on the size of the organisation. TQM and Non-TQM deploying organisations were classified in three groups depending on the number of employees as follows:

Table 6.2: Classification of Organisations based on Number of Employees

Classification	No. of Employees
Micro	up to 10
Small	more than 10 and less than 100
Medium	more than 100 and less than 500

6.2.8 Contingency Analysis (Measurement Equivalence or Invariance ME / I)

The propositions presented in Chapter One consists of two parts (propositions 1 and 3) examine the invariance of the levels of the constructs across the sub group based on Organisation Size and TQM Maturity.

Propositions 2 and 4 examine the invariance of the path relationship across subgroups.

The main steps in applying the Contingency Analysis are summarised as a flow diagram shown in Figure 6.6. Issues in applying Contingency Analysis in each of the steps of Figure 6.6 are addressed as follows; the first step involves the determination of the invariance of the levels of Model constructs across the various sub groups as shown in Table 6.2

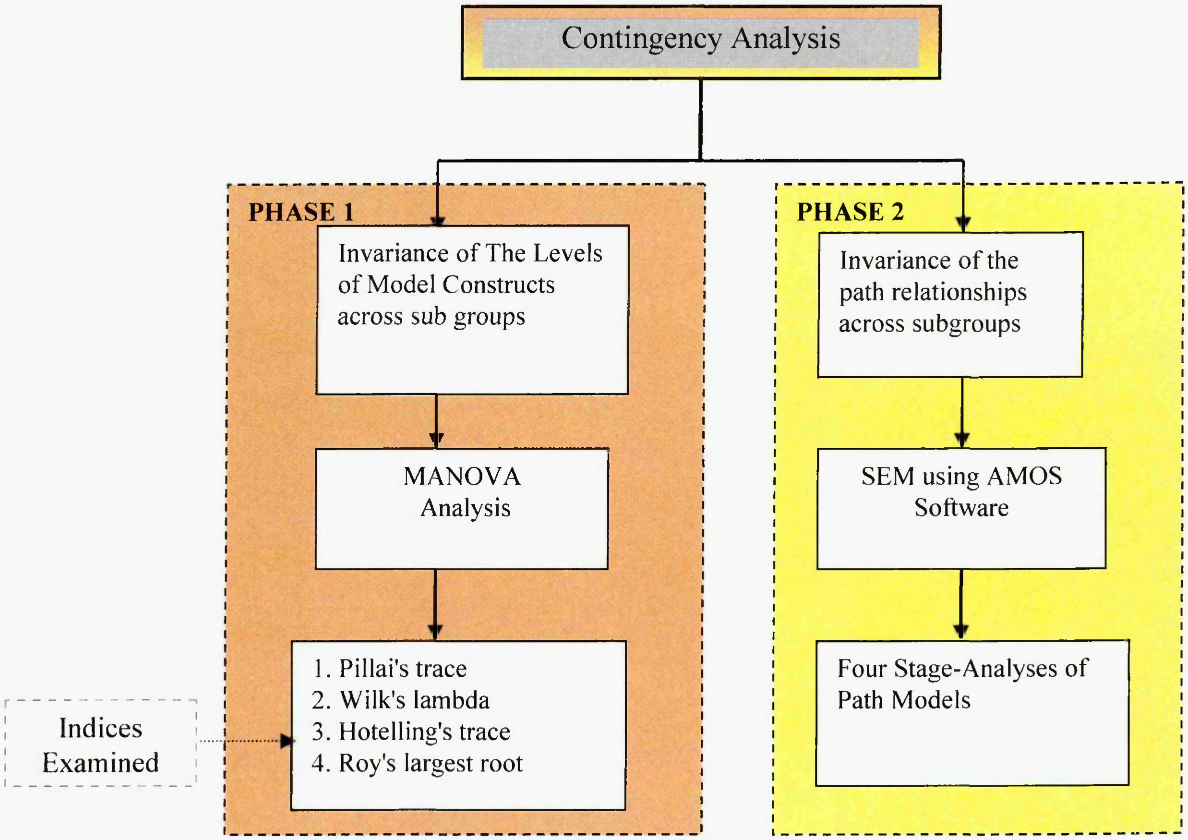


Figure 6.6: The Subgroup Structural Model Analysis

(Source-Author's Interpretation of the SEM and MANOVA)

The second step of the contingency analysis involves SEM and the following sub section describes the issues involved. This is to test if the model relationships vary across the sub groups (less experienced versus experienced, small versus medium), and a four-stage analysis of the path models for the various subgroups using AMOS 4.0 was conducted.

The following four steps will be conducted in the analysis

1. Path models were run separately for each of the four subgroups to check if the path models adequately fit the subgroup sample
2. Generation of Standardized and Unstandardized
3. Testing the Invariance (χ^2, df, p) and
4. Aggregate invariance

Stage 1

The model fit indices demonstrated that the overall baseline path model shown in Fig 6.6 fits well for all sub-group (small organisations, medium organisations, less experienced and experienced)

As the overall measurement model provides a baseline for evaluating the invariance of measurement across subgroups, it is necessary to evaluate its fit to the subgroup samples before evaluating the path model and its invariance across subgroups.

Stage 2

This involved the generation of standardized and unstandardized coefficients and associated test statistics such as the estimate and its standard error. These results are reported in Tables 6.43 and 6.44.

Stage 3

The goodness of fit indices are used to test the invariance (χ^2 df, p) for the second order TQ-SMART Confirmatory Factor Analysis model. This is equivalent to the parameter testing part as shown in Figure 6.4. The full description and implications of the goodness-of-fit indices are provided in sub section 7.7. The chi-square (χ^2) statistic is used for the overall fit of the model.

Stage 4

Aggregate invariance is used for assessing the convergent validity in terms of the factors loadings. The second order factor loadings of the TQ-SMART are presented in Table 6.42 and are all above the required value of 0.5.

In summary, the analysis involved in the contingency analysis are a combination of the MANOVA as described in sub section 6.2.7 and Structural Equation Modelling (SEM) as shown in Figure 6.4

6.2.9 Cluster Analysis Using Discriminant Analysis and Canonical Correlation

In additional to the traditional methods of analysis such as Analysis of Variance (ANOVA) and Multivariate Analysis of Variance MANOVA (See 6.2.7 and 6.2.7), further analytic methods used in order to address the comments are Discriminant Analysis (DA) and Canonical Correlation.

One of the objectives of this study was to examine the levels of quality management initiatives of SMEs within the UK Construction Industry. In doing so, a general question facing this area of inquiry was how to organise the observed data into meaning structures that is to develop taxonomies. The general approach has been to classify TQM deploying organisation on a Yes/No basis. Through cluster analysis the organisations are classified according to their levels of TQM. These have been categorised into three levels, namely high, medium and low. These classifications are elaborated upon in section 6.2.10. Another classification approach used is that of Hierarchical Tree.

DA has the added advantage over ANOVA and MANOVA in that it can actually put cases into groups on a discriminating function identified classification. For example, in this study the case of the TQM deploying organisations were discriminated into the following two functions; Size and TQM Maturity. Furthermore DA makes an effort to interpret the patterns of differences among the predictors.

Table 6.3: Summary of Discriminating Functions

Cases	Discrimination Function
TQM Deploying (n=20)	• Size (Medium versus Small) • TQM Maturity (Experienced vs. Less Experienced) • Organisation Performance (High, Medium, Low)
TQM and non-TQM (n=63)	• Size (Medium versus Small) • TQM Level (High, Medium and Low)
Non-TQM Deploying (n=43)	• Size (Medium versus Small) • TQM Level (High, Medium and Low)

Analysis

The discriminant function associated with the ten major dimensions of TQM deployment can be expressed as follows

$$\mathbf{D_{TQM} = W_1X_1 + W_2X_2 + W_3X_3 + W_4X_4 + W_5X_5 + W_6X_6 + W_7X_7 + W_8X_8 + W_9X_9 + W_{10}X_{10}}$$

where X_i (predictor variables) are metric with 1-5 points in which the measured points 1-2 are low, 3 is medium and 4-5 High. Whereas the discriminant function associated with the four major dimensions of TQM organisation performance is expressed as follows;

$$\mathbf{D_{ORGPER} = W_1Y_1 + W_2Y_2 + W_3Y_3 + W_4Y_4}$$

Where Yi (predictor variables) are metric with 1-5 points in which the measured points 1 is hardly, 3 is not at all and 5 is greatly. The output of the canonical correlation such as eigenvalues, canonical correlations, significance of roots and canonical scores/weights are reported in Chapter Six, sub sections 6.3.9 and 6.3.12.2).

6.2.10 Computation of Relative Advancement Indices

The *relative advancement index* (RAI) derived to summarize the advancement of each implementation construct was computed as

$$\mathbf{RAI} = \frac{\sum w}{AxN} \text{ ....} \textbf{Equation 6.1}$$

Adopted from Pheng and Gracia (2002)

Where:

ω = weighting as assigned by each respondent in a range 1 to 5, where 1 implies 'have not begun implementation' and 5 implies 'highly advanced in implementation';

A = the highest weight (5);

N= the total number in the sample.

A low relative advancement index indicates that the construct is least practiced by the organisation, whereas a high index indicates that the advancement of the construct is high.

Where the RAIs were the same for two or more constructs (variables), rank differentiations are achieved by examining the distribution of the rating against such variables. Kumaraswamy and Chan (1998) to compute a mean score used a similar formula

6.2.11 Computation of The Level of TQM Implementation

In order to assess the levels of TQM advancement, an average value for all the ten constructs was deemed to represent the levels of advancement of TQM. This approach of adopting the vector was used by Saraph et al (1989)

Level of TQM Implementation = $\frac{\sum Wi}{N}$ **.................Equation 6.2**

Where:

$\sum$Wi = The sum of the average of each construct

N= the total number of the Implementation Constructs (N = 10).

Table 6.4: Scoring the Levels of TQM Implementation

Average Score ($\sum$Wi)	RAI	TQM Level
4.0 to 5.0	0.8 to 1.0	High (H)
3.0 to < 4.0	0.6 to < 0. 8	Medium (M)
1.0 to < 3. 0	0.2 to < 0.6	Low (L)

The generated scores are from the relative advancement indices and the mean values. These values will form the basis for the classification of the proposed new assessment and monitoring tool.

6.2.12 Computation of The Total Quality Management Index (TQMI)

The estimated unstandardized weights for the ten deployment factor indicators ($\omega_{\eta 101}$, $\omega_{\eta 102}$, $\omega_{\eta 103}$, $\omega_{\eta 104}$, $\omega\eta_{105}$, $\omega\eta_{106}$, $\omega\eta_{107}$, $\omega_{\eta 108}$, $\omega_{\eta 109}$, and $\omega_{\eta 1010}$) for the ten total quality management indicators

- (executive commitment [y_{101}]
- adopting quality philosophy [y_{102}]
- customer focus [y_{103}],
- supplier focus [y_{104}]
- benchmarking [y_{105}]
- training [y_{106}]
- open organisation [y_{107}]
- employee empowerment [y_{108}]
- zero defects [y_{109}]
- measurement [y_{1010}])

are used to estimate the total quality management (η_{10}) construct $\eta_{10} = \omega_{\eta 101}y_{101} + \omega_{\eta 102}\, y_{102} + \omega_{\eta 103}\, y_{103} + \omega_{\eta 104}y_{104} + \omega\eta_{105}\, y_{105} + \omega\eta_{106}\, y_{106} + \omega\eta_{107}\, y_{107} + \omega_{\eta 108}y_{108} + \omega_{\eta 109}\, y_{109} + \omega_{\eta 1010}y_{1010}$

and compute its case values through indicators' case values. Mathematically, an organisations TQMI is defined as:

$$\textbf{TQMI} = 100 \times [\,E\{\eta_{10}\} - Min\{\eta_{10}\}] \div [\,Max\{\eta_{10}\} - Min\{\eta_{10}\}] \text{ ...... Equ 6.3}$$

Where E{n}, Min {n} and Max {n} denotes the expected minimum and maximum range value of the variable. For example, the Executive Commitment Construct has the E value of 4.10 which is the mean aggregated value of its three variables. The Min and Max Values are 1.0 and 5.0 respectively, therefore the TQMI for the Executive Commitment Construct can be computed as follows

$$100 \times [4.10 - 1.00] / [5.0 - 1.0] = 77.5\%$$

The significance of the TQMI is that when applied to measure the percentage of TQM advancement, there is a reduction in the value of the RAI obtained using equation 6.1. A similar approach of using the TQMI was used by Joseph (1999) in his study of the Indian Manufacturing industries. It is also similar to the Customer Satisfaction Index (CSI) obtained by Chan et al (2003a)

Since the scales for the survey range from 1 (not started) to 5 (highly advanced), the TQMI formula is simplified to:

Method 1

$$TQI = \sum_{i=1}^{10} Fi\,(\sum_{j=1}^{Ki} fijRtij\;) \text{ ....} \textbf{Equation 6.4}$$

where $\sum_{i=1}^{10} Fi = 1$, $1 \leq R_{ij} \leq 5$

Fi = The importance weight of a Quality Management critical factor (for i = 1,...., 10)

f_{ij}...... = .The importance weight of an item associated with a Quality Management critical factor (for i = 1, ..., 10; and j = 1, ..., k_i)

Ki = The number of items within each Total Quality Management construct

That is, the UK Construction related SME's TQMI equals the weighted average of its ten satisfaction indicators mean values multiplied by a scaling constant 5. If all the respondents gave the highest possible score of 5 out of ten indicators, the organisations TQMI can reach the highest and maximum score of 100% or 360 Degrees if using the radial advancement chart. This would be equivalent to the World Class Status.

6.2.13 Computation of the Total Quality Management Performance Index (TQMPI)

The Total Quality Management Performance is measured on the similar lines as the TQMI, but this time using the four performance indicators of financial performance, customer satisfaction, employee satisfaction, and operating indicators.

TQMPI = 100 x [E $\{\eta_4\}$-Min $\{\eta_4\}$] ÷ [Max $\{\eta_4\}$-Min $\{\eta_4\}$] ..Equation 6.5

and Maximum Level of Performance = **MLP** $= \frac{\sum w}{AxN}$

6.2.14 Computation of The Coefficient of Variation (CV)

The coefficient of variation (CV) is used as a general measure of standardised skewness on the TQM Implementation constructs by the Industry. This is similar to the Importance Index as utlised by Pongpeng and Liston (2003)

$$\textbf{CV} = \frac{\text{Standard deviation of scores on dimension}}{\text{Mean of scores on dimension}}$$ **........Equation 6.6**

The coefficient of variation or Importance Index is utilised to enable the similarities and differences between the TQM and Non-TQM to be drawn. The inference to be drawn is that a high average score with a low CV on a

TQM dimension is used as an industry indicator of excellent TQM performance. (Huq and Stolen, 1998). They further state that the industry coefficient of variation on a particular dimension which is expressed as a percentage can be used as a measure about consistency with which companies adhere to that TQM dimension in the industry. For the purpose of this research, the CV is used as a comparative basis between TQM and Non-TQM deploying UK Constructional related SMEs.

6.2.15 Analysis of Case Studies

Grounded theory is used for the analysis of the qualitative data as it is shown to be of practical value in quality research. (Largrosen, 2001). The same approach used for the quantitative analysis was adopted and the case studies were subjected to the four tests of Internal Validity, External Validity, Reliability and Construct Validity. The methods are explained in more detail in the subsequent chapters. Interpretative approach as advocated by McCabe et al (1998) is the format used for presenting the case studies. The main steps in the case study methodology are summarised as a flow diagram shown in Figure 6.75. The steps undertaken in the case study methodology are explained in detail under their relevant sub sections as indicated in Figure 6.75. The first step elaborated upon and further presented in sub section 6.11 is that of the case study protocol. According to Yin (1994) citied in Voss et al (2002), the reliability and validity of case research data will be enhanced by a well designed research protocol. McCutcheon and Meredith (1993) note that the issue of triangulation should be addressed when developing the research protocol and instrument. For ease of interpretation, the boxes in Figure 6.75 are denoted by their relevant sub section numbers. This is the order in which the issues are addressed under the case study section.

Method 3: Case Studies

Different methods of case analysis techniques, both within and across are as follows;

- Typology Comparisons
- Forced Pairings
- Juxtapose Components

6.2.16: Application of Methodological Triangulation

Following the analysis of the quantitative study and its associated statistical analysis as indicated in sub sections 6.2.1 to 6.2.11 and the qualitative study in form of the case studies (see 6.2.12), and in order to ascertain how the different results could be put together to obtain a broader picture of the application of the TQM deployment constructs, two of the four types of triangulation as advocated by Denzin (1989) and also used by Love et al (2002a), are applied. These are as follows;

- Data triangulation
- Investigator triangulation
- Methodological triangulation
- Inter-disciplinary triangulation

A brief explanation of each method is provided in the methodological section of chapter two. Figure 6.7 shows the diagrammatical representation showing the fusion of the three methods utilised, namely statistical analysis, case studies and literature review is presented in chapter six. The arrows equally depict the linkages.

Method 1: Literature Review

- Identification of Critical Success factors of Quality Management by drawing on literature from various disciplines such as organisation behaviour, service quality and management

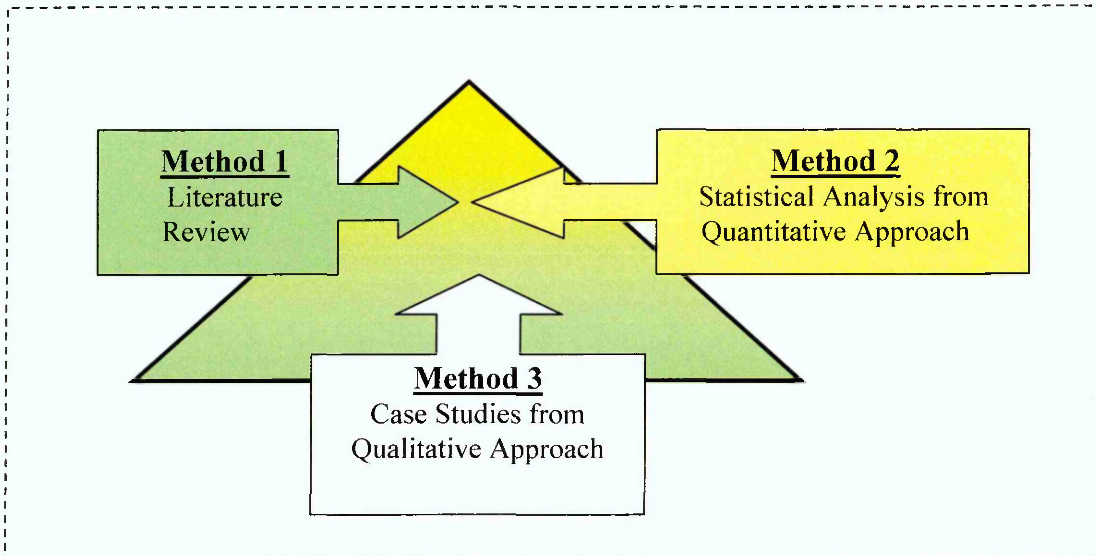


Figure 6.7: Validation Process of the Methodological Triangulation
Source (Author's interpretation)

Method 2: Statistical Analysis

Quantitative data deals in numbers and statistical data obtained by enumerative induction while qualitative data expresses concepts and ideals.

Method 3 - Case Studies as discussed in the preceding sub section

Ammenwerth et al (2003) describes the two major objectives of triangulation as validation of results and completeness of results. The application of triangulation and its achievement of the results is explained in sub section 6. 16.

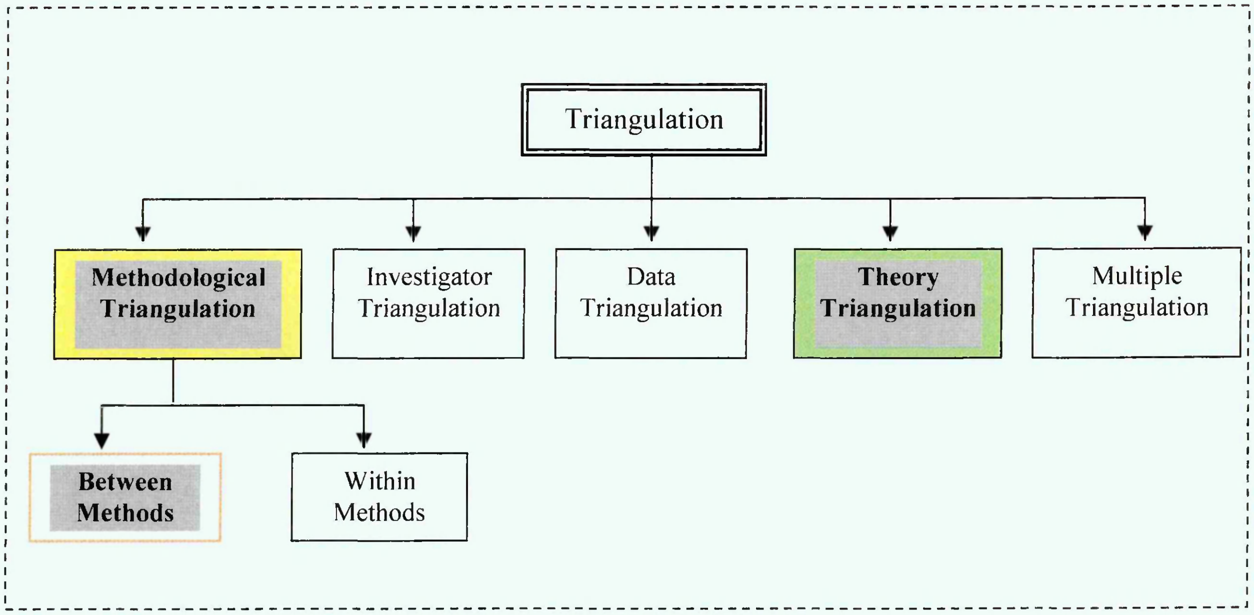


Figure 6.8: Varieties of triangulation, according to Denzin (1989)

6.2.17 : Explanation of the Box and Whisker Plots

The box and whisker plot shown in Fig 6.9 provides a graphical presentation of data for displaying features such as dispersion, location and skewness. The bottom of the box corresponds to the first quartile (Q_1) and indicates the value of the variable to which 25% of the observations are less than or equal. Similarly the top of the box corresponds to the third quartile. The length of the box called interquartile range (IQR) is a measure of dispersion of the data. A line within the box indicates the median (50th percentile) that is in this side is drawn with a symbol 'O' to avoid an overlay of both lines of the box. Two whiskers are extended from the box. The lower whisker starts at max $\{X_{(n)}, Q_1 - 1.5(Q_3 - Q_1)\}$ and the upper whisker ends at min $\{X_{(n)}, Q_1 + 1.5(Q_3 - Q_1)\}$, where $X_{(1)}$and $X_{(2)}$, are the smallest and largest value of observations. Outliers are data points beyond the lower and upper whisker, plotted with asterisks.

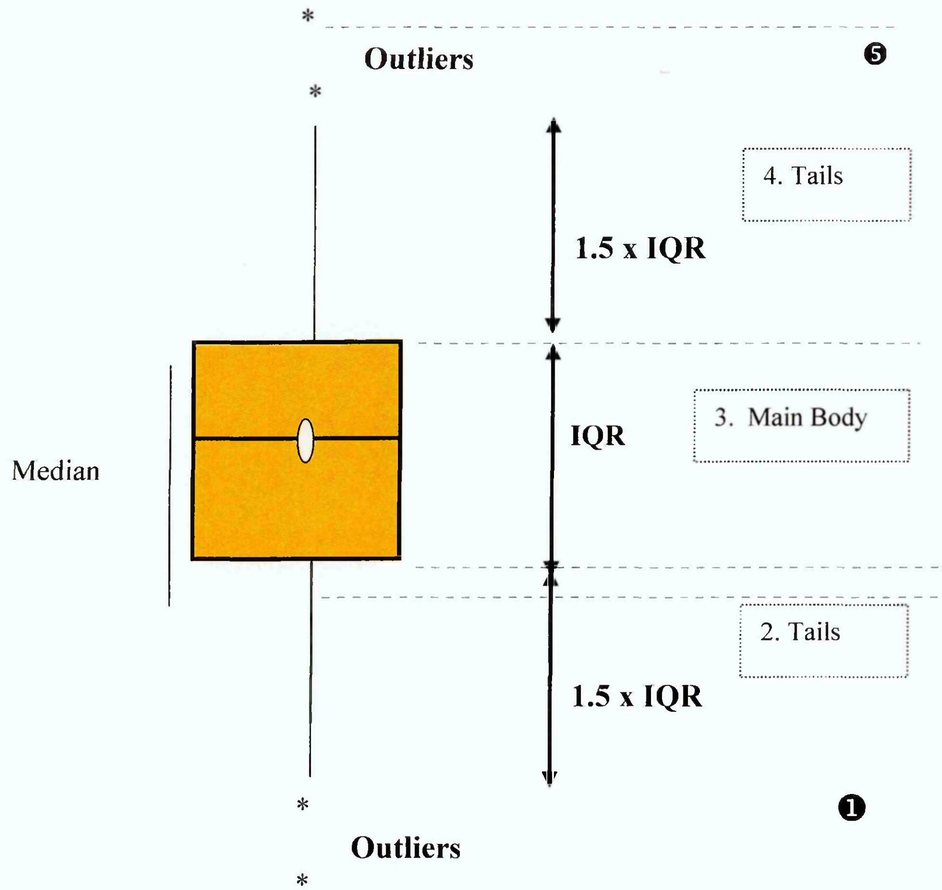


Figure 6.9: Explanation of a Box and Whisker plot
Source: Jung and Hunter, (2001)

Finally the box whisker plots have been used as they highlight the possibility of using cross-tabulation to perform preliminary evaluation of relationships involving nominally scaled variables (Forza, 2002).

Cortina (2002) observes how extreme values can have an inordinate impact on empirical results and the conclusions that can be drawn from them. Two outlier categories are variance covariance.

6.2.18 Application of CFA in the Basic Second Order

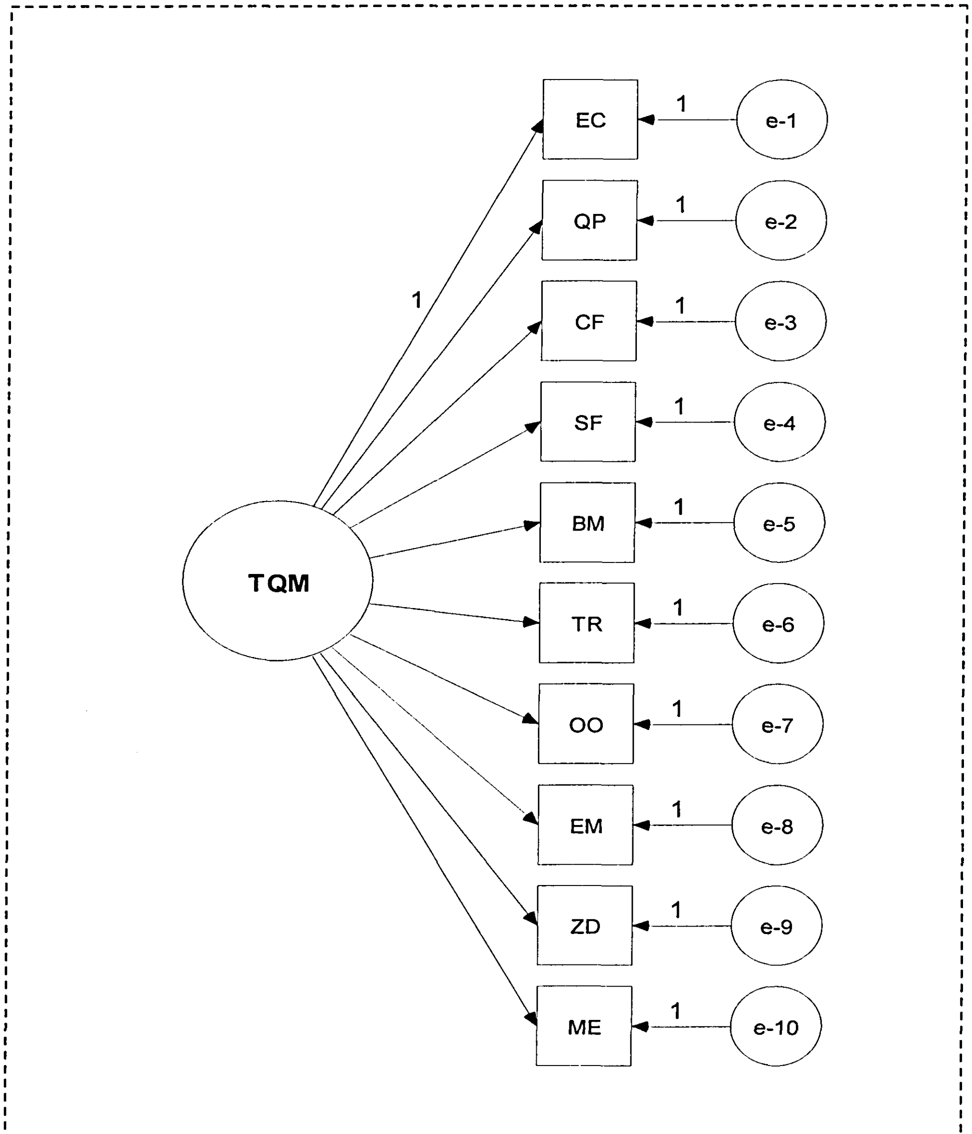


Figure 6.10: Second Order Confirmatory Factor Analysis of the 10 Factor Model of TQM Deployment

The Second-Order Factor Approach offers according to Williams et al (2003), the greatest flexibility when the goal of the research is to examine the antecedents and consequences of change. Given the situation described in sub section 6.7.2.1 where the objective is to ascertain the differences in time lag analysis, the diagram shown in Figure 6.10 will be used as the basis for testing for invariance across different groups, for e.g. between experience and less experienced groups. The ten factors shown in Figure 6.10 can be represented by the following equation;

Second Order Approach (SOA)

Structural Equation : $= \Gamma \xi + S$.................. **Equation 6.7**

$(10 \times 1) = (10 \times 1)(1 \times 1) + (10 \times 1)$

The structural equation links the ten quality management factors to the latent factor "total quality management" ξ. These ten factors are shown in Fig 6.10 as:

- Executive Commitment (EC)
- Adopting the Philosophy (QP)
- Customer Focus (CF)
- Supplier Focus (SF)
- Benchmarking (BM)
- Training (TR)
- Open Organisation (OO)
- Employee Empowerment (EE)
- Zero Defects (ZD)
- Measurement (ME).

Invariance will be tested by examining the factor covariance, for example between EC and QP. On the other hand, the linkages between the variables (indicants) and their respective constructs can be represented by the following equation.

First Order Approach (FOA)

Measurement Equation : $y = \Lambda y \, \eta + \varepsilon$ .... **Equation 6.8**

$(34 \times 1) = (34 \times 10)(10 \times 1) + (34 \times 1)$

The measurement equation links observed indicators y to their respective hypothesized quality factors η. First order factors are given by Λy while second-order factor loadings are given by Γ. The future diagram showing the linkages between the structural and measurement equations forms part of the

Confirmatory Factor Analysis and is dealt with in Chapter Six (Figure 6.53). The loading on the first variable (EC) as shown in Figure 6.10 is fixed to 1.0 to scale the latent variable. With this loading fixed, the one factor model has 20 free parameters, including 9 remaining factor loadings and 11 variances (of 10 measurement errors denoted as e_{-1} through to e_{-10} and a latent variable). With 10 observable variables, there are:

[10(10+1)]/2 =55 observations,
thus the degrees of freedom = 55 - 20 = 35.

The measurement model forms the basis of the second test for invariance by examining the group invariance related to the Factor and its respective variables. The results of this CFA are tabulated in Tables 6.25 and 6.27 and explained in subsection 6.22.

Finally the sum of the structural and measurement model, known as the Global Model forms the basis of Structural Equation Modelling.

Global Model = Structural Model + Measurement Model

The global model incorporating the measurement and structural model is specified to test the fitness between the theoretical specifications and the empirical data set. The global model is illustrated in Figure 6.4. According to Larson and Sinha (1995), Measurement models as illustrated in Figure 6.4 specify how the constructs are measured in terms of observed variables or indicators. In the current study, indicators for the TQM measurement instrument based on the Powell (1995) refined instrument are drawn from 34 numbered survey items, and for the Business and Organisation Performance Indicators, 15 numbered survey items. Whereas the Structural Models specify an expected relationship between the constructs, the proposed Global model combines the measurement and structural models.

This sub section presented the data analysis to be used at the macro and micro levels from the survey point of view as well as the methodology to use in the case study. As argued by Forza (2002), preliminary analysis is performed before measurement quality assessment in order to establish and check the assumptions underlying the tests.

6.2.19 Application of Path Analysis

This sub section describes the various steps undertaken to analyse the data in order to achieve objective four, that is to explore (investigate) the relative magnitude of the direct and spurious (indirect) relationship between TQM and Organisation performance. The specific steps in the analysis of the TQM-BOPI relationship is illustrated in a form of a flow chart involving the five steps. This is adapted from Prescott et al (1986)

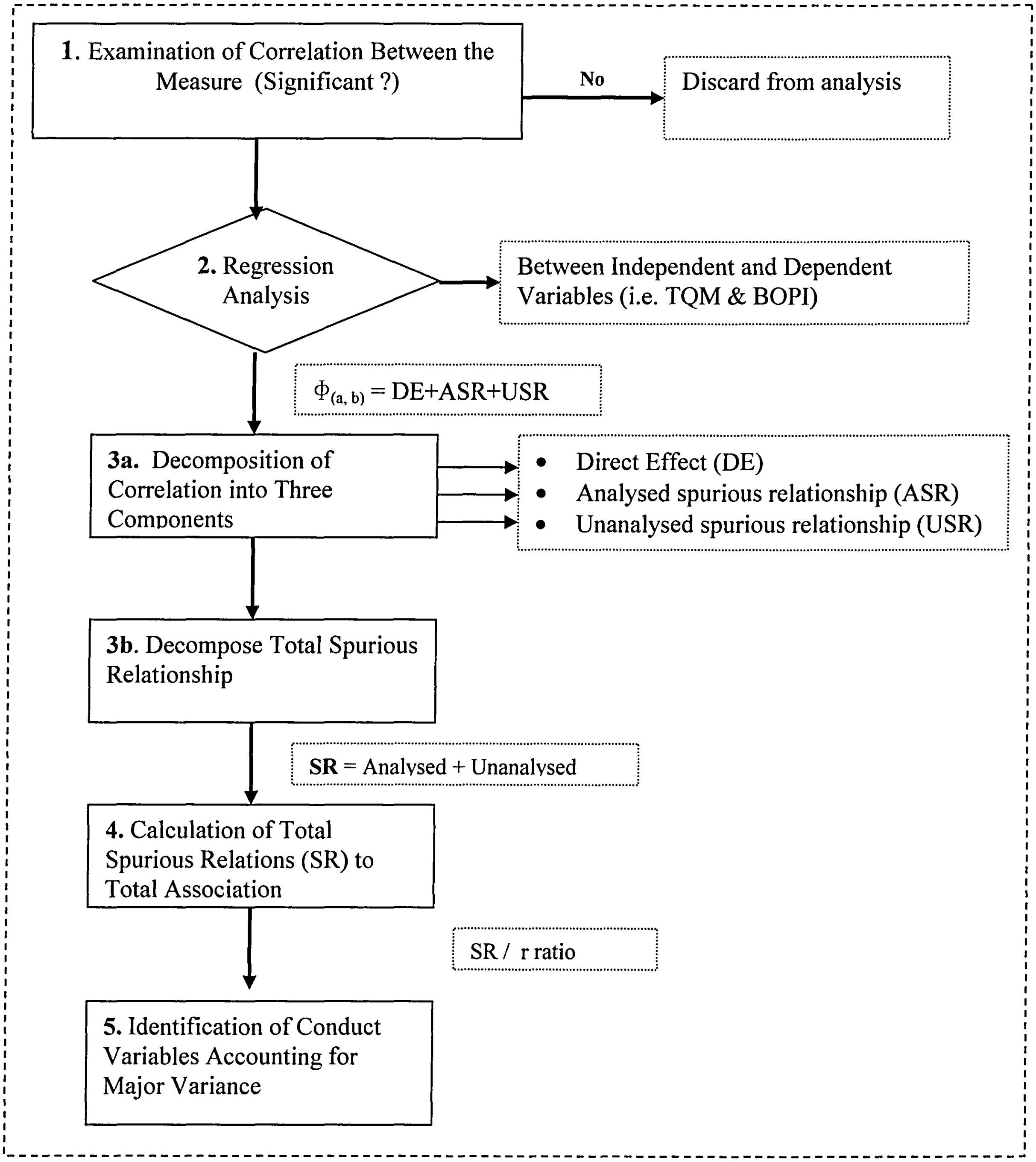


Figure 6.11: Analytic Procedure in Direct and Indirect Effects

Author's interpretation of Prescott et al (1986) description.

Chapter Six

Data Collection & Synthesis

CHAPTER SIX: DATA COLLECTION & SYNTHESIS

6.1 Introduction

The aim of this Chapter is to present the findings of the statistical analysis using the SPSS and AMOS software package, and the qualitative analysis through case studies. Formal correlation analysis and path analytical techniques are explored. Comparisons between TQM and non-TQM deploying organisations on the assessment of TQM principles are presented. The ten constructs of TQM Implementation as stated in part two of the questionnaire and the 15 items four-factor TQM performance indicators are presented. This includes results of the hypothesis testing as formulated in Chapter 2. The results of the analysis are presented in Tables 6.1 to 6.44 and illustrated in Figures 6.1 through 6.79 and in Chapter 7, Tables 7.1 to 7.23 others are in the appendices E and D. The Chapter is sub divided into fifteen sections and structured as follows;

- first, the introduction is provided,
- second, the methods in the data analysis are explored,
- third, present the descriptive statistics of the demographics and explore the descriptive statistics of the TQM deployment constructs.

Figure 6.11 captures the entire survey document and highlights the detailed order of presentation. Also this Chapter in section 6.4 reports on the impact of organisation size, presence of unions and TQM maturity on the total quality management practices on business and organisational performance. This is followed by sections 6.5 and 6.6 which discuss the descriptive statistics for the TQM deployment constructs and the correlation matrix. Section 6.7 explores the advocated benefits of the implementation process. Descriptive statistics and Reliability analysis of the business and organisational performance indicators (BOPI), and the assessment of the competitive environment are presented in sections 6.8 and 6.9 respectively. The results of the Confirmatory Factor Analysis and justification, empirical validation of the measurement instrument are examined in section 6.10. Finally sections 6.11

through to 6.15 presents the case study methodology, with the associated cross case analysis and discussion of the triangulation approach. Chapter Six concludes with the summary and sets the groundwork for the model re-development and validation in Chapter Seven.

6.2 Data Analysis

A total of ten dimensions of total quality management practices in UK constructional related SME's were perceptualised and measured using the five-point Likert scale (1=have not begun, 5=highly advanced in Implementation). Performance of TQM success was measured by the three-point Likert scale (1 = Not at all, 3 = hardly and 5 = greatly). The *Statistical Packages for the Social Sciences (SPSS)* was used for the analysis. Two levels of data analysis are conducted: a macro-level analysis of aggregate, surface characteristics of the respondents and a micro-level analysis of deeper, fined data methods.

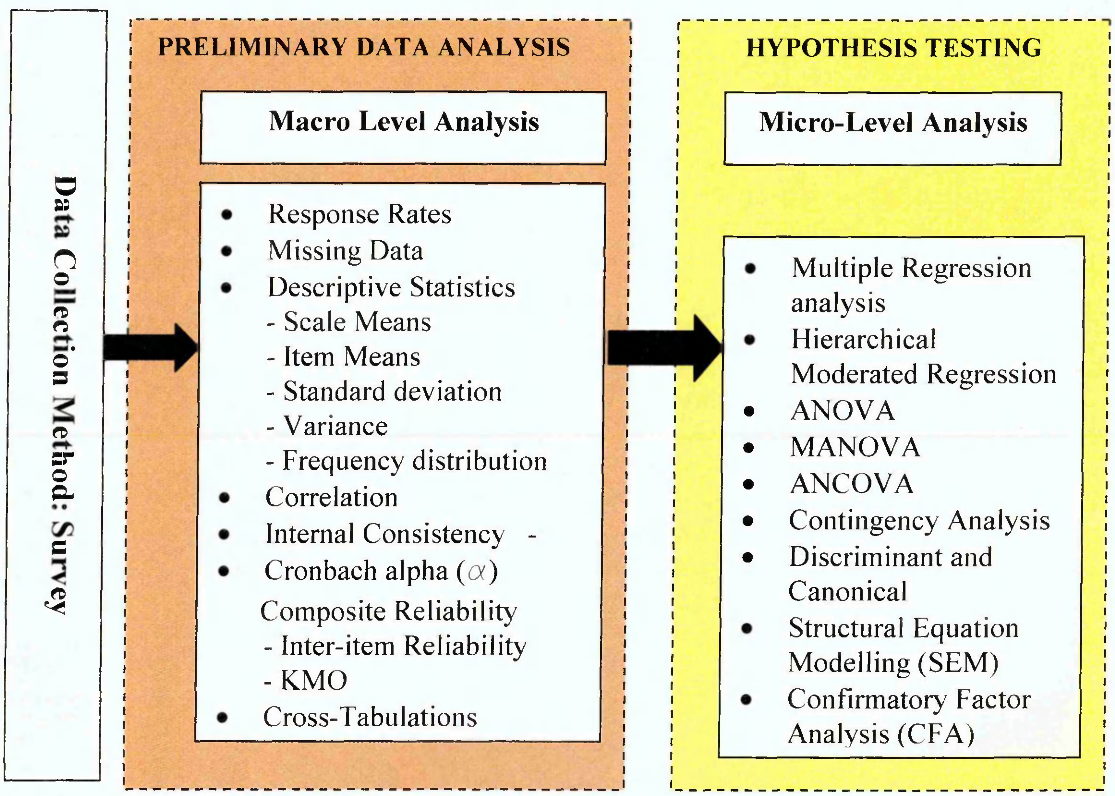


Figure. 6.1. Data Analysis Map
Source: Adapted from Boyer et al (2002)

As shown in Figure 6.1, the macro-level is concerned with the aggregate measures of the descriptive statistics, where as in the micro-level, there is the evaluation of the measurement and structural model, TQ-SMART, using fine grained methods such as structural equation modelling (SEM)

According to Forza (2002), Data analysis can be schematically divided into two phases: preliminary and hypothesis testing. Boyer et al (2002) described these phases as macro-level and micro-level analysis. This study adopted both approaches and a summary of the data analysis techniques utilised in the survey part of the research is shown in Figure 6.1. Data was further subjected to tests to determine whether it met the parametric or non-parametric criteria. A full description of the conditions is highlighted in Chapter 3. The methods involved in the macro and micro level of analysis are presented in the following sub-section which is followed by the presentation of the results of data analysis.

6.2.1 Mean Scores and Correlation Analysis

For the two ordinal variables, the following methods are used in order to determine whether each scale is measuring a single ideal; each individual variable was paired with the summed score for that category. The results are shown in the appendices

- Spearman rank order correlation (rho)
- Kendall rank order correlation (tau)
- Kendall's coefficient of concordance (*W*)

The Spearman rank order correlation involved the pairing of each individual variable with the summated score for that category.

The Kendall's coefficient of concordance was used to assess the degree of consensus or measure of agreement of respondents within a group on the ranking of the importance of the TQM constructs or critical success factors as commonly known in literature. The analysis procedure has been used by other similar survey studies such as Anderson and Sohal (1999) and Chan et al (2003). Correlation analysis is used to provide a summary between pairs of variables such as TQM and Business and Organisation Performance.

For the variables measured at an interval (i.e a five-point weighting scale where 1= not advanced and 5 = highly advanced), the Pearson Product Moment Correlation was computed to test the correlations between the TQM constructs and TQM performance. Based on the simple formulation of N*(N-1)/2, where N is the number of variables, the data generated 561 pairs which are shown in the appendix.

6.2.2 Reliability Analysis

The following measures are used in the thesis for the reliability test. A brief description is provided and the results of the analysis can be found in the subsequent sub sections and the appendices D.

- Cronbach Alpha (α)
- Kaiser-Meyer-Olkin (KMO) Sampling measure of adequacy (SMA)
- Barletts Measure

The degree to which multiple indicators share in their measure of a construct (Field, 2000) was conducted using Cronbach's alpha coefficient. This was calculated for each of the variables and summated score for the construct.

To supplement the stability, the Kaiser-Meyer-Olkin (KMO) sampling measure of adequacy and the Barlett's test of Sphericity were conducted. The KMO Statistic varies between 0 and 1, and is defined as an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients and for the original matrix. It is recommended that the value of KMO should be greater than 0.5 if the sample is to be adequate (Field 2000). The findings from the survey have a KMO value of 0.788 and indicate that the sample was adequate and that 'factor analysis' is appropriate for this data

Barlett's measure tests the null hypothesis that the original correlation matrix is an identity matrix. The result of the test was 2122.876 with an associated significance level of 0.0000. All the results suggested that the data collected was adequate for factor analysis. The KMO for individual variables are shown in the Appendix D (Table D28), the small value of the significance level ($p < 0.001$) indicates that a factor analysis may be used.

6.2.3 Confirmatory Factor Analysis

Confirmatory Factor Analysis is used to check the construct validity using convergent validity and scale undimensionality. The rationale behind the usage of confirmatory factor analysis according to Gumus and Koleoglu (2002) is to serve three main purposes. The first is to minimise variables under a minimal number of factors, after computing their correlations. The second is to limit the structure of variables under factor, and the final purpose is that it is a hypothesis test for the certain factors computed for values.

Confirmatory Factor Analysis (CFA) is used to determine whether the patterns of variance and covariance in the data are consistent with a specified structural model. The three approaches for SEM Construction and development are; strictly confirmatory, model generation and model comparison.

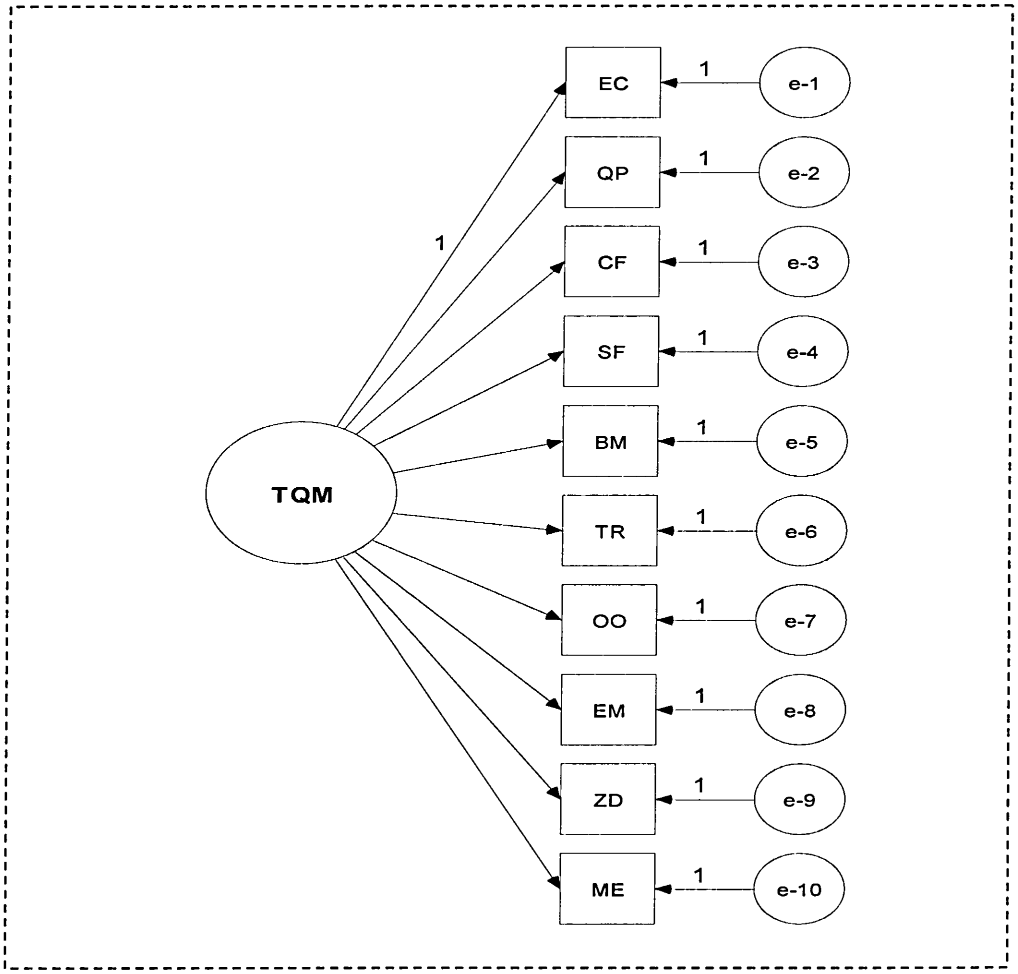
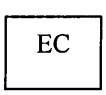
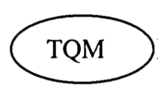


Figure 6.2: Model of the Second-Order Confirmatory Factor Analysis

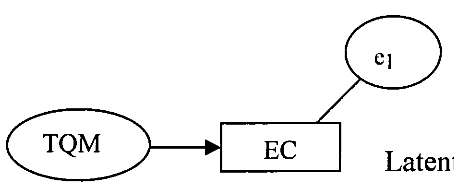
Path Diagram Symbol Notation or explanation of the labels



Observed variable or indicator



Latent variable or factor



Latent variable measured by indicator with error term

In Figure 6.2, the ten model constructs are shown in the boxes. e_1 to e_{10} and represent the measurement error of the observed variables. The arrows depict linear relationships. To cope with identifiably, the TQM→EC path is restricted to 1 as conventionally accepted.

Another valid reason for the use of CFA is that it is ideal when the researcher has hypothesized the structure (i.e. which questions go with which construct) and wishes to test data for the predetermined structure (Spector, 1992).

Joreskog and Sorbon (1989) state the four steps that characterize CFA as follows: Model Specification, Model Data Fit, Model Comparison, and Model Re-specification. The main steps in applying Confirmatory Factor Analysis in Structural Equation Modelling are summarised as a flow diagram shown in Figure 6.3

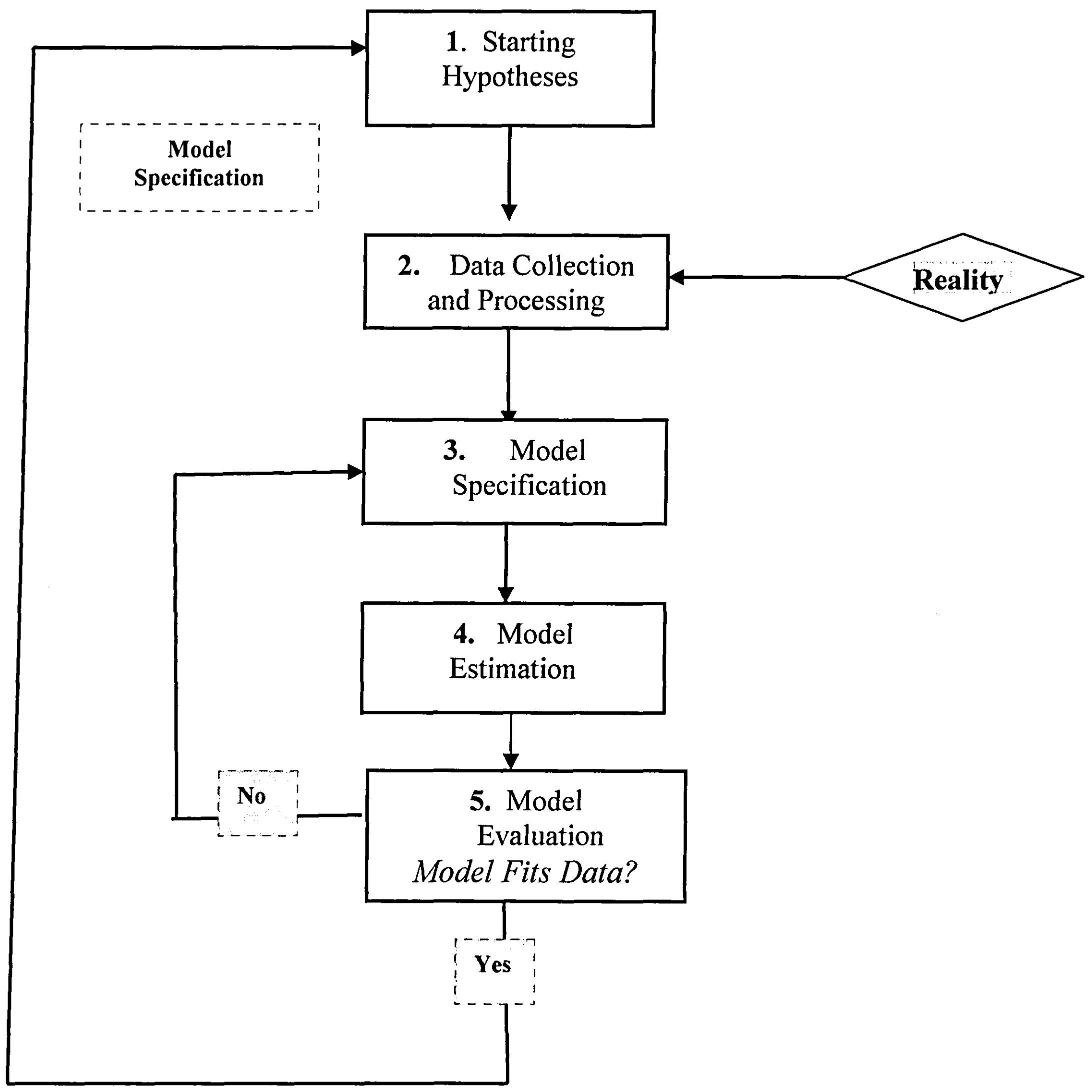


Figure 6.3: The Confirmatory Factor Analysis Process Using Structural Equation Modelling (SEM)

The issues in applying CFA in each of the steps of Figure 6.3 are addressed in the following

1. Model Specification

Proposing alternative models of factor structure such as logic, theory or previous studies based on a review of the literature research. This led to the following models of comparison:

- Soft versus Hard Factors as illustrated in Figure 6.68
- Ten Factor Model as illustrated in Figures 6.2 and 6.10

The method is based on logic, theory or previous studies. In this study, this stage involves the refinement of the Powell (1995) instrument developed for assessing the quality levels in manufacturing and service organisations

2. Model Data Fit

This step can be described as assessing the degree to which data and proposed models meets the assumptions of Structural Equation Modelling. The method used is through the goodness of fit criteria and should be evaluated at several levels. Firstly for the overall model and secondly for the measurement & structural models separately.

3. Model Comparison

This involves comparing fit indices for alternative models that subjectively indicate whether the data fit the theoretical model. The method used is a multiple trait method and assessing convergent validity –(CFA) method.

4. Model Re-Specification

This usually occurs when the model fit indices suggest a poor fit. By using Modification Indices, the model can be respecified. This involves the researcher making a decision regarding how to delete, add, or modify paths in the model, and then subsequently returns to the analysis.

6.2.4 Assessment of Fit Criteria

This study used SEM in order to provide additional assessment of the instrument used in the study of Powell (1995), but to a greater extent and based more on the construction environment as opposed to the manufacturing and service environment. The main steps in applying SEM are summarised as a flow diagram shown in Figure 6.4. Issues in applying SEM in each of the steps of Figure 6.4 are addressed in more detail in sub section 6.2.18. Li et al (2003) defines the Goodness-of-fit criteria as how the model fit determines the degree to which the structural equation models fit the sample data. Other fit indices to be used in step are Chi-square (χ^2). Normed Fit Index (NFI) and Bentler and Tucker. A detailed list of available assessment methods for fit is shown in Chapter 7. As illustrated in Figure 6.4, the structural equation modelling consists of two parts, the measurement and structural model.

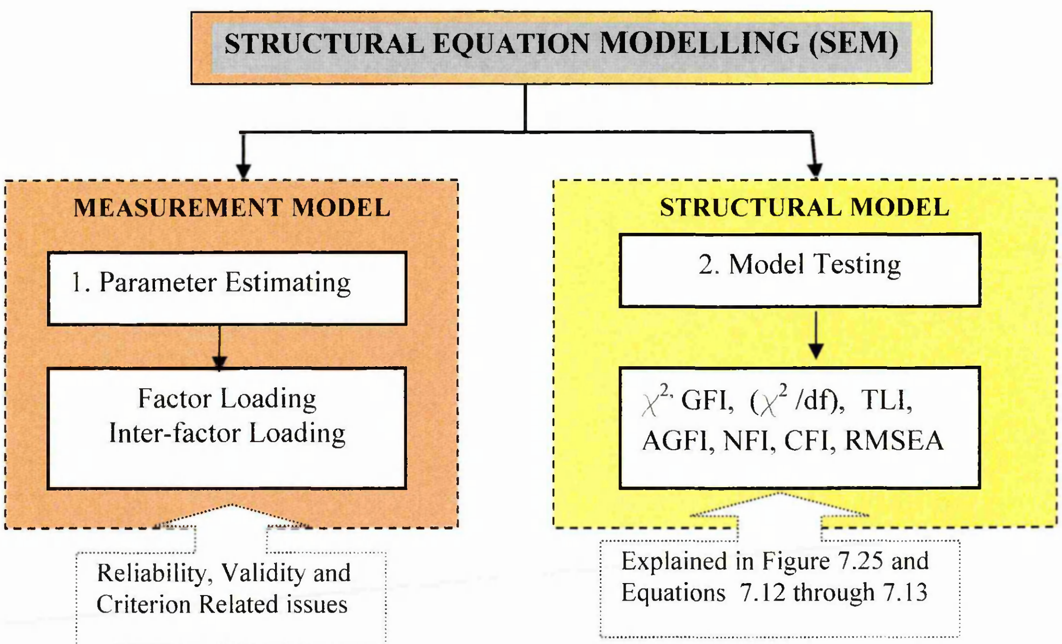


Figure 6.4: Basic Components of Structural Equation Modelling (Author's Interpretation)

Parameter Estimating generates the unstandardized estimates which could be unanalysed association between factors or measurement errors. The factor loadings are interpreted as unstandardized regression coefficients that estimate the direct effects of the factors on the indicators (Kline, 1985). The parameters that will be calculated first are the weighted mean, and variance for each composite measure. Then the maximised reliability coefficients, in the form suggested by Werts et al (1978).

Model Testing: This involves the demonstration of re-specification, through the modification of an initial CFA model with mediocre or poor fit to the data. Several models are tested ranging from testing for a single factor, where TQM is hypothesised as one factor to a multifactor model (i.e. the ten factor, three factor mechanistic model and seven factor organismic models.)

6.2.5 Multiple Regression Analysis

The purpose of this analysis was to determine the independent variables (Factors 1-10) which are related to the dependent variables of performance measures. This is achieved by using a stepwise regression analysis procedure. The results for the 10 construct regression model showing the unstandardized coefficient (B), std error, Standardardized coefficients (Beta), 't' and significance values are shown in the appendix D. The study initially used multiple regressions in the analysis of the relations between variables.

The main stages in applying multiple regression analysis are summarised as a flow diagram shown in Figure 6.5.

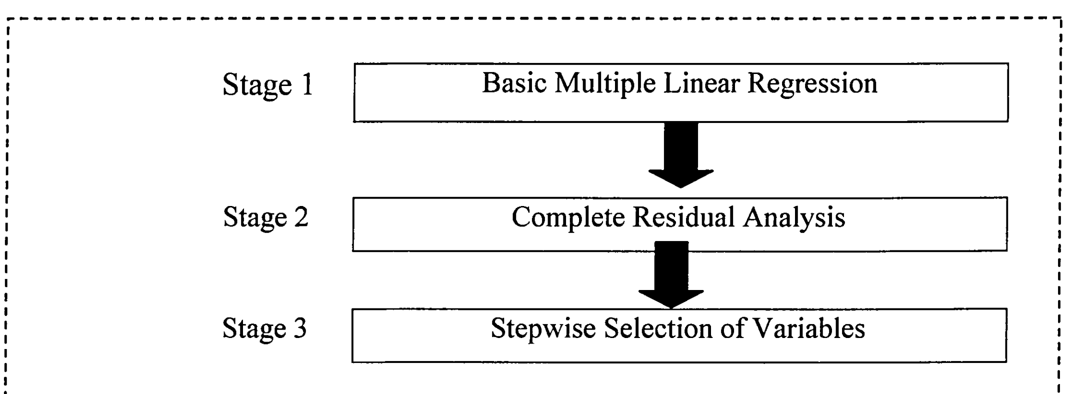


Figure 6.5 Stages in the Regression Process

Issues in applying regression analysis in each of the stages of Figure 6.5 are addressed in the following; **Stage 1** was the basic multiple linear regression using each dependent variable with all independents. In this case all the ten TQM constructs were entered as independent variables with each of the fifteen dependent variables (performance measurement variables), the results of which are the t-values and Beta (β) which are reported in the appendix D. **Stage 2** involved a complete residual analysis which was conducted to determine the prior assumptions of linearity and homoscedascity where valid. The primary method used to test the distribution normality of residuals was the Chi-square (χ^2) goodness of fit. The chi-square (χ^2) tests conducted on the residuals of each regression indicated the acceptance of normality for the dependent variables. The standardised estimates allow the evaluation of the relative contributions of each predictor (the ten deployment constructs) to each outcome variables. Finally **stage 3** involved the stepwise selection of variables.

6.2.6 Analysis of Variance (ANOVA)

To find out how much variation exists among the constructional related SME's concerning the implementation of TQM, both the Kruskal Wallis test (K-W) and the one way variance test (ANOVA) were employed to state the similarities or dissimilarities among the SMEs. The results of the descriptive statistics such as the mean and standard deviations are presented in Appendix D (Tables D4 and D5) for both the TQM and Non TQM deployment constructs and the various measures for the business and organisational performance. The preliminary results for the Analysis of Variance (ANOVA) was used to test the TQ-SMART measuring instrument and revealed a significant difference of variance between the measures ($F = 10.4659$, $p = .0000$). ANOVA has been used to test the hypothesis, in order to identify if differences of averages between

- TQM and non-TQM organisations
- experienced and less experienced
- small-sized and medium-sized, were significant.

6.2.7 Multivariate Analysis of Variance (MANOVA) & Multivariate Analysis of Covariance (MANCOVA)

MANOVA and MANCOVA are used in order to assess group differences across the 15 dependent business and organisation performance indicators simultaneously. In order to address the analysis of the time lag between inception and improvement, a sub group analysis of the measurement model fit indices was carried out based on the TQM duration. TQM deploying organisations were classified in two groups depending on the number of years TQM was in place. The classification as used by Ahire and Dreyfus (2000) is as follows;

Table 6.1: Classification of Organisations based on TQM Maturity

Classification	No. of years TQM in place
Recent TQM Implementers	up to 3
Experienced TQM Implementers	more than 3

Other studies to have used the three year cut off point are Dawson and Patrickson, (1991) and Ahire (1996). The results of the MANOVA such as the four indices of multivariate tests of significance namely; Pillai's trace, Wilk's lambda, Hotelling's trace, and Roy's largest root are presented in Appendix ??. Furthermore, according to Hair et al (1992) as citied in Terziovski and Samson (1999), the Pillai's criterion or Wilk's Lambda are the best statistical measures to assess whether an overall significance difference is found between groups. The implications based on the results are discussed in this Chapter. One of the objectives of this study is to determine if there are any differences in quality management implementation and quality outcomes across UK Construction related SMEs, and if so, how and why they differ. One approach taken is to investigate organisation size as a context factor and establish whether organisation size may impede successful TQM implementation. The following sub section (6.2.7.1) describes the data analysis to be employed.

6.2.7.1 Analysis of the Impact of Organisational size on TQM Implementation and Outcomes

In order to address how the research contributes to the application and development of TQM within SMEs, the following factors were taken into consideration: Industry effects and impact of organisation size. Measurement model fit indices were carried out based on the size of the organisation. TQM and Non-TQM deploying organisations were classified in three groups depending on the number of employees as follows:

Table 6.2: Classification of Organisations based on Number of Employees

Classification	No. of Employees
Micro	up to 10
Small	more than 10 and less than 100
Medium	more than 100 and less than 500

6.2.8 Contingency Analysis (Measurement Equivalence or Invariance ME / I)

The propositions presented in Chapter One consists of two parts (propositions 1 and 3) examine the invariance of the levels of the constructs across the sub group based on Organisation Size and TQM Maturity.

Propositions 2 and 4 examine the invariance of the path relationship across subgroups.

The main steps in applying the Contingency Analysis are summarised as a flow diagram shown in Figure 6.6. Issues in applying Contingency Analysis in each of the steps of Figure 6.6 are addressed as follows; the first step involves the determination of the invariance of the levels of Model constructs across the various sub groups as shown in Table 6.2

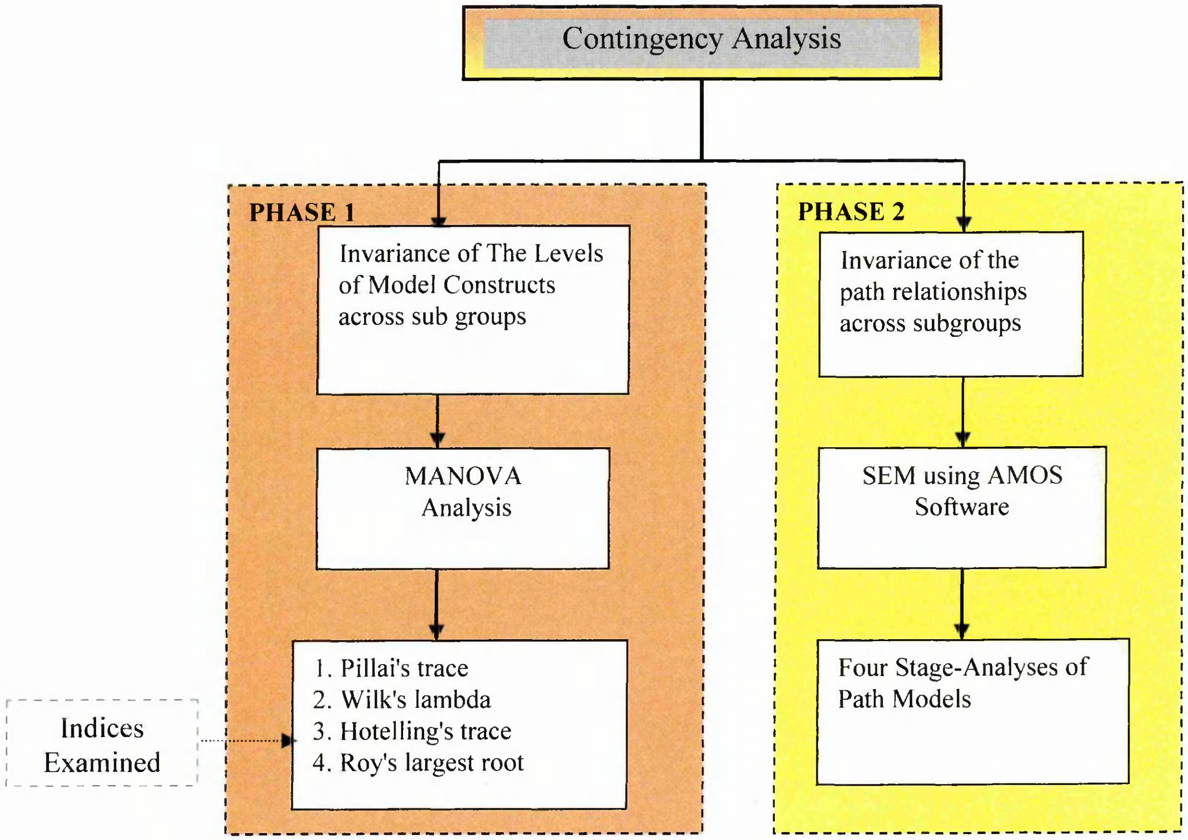


Figure 6.6: The Subgroup Structural Model Analysis

(Source-Author's Interpretation of the SEM and MANOVA)

The second step of the contingency analysis involves SEM and the following sub section describes the issues involved. This is to test if the model relationships vary across the sub groups (less experienced versus experienced, small versus medium), and a four-stage analysis of the path models for the various subgroups using AMOS 4.0 was conducted.

The following four steps will be conducted in the analysis

1. Path models were run separately for each of the four subgroups to check if the path models adequately fit the subgroup sample
2. Generation of Standardized and Unstandardized
3. Testing the Invariance (χ^2, df, p) and
4. Aggregate invariance

Stage 1

The model fit indices demonstrated that the overall baseline path model shown in Fig 6.6 fits well for all sub-group (small organisations, medium organisations, less experienced and experienced)

As the overall measurement model provides a baseline for evaluating the invariance of measurement across subgroups, it is necessary to evaluate its fit to the subgroup samples before evaluating the path model and its invariance across subgroups.

Stage 2

This involved the generation of standardized and unstandardized coefficients and associated test statistics such as the estimate and its standard error. These results are reported in Tables 6.43 and 6.44.

Stage 3

The goodness of fit indices are used to test the invariance (χ^2 df, p) for the second order TQ-SMART Confirmatory Factor Analysis model. This is equivalent to the parameter testing part as shown in Figure 6.4. The full description and implications of the goodness-of-fit indices are provided in sub section 7.7. The chi-square (χ^2) statistic is used for the overall fit of the model.

Stage 4

Aggregate invariance is used for assessing the convergent validity in terms of the factors loadings. The second order factor loadings of the TQ-SMART are presented in Table 6.42 and are all above the required value of 0.5.

In summary, the analysis involved in the contingency analysis are a combination of the MANOVA as described in sub section 6.2.7 and Structural Equation Modelling (SEM) as shown in Figure 6.4

6.2.9 Cluster Analysis Using Discriminant Analysis and Canonical Correlation

In additional to the traditional methods of analysis such as Analysis of Variance (ANOVA) and Multivariate Analysis of Variance MANOVA (See 6.2.7 and 6.2.7), further analytic methods used in order to address the comments are Discriminant Analysis (DA) and Canonical Correlation.

One of the objectives of this study was to examine the levels of quality management initiatives of SMEs within the UK Construction Industry. In doing so, a general question facing this area of inquiry was how to organise the observed data into meaning structures that is to develop taxonomies. The general approach has been to classify TQM deploying organisation on a Yes/No basis. Through cluster analysis the organisations are classified according to their levels of TQM. These have been categorised into three levels, namely high, medium and low. These classifications are elaborated upon in section 6.2.10. Another classification approach used is that of Hierarchical Tree.

DA has the added advantage over ANOVA and MANOVA in that it can actually put cases into groups on a discriminating function identified classification. For example, in this study the case of the TQM deploying organisations were discriminated into the following two functions; Size and TQM Maturity. Furthermore DA makes an effort to interpret the patterns of differences among the predictors.

Table 6.3: Summary of Discriminating Functions

Cases	Discrimination Function
TQM Deploying (n=20)	• Size (Medium versus Small) • TQM Maturity (Experienced vs. Less Experienced) • Organisation Performance (High, Medium, Low)
TQM and non-TQM (n=63)	• Size (Medium versus Small) • TQM Level (High, Medium and Low)
Non-TQM Deploying (n=43)	• Size (Medium versus Small) • TQM Level (High, Medium and Low)

Analysis

The discriminant function associated with the ten major dimensions of TQM deployment can be expressed as follows

$$\mathbf{D_{TQM} = W_1X_1 + W_2X_2 + W_3X_3 + W_4X_4 + W_5X_5 + W_6X_6 + W_7X_7 + W_8X_8 + W_9X_9 + W_{10}X_{10}}$$

where X_i (predictor variables) are metric with 1-5 points in which the measured points 1-2 are low, 3 is medium and 4-5 High. Whereas the discriminant function associated with the four major dimensions of TQM organisation performance is expressed as follows;

$$\mathbf{D_{ORGPER} = W_1Y_1 + W_2Y_2 + W_3Y_3 + W_4Y_4}$$

Where Yi (predictor variables) are metric with 1-5 points in which the measured points 1 is hardly, 3 is not at all and 5 is greatly. The output of the canonical correlation such as eigenvalues, canonical correlations, significance of roots and canonical scores/weights are reported in Chapter Six, sub sections 6.3.9 and 6.3.12.2).

6.2.10 Computation of Relative Advancement Indices

The *relative advancement index* (RAI) derived to summarize the advancement of each implementation construct was computed as

$$\mathbf{RAI} = \frac{\sum w}{AxN} \quad \textbf{..........................Equation 6.1}$$

Adopted from Pheng and Gracia (2002)

Where:

ω = weighting as assigned by each respondent in a range 1 to 5, where 1 implies 'have not begun implementation' and 5 implies 'highly advanced in implementation';

A = the highest weight (5);

N= the total number in the sample.

A low relative advancement index indicates that the construct is least practiced by the organisation, whereas a high index indicates that the advancement of the construct is high.

Where the RAIs were the same for two or more constructs (variables), rank differentiations are achieved by examining the distribution of the rating against such variables. Kumaraswamy and Chan (1998) to compute a mean score used a similar formula

6.2.11 Computation of The Level of TQM Implementation

In order to assess the levels of TQM advancement, an average value for all the ten constructs was deemed to represent the levels of advancement of TQM. This approach of adopting the vector was used by Saraph et al (1989)

$$\textbf{Level of TQM Implementation} = \frac{\sum Wi}{N} \quad \textbf{.................Equation 6.2}$$

Where:

$\sum$Wi = The sum of the average of each construct

N= the total number of the Implementation Constructs (N = 10).

Table 6.4: Scoring the Levels of TQM Implementation

Average Score ($\sum$Wi)	RAI	TQM Level
4.0 to 5.0	0.8 to 1.0	High (H)
3.0 to < 4.0	0.6 to < 0. 8	Medium (M)
1.0 to < 3. 0	0.2 to < 0.6	Low (L)

The generated scores are from the relative advancement indices and the mean values. These values will form the basis for the classification of the proposed new assessment and monitoring tool.

6.2.12 Computation of The Total Quality Management Index (TQMI)

The estimated unstandardized weights for the ten deployment factor indicators ($\omega_{\eta 101}$, $\omega_{\eta 102}$, $\omega_{\eta 103}$, $\omega_{\eta 104}$, $\omega\eta_{105}$, $\omega\eta_{106}$, $\omega\eta_{107}$, $\omega_{\eta 108}$, $\omega_{\eta 109}$, and $\omega_{\eta 1010}$) for the ten total quality management indicators

- (executive commitment [y_{101}]
- adopting quality philosophy [y_{102}]
- customer focus [y_{103}],
- supplier focus [y_{104}]
- benchmarking [y_{105}]
- training [y_{106}]
- open organisation [y_{107}]
- employee empowerment [y_{108}]
- zero defects [y_{109}]
- measurement [y_{1010}])

are used to estimate the total quality management (η_{10}) construct η_{10} = $\omega_{\eta 101}y_{101} + \omega_{\eta 102}\, y_{102} + \omega_{\eta 103}\, y_{103} + \omega_{\eta 104}y_{104} + \omega\eta_{105}\, y_{105} + \omega\eta_{106}\, y_{106} + \omega\eta_{107}\, y_{107} + \omega_{\eta 108}y_{108} + \omega_{\eta 109}\, y_{109} + \omega_{\eta 1010}y_{1010}$

and compute its case values through indicators' case values. Mathematically, an organisations TQMI is defined as:

TQMI = 100 x [E $\{\eta_{10}\}$-Min $\{\eta_{10}\}$] ÷ [Max $\{\eta_{10}\}$-Min $\{\eta_{10}\}$] ...... Equ 6.3

Where E{n}, Min {n} and Max {n} denotes the expected minimum and maximum range value of the variable. For example, the Executive Commitment Construct has the E value of 4.10 which is the mean aggregated value of its three variables. The Min and Max Values are 1.0 and 5.0 respectively, therefore the TQMI for the Executive Commitment Construct can be computed as follows

$$100 \times [4.10 - 1.00] / [5.0-1.0] = 77.5\%$$

The significance of the TQMI is that when applied to measure the percentage of TQM advancement, there is a reduction in the value of the RAI obtained using equation 6.1. A similar approach of using the TQMI was used by Joseph (1999) in his study of the Indian Manufacturing industries. It is also similar to the Customer Satisfaction Index (CSI) obtained by Chan et al (2003a)

Since the scales for the survey range from 1 (not started) to 5 (highly advanced), the TQMI formula is simplified to:

Method 1

$$TQI = \sum_{i=1}^{10} Fi \left(\sum_{j=1}^{Ki} fijRtij \right) \text{ .... } \textbf{Equation 6.4}$$

where $\sum_{i=1}^{10} Fi = 1, \quad 1 \leq R_{ij} \leq 5$

Fi = The importance weight of a Quality Management critical factor (for i = 1,...., 10)

$f_{ij......}$ = The importance weight of an item associated with a Quality Management critical factor (for i = 1, ..., 10; and j = 1, ..., k_i)

Ki = The number of items within each Total Quality Management construct

That is, the UK Construction related SME's TQMI equals the weighted average of its ten satisfaction indicators mean values multiplied by a scaling constant 5. If all the respondents gave the highest possible score of 5 out of ten indicators, the organisations TQMI can reach the highest and maximum score of 100% or 360 Degrees if using the radial advancement chart. This would be equivalent to the World Class Status.

6.2.13 Computation of the Total Quality Management Performance Index (TQMPI)

The Total Quality Management Performance is measured on the similar lines as the TQMI, but this time using the four performance indicators of financial performance, customer satisfaction, employee satisfaction, and operating indicators.

TQMPI = 100 x [E $\{\eta_4\}$-Min $\{\eta_4\}$] $\div$ [Max $\{\eta_4\}$-Min $\{\eta_4\}$] ..Equation 6.5

and Maximum Level of Performance = **MLP** $= \frac{\sum w}{AxN}$

6.2.14 Computation of The Coefficient of Variation (CV)

The coefficient of variation (CV) is used as a general measure of standardised skewness on the TQM Implementation constructs by the Industry. This is similar to the Importance Index as utlised by Pongpeng and Liston (2003)

$$CV = \frac{\text{Standard deviation of scores on dimension}}{\text{Mean of scores on dimension}}$$ **........Equation 6.6**

The coefficient of variation or Importance Index is utilised to enable the similarities and differences between the TQM and Non-TQM to be drawn. The inference to be drawn is that a high average score with a low CV on a

TQM dimension is used as an industry indicator of excellent TQM performance. (Huq and Stolen, 1998). They further state that the industry coefficient of variation on a particular dimension which is expressed as a percentage can be used as a measure about consistency with which companies adhere to that TQM dimension in the industry. For the purpose of this research, the CV is used as a comparative basis between TQM and Non-TQM deploying UK Constructional related SMEs.

6.2.15 Analysis of Case Studies

Grounded theory is used for the analysis of the qualitative data as it is shown to be of practical value in quality research. (Largrosen, 2001). The same approach used for the quantitative analysis was adopted and the case studies were subjected to the four tests of Internal Validity, External Validity, Reliability and Construct Validity. The methods are explained in more detail in the subsequent chapters. Interpretative approach as advocated by McCabe et al (1998) is the format used for presenting the case studies. The main steps in the case study methodology are summarised as a flow diagram shown in Figure 6.75. The steps undertaken in the case study methodology are explained in detail under their relevant sub sections as indicated in Figure 6.75. The first step elaborated upon and further presented in sub section 6.11 is that of the case study protocol. According to Yin (1994) citied in Voss et al (2002), the reliability and validity of case research data will be enhanced by a well designed research protocol. McCutcheon and Meredith (1993) note that the issue of triangulation should be addressed when developing the research protocol and instrument. For ease of interpretation, the boxes in Figure 6.75 are denoted by their relevant sub section numbers. This is the order in which the issues are addressed under the case study section.

Method 3: Case Studies

Different methods of case analysis techniques, both within and across are as follows;

- Typology Comparisons
- Forced Pairings
- Juxtapose Components

6.2.16: Application of Methodological Triangulation

Following the analysis of the quantitative study and its associated statistical analysis as indicated in sub sections 6.2.1 to 6.2.11 and the qualitative study in form of the case studies (see 6.2.12), and in order to ascertain how the different results could be put together to obtain a broader picture of the application of the TQM deployment constructs, two of the four types of triangulation as advocated by Denzin (1989) and also used by Love et al (2002a), are applied. These are as follows;

- Data triangulation
- Investigator triangulation
- Methodological triangulation
- Inter-disciplinary triangulation

A brief explanation of each method is provided in the methodological section of chapter two. Figure 6.7 shows the diagrammatical representation showing the fusion of the three methods utilised, namely statistical analysis, case studies and literature review is presented in chapter six. The arrows equally depict the linkages.

Method 1: Literature Review

- Identification of Critical Success factors of Quality Management by drawing on literature from various disciplines such as organisation behaviour, service quality and management

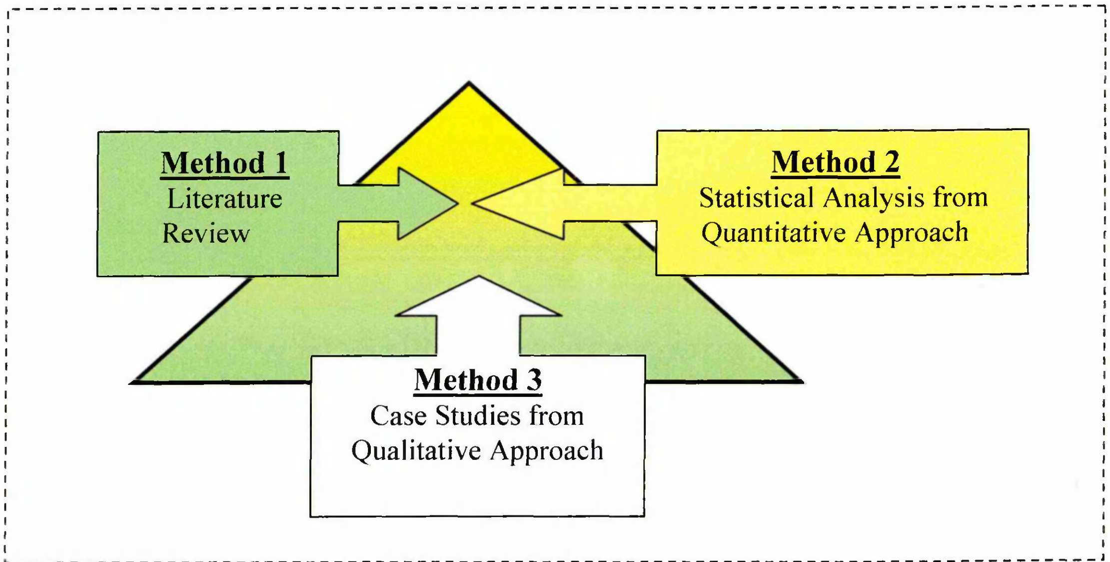


Figure 6.7: Validation Process of the Methodological Triangulation
Source (Author's interpretation)

Method 2: Statistical Analysis

Quantitative data deals in numbers and statistical data obtained by enumerative induction while qualitative data expresses concepts and ideals.

Method 3 - Case Studies as discussed in the preceding sub section

Ammenwerth et al (2003) describes the two major objectives of triangulation as validation of results and completeness of results. The application of triangulation and its achievement of the results is explained in sub section 6. 16.

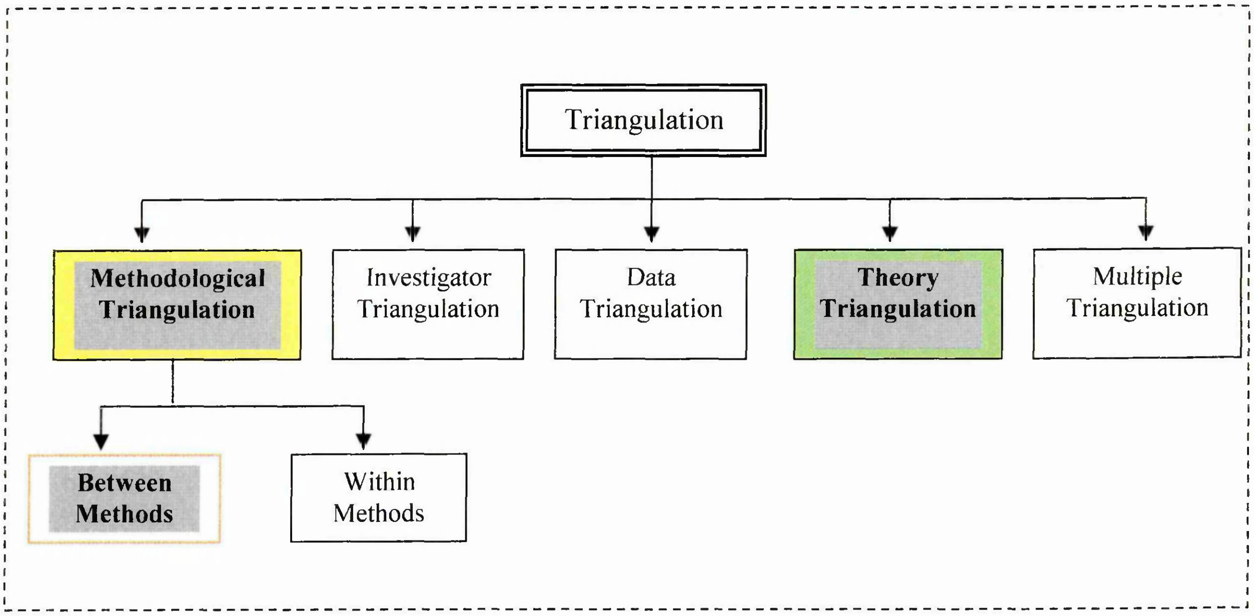


Figure 6.8: Varieties of triangulation, according to Denzin (1989)

6.2.17 : Explanation of the Box and Whisker Plots

The box and whisker plot shown in Fig 6.9 provides a graphical presentation of data for displaying features such as dispersion, location and skewness. The bottom of the box corresponds to the first quartile (Q_1) and indicates the value of the variable to which 25% of the observations are less than or equal. Similarly the top of the box corresponds to the third quartile. The length of the box called interquartile range (IQR) is a measure of dispersion of the data. A line within the box indicates the median (50th percentile) that is in this side is drawn with a symbol 'O' to avoid an overlay of both lines of the box. Two whiskers are extended from the box. The lower whisker starts at max $\{X_{(n)}, Q_1 - 1.5(Q_3 - Q_1)\}$ and the upper whisker ends at min $\{X_{(n)}, Q_1 + 1.5(Q_3 - Q_1)\}$, where $X_{(1)}$and $X_{(2)}$, are the smallest and largest value of observations. Outliers are data points beyond the lower and upper whisker, plotted with asterisks.

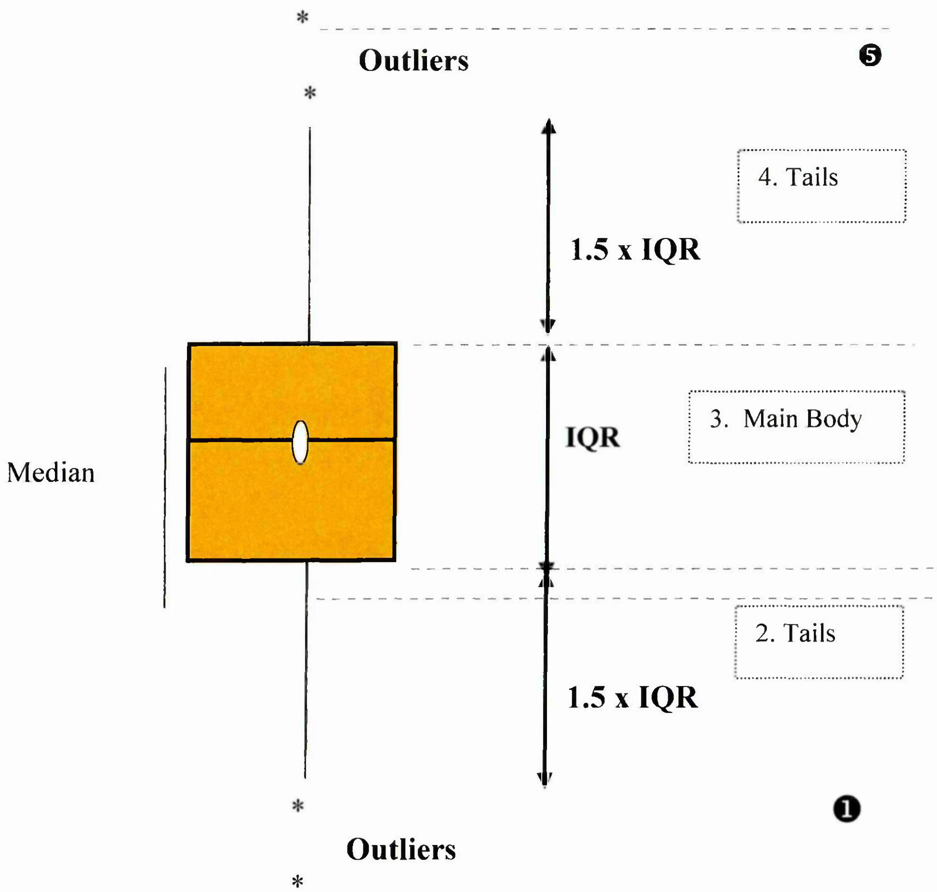


Figure 6.9: Explanation of a Box and Whisker plot
Source: Jung and Hunter, (2001)

Finally the box whisker plots have been used as they highlight the possibility of using cross-tabulation to perform preliminary evaluation of relationships involving nominally scaled variables (Forza, 2002).

Cortina (2002) observes how extreme values can have an inordinate impact on empirical results and the conclusions that can be drawn from them. Two outlier categories are variance covariance.

6.2.18 Application of CFA in the Basic Second Order

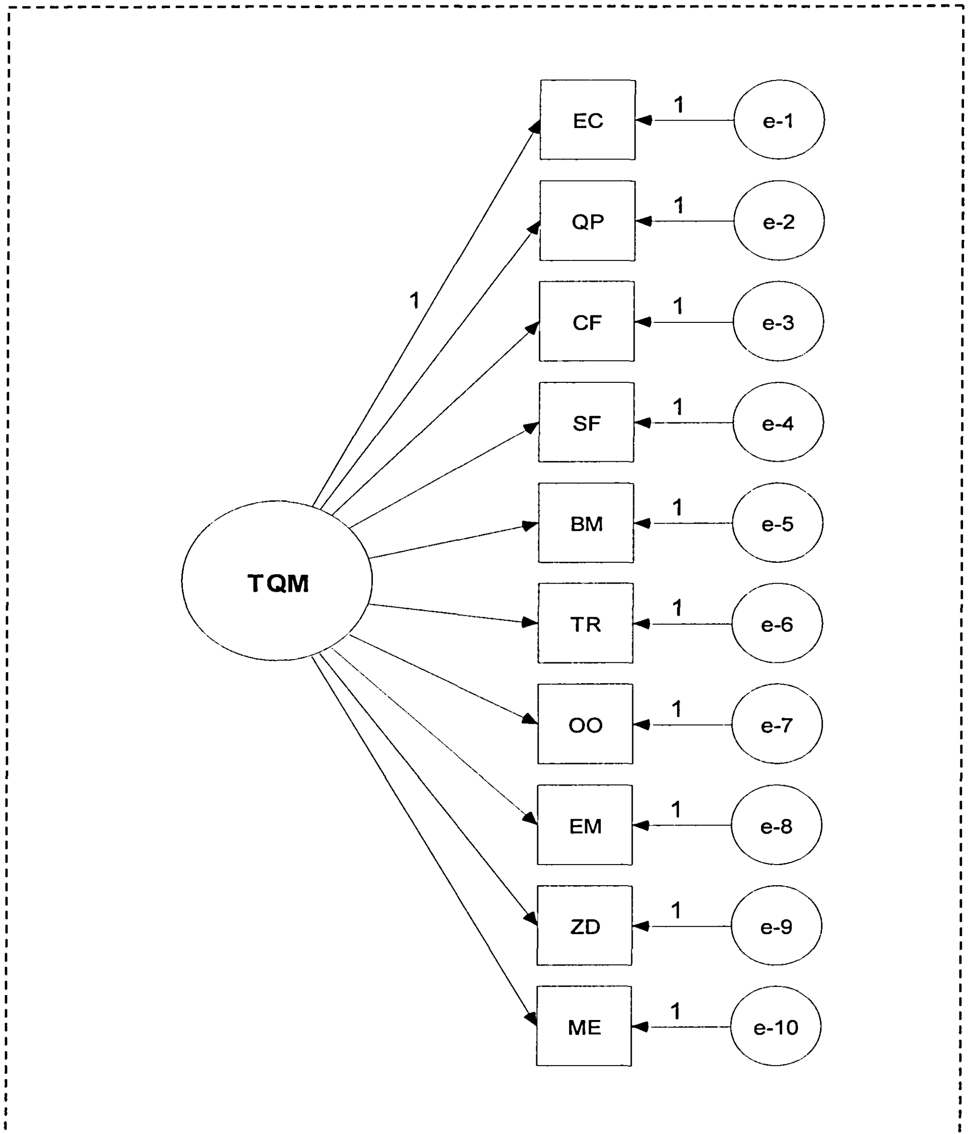


Figure 6.10: Second Order Confirmatory Factor Analysis of the 10 Factor Model of TQM Deployment

The Second-Order Factor Approach offers according to Williams et al (2003), the greatest flexibility when the goal of the research is to examine the antecedents and consequences of change. Given the situation described in sub section 6.7.2.1 where the objective is to ascertain the differences in time lag analysis, the diagram shown in Figure 6.10 will be used as the basis for testing for invariance across different groups, for e.g. between experience and less experienced groups. The ten factors shown in Figure 6.10 can be represented by the following equation;

Second Order Approach (SOA)

Structural Equation : $= \Gamma \xi + S$.................. **Equation 6.7**

$(10 \times 1) = (10 \times 1)(1 \times 1) + (10 \times 1)$

The structural equation links the ten quality management factors to the latent factor "total quality management" ξ. These ten factors are shown in Fig 6.10 as:

- Executive Commitment (EC)
- Adopting the Philosophy (QP)
- Customer Focus (CF)
- Supplier Focus (SF)
- Benchmarking (BM)
- Training (TR)
- Open Organisation (OO)
- Employee Empowerment (EE)
- Zero Defects (ZD)
- Measurement (ME).

Invariance will be tested by examining the factor covariance, for example between EC and QP. On the other hand, the linkages between the variables (indicants) and their respective constructs can be represented by the following equation.

First Order Approach (FOA)

Measurement Equation : $y = \Lambda y \eta + \varepsilon$ .... **Equation 6.8**

$(34 \times 1) = (34 \times 10)(10 \times 1) + (34 \times 1)$

The measurement equation links observed indicators y to their respective hypothesized quality factors η. First order factors are given by Λ**y** while second-order factor loadings are given by Γ. The future diagram showing the linkages between the structural and measurement equations forms part of the

Confirmatory Factor Analysis and is dealt with in Chapter Six (Figure 6.53). The loading on the first variable (EC) as shown in Figure 6.10 is fixed to 1.0 to scale the latent variable. With this loading fixed, the one factor model has 20 free parameters, including 9 remaining factor loadings and 11 variances (of 10 measurement errors denoted as e_{-1} through to e_{-10} and a latent variable). With 10 observable variables, there are:

$[10(10+1)]/2 = 55$ observations,

thus the degrees of freedom = 55 - 20 = 35.

The measurement model forms the basis of the second test for invariance by examining the group invariance related to the Factor and its respective variables. The results of this CFA are tabulated in Tables 6.25 and 6.27 and explained in subsection 6.22.

Finally the sum of the structural and measurement model, known as the Global Model forms the basis of Structural Equation Modelling.

Global Model = Structural Model + Measurement Model

The global model incorporating the measurement and structural model is specified to test the fitness between the theoretical specifications and the empirical data set. The global model is illustrated in Figure 6.4. According to Larson and Sinha (1995), Measurement models as illustrated in Figure 6.4 specify how the constructs are measured in terms of observed variables or indicators. In the current study, indicators for the TQM measurement instrument based on the Powell (1995) refined instrument are drawn from 34 numbered survey items, and for the Business and Organisation Performance Indicators, 15 numbered survey items. Whereas the Structural Models specify an expected relationship between the constructs, the proposed Global model combines the measurement and structural models.

This sub section presented the data analysis to be used at the macro and micro levels from the survey point of view as well as the methodology to use in the case study. As argued by Forza (2002), preliminary analysis is performed before measurement quality assessment in order to establish and check the assumptions underlying the tests.

6.2.19 Application of Path Analysis

This sub section describes the various steps undertaken to analyse the data in order to achieve objective four, that is to explore (investigate) the relative magnitude of the direct and spurious (indirect) relationship between TQM and Organisation performance. The specific steps in the analysis of the TQM-BOPI relationship is illustrated in a form of a flow chart involving the five steps. This is adapted from Prescott et al (1986)

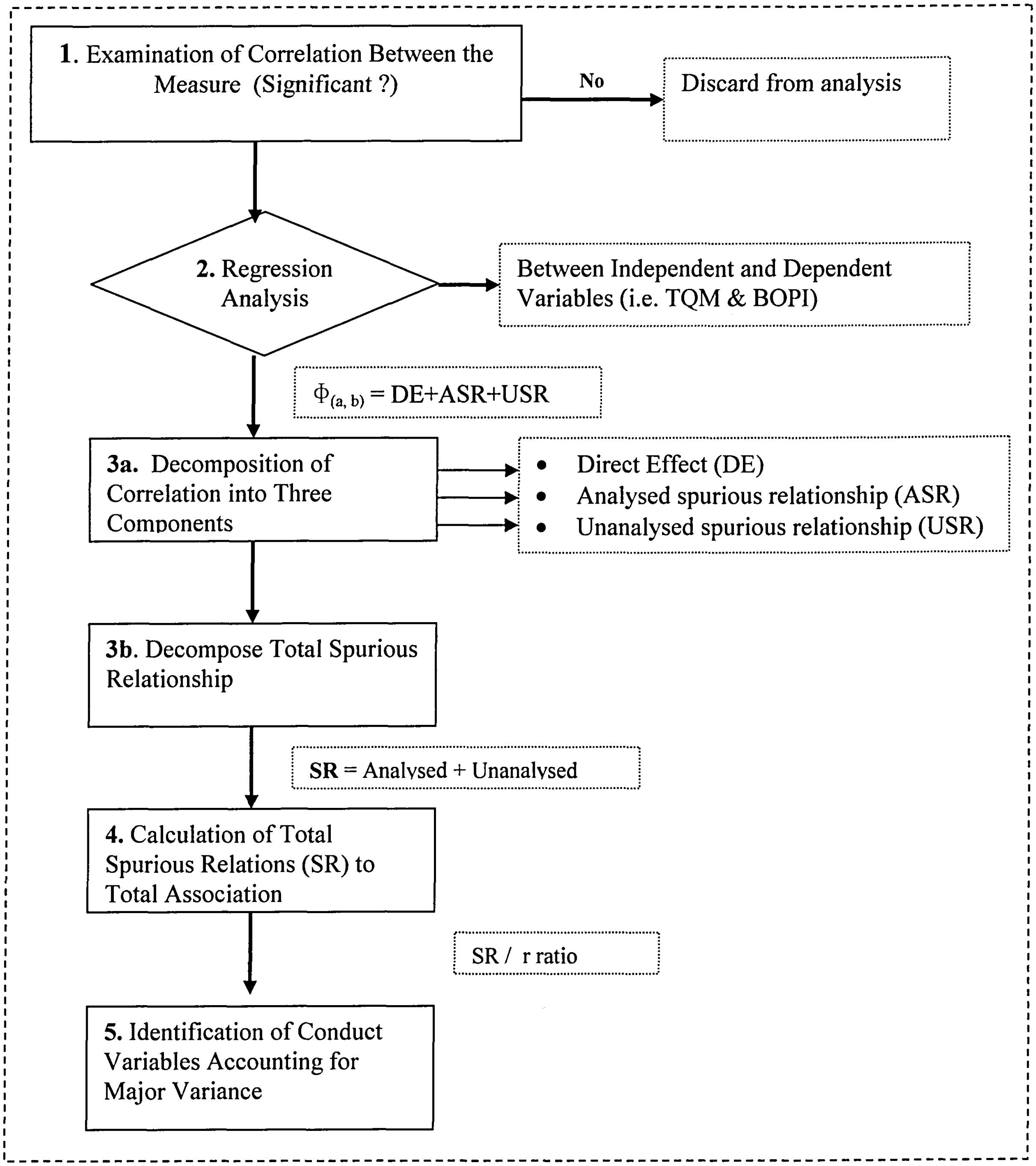


Figure 6.11: Analytic Procedure in Direct and Indirect Effects

Author's interpretation of Prescott et al (1986) description.

6.2.20 Checking of Assumptions and Tests Associated with Path Analytical Techniques

Prior to testing the hypothesis based on the results of Path Analytical analysis, three tests of the assumptions were carried out. The steps and the associated tests are shown in form of a flow chart in Figure 6.12.

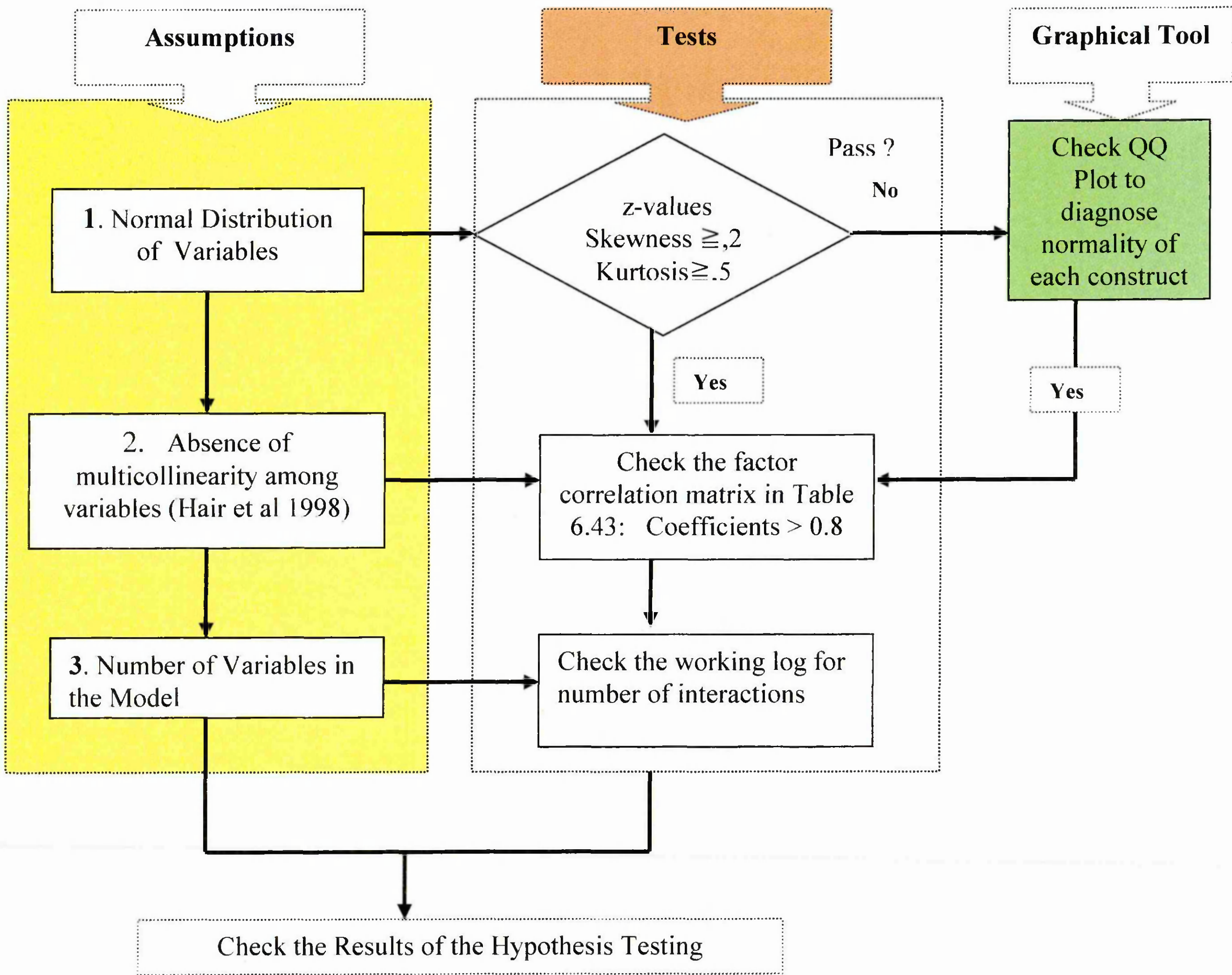


Figure 6.12: Check of Assumptions Associated with Path Analytical Techniques

Source: Author's Interpretation of Peng et al (2004) explanation

The steps involved in checking the assumptions are discussed as follows;

1. Normal Distribution of Variables
2. Absence of Multi Collinearity among Variables
3. Number of Variable in the Model.

In the examination of the relationship between the TQM practices and Business and Organisation Performance Indicators (BOPI), the three steps illustrated in Figure 6.12 are used to diagnosis the assumptions prior to checking the results of the hypothesis as outlined in Chapter Two and reported in Chapter's Six and Eight.

1. Normal Distribution of Variables

As outlined by Noronha (1999), certain widely used estimation methods in SEM such as Maximum Likelihood (ML) and Generalized Least Square (GLS) do not hold under excessive non normality (the skewness and kurtosis of the thirty four observed variables are checked and reported in Appendix D, (Table D27)

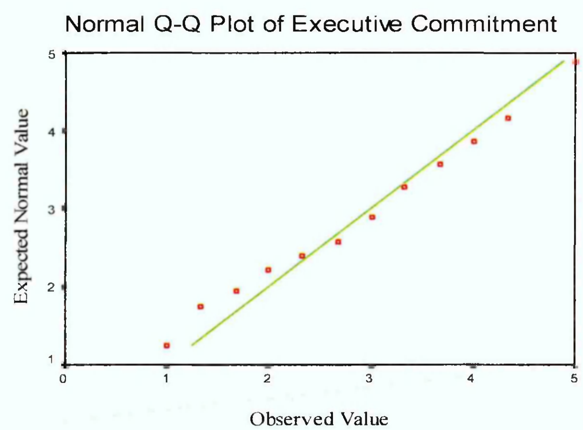


Figure 6.13: Example of Executive Commitment Q-Q Plot

Figure 6.13 is an illustration of the Q-Q plot for the "Executive Commitment " Factor. Encouragingly, as depicted in Figure 6.13 a linear relationship is observed, indicating that it can be judged as no significant violation to the normality assumption. (Peng et al, 2004)

2. Absence of Multi Collinearity among Variables

Checking for the absence of Multi collinearity for the TQM deployment constructs is achieved through an examination of Table 6:28 and Table 7.5 which is the relationship among the first order factors for the TQM deployment constructs and the Business and Organisation Performance Indicators respectively.

3. Number of Variable in the Model.

This is done through checking the interaction log of the SEM.

The following sub section now presents the preliminary data analysis of the demographics, TQM deployment factors and the Business and Organisational Performance Measures. An assessment of the competitive environment is also conducted.

6.3 Descriptive Statistics of the Organisational Characteristics

This sub section presents the descriptive statistics of the demographics based on the macro-level analysis as highlighted in the data analysis map in Figure 6.1. This is followed by the descriptive statistics of the TQM critical success factors in sub-section 6.4. For ease of clarity the data is presented in the same order as the survey document. The steps and order undertaken in the presentation is shown in the following flowchart (Figure 6.14)

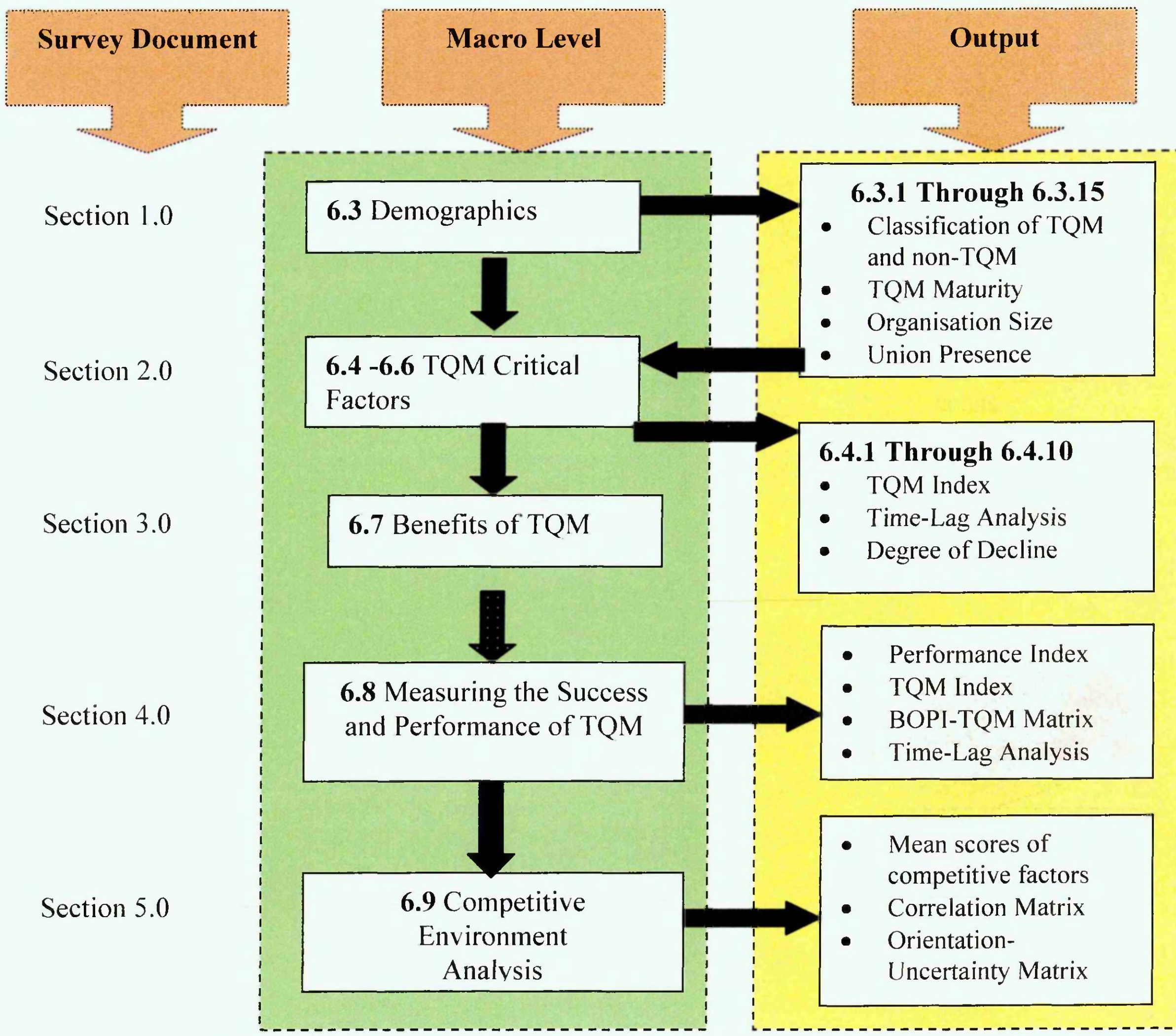


Figure 6.14: Linkages between the Survey Document, Analysis and Output on the Macro Level

As indicated in Figure 6.14, the output of section 1 will form the basis for subsequent analysis based on classification of the moderating variables such as TQM age and Organisation Size. The output of the macro-level is used as inputs for the micro-level analysis explored in Chapter Seven

6.3.1 Demographics

Out of the 350 delivered questionnaires, 82 were returned by the respondents and 63 (75.1 per cent) were found complete and useful for data. Thus the valid response rate was 18.0%. The analysis of the first part of the questionnaire (i.e. demographics) provided an understanding of the key findings of the thesis. Aspects such as:

- the number of employees in the organisation,
- turnover,
- the position and number of years occupied by the respondent
- the nature of the business activity
- if it was a TQM deploying organisation?
- number of years TQM had been in place?
- whether the organisation was unionised and the advancement of any quality program in place were mainly considered?.

6.3.2 Missing Data

As described in Chapter Two, this is resolved by a commonly used method known as 'simple mean imputation'. Alternatively, the approach would be to exclude the data, though this approach could be misleading. There was no case of missing data in this study. Any missing data and "not applicable" responses would be substituted with values calculated using the "expectation-maximization" interactive method of SPSS Statistical analysis package (Singh and Smith, 2004)

6.3.3 Non-Response Bias

The responses of early and late waves of returned survey were compared to provide support of non-response bias. Non-response bias can be defined as the difference between the answers of respondents and non-respondents. The responses were divided into early and late waves of returned surveys to test for non-response bias of the survey data. To check the sample representative ness, early respondents were compared with late respondents (two tailed *t*-test) in some of the key attributes. No significant differences were noted in these attributes between the early and late respondents. The first 40 questionnaires that were received without any follow-up were considered as early respondents. The last wave of the surveys received was considered to be representative of non-respondents. Therefore it can be concluded that non-response bias was not a concern for this study.

6.3.4 Number of Employees and Position of Respondents

For this study, the survey only considered SME's with the number of employees between 1 and 500. Analysis of the results shows the highest number of respondents, about 21 (33.33 per cent) had between 100 and 249 employees. This was followed by 17 respondents (26.98 per cent) in the 250-499 employee range. For comparative purposes, the three categories of fewer than 10, 11-49 and 50-99 were combined to form the small-sized sample.

Table 6.5: Sample Data

Implementing TQM	Number of Employees						Total
	Under 10	11-49	50-99	100-249	250-499	> 499	
Yes			5	7	8	0	20
No	1	6	7	14	9	0	43
Total	1	6	12	21	17	0	63

This combination generated a total sample of 19 (30.15 per cent). Table 6.5 presents a summary of the number of employees for both the TQM and non-TQM organisations.

6.3.4.1 Respondent's Profile

Table 6.6: Designation of respondents in terms of frequency was as follows:

Respondents	Frequency	Percentage
Chief Executive Officer	1	1.58
Quality Director	6	9.52
Quality Co-ordinator	1	1.58
Managing Director	15	23.80
Quality Manager	30	47.62
Others	10	15.87

The profile of respondents is shown in Table 6.6. The characteristics of the individual respondents were assessed and the majority were Quality Managers (47.62 per cent), Managing Directors (23.8 percent), Quality Directors (9.52 per cent), with the remainder being Quality Co-ordinators or Chief Executive Officers. Furthermore, each had been employed with their present organisations for a considerable period (mean = 11.14 years; std dev. = 9.3) which by implication meant they had enough experience of the quality management systems. Therefore it can be concluded that this study represents top management assessment of current quality management initiatives in the UK construction related SMEs.

Table 6.7 The range of respondents in terms of their business activities were:

Business	Frequency	Percentage
Main Contractor	55	87.30
Management	2	3.175
Suppliers	2	3.175
Sub Contractors	2	3.175
Sub Contractors/Suppliers	2	3.175
Total	**63**	**100**

The majority of the main respondents by business activity were the Main Contractors (87.3%). The remainder of the respondents were equally split in terms of representation. Approximately 3.17 percent were Management, Suppliers, Sub-contractors and combined Sub-contractor and suppliers.

6.3.5 Turnover versus Implementing TQM Cross Tabulation

The majority of the main respondents (23) had turnover in the region of 20-50 million pounds. Figure 6.15 illustrates the turnover of the respondents.

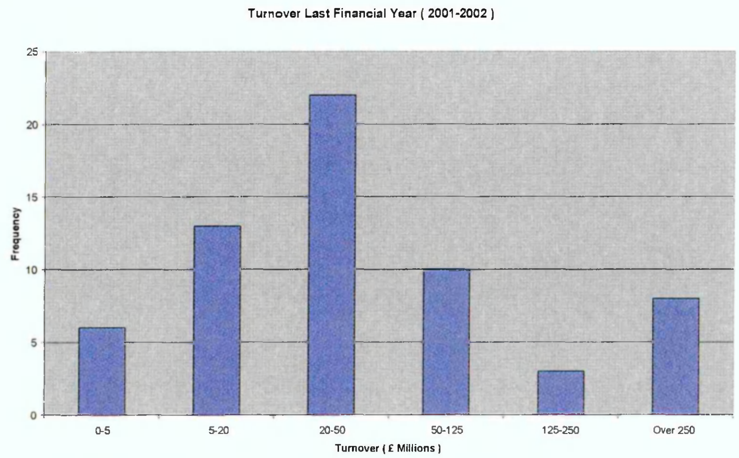


Figure 6.15 Turnover of Respondents for 2001-2002

6.3.6 Status of TQM Implementation

A specific question in the survey asked if the responding organisations had implemented a formal TQM program and based on the results, UK Constructional related SME's were classified as either TQM deploying or Non-TQM deploying. Of the 63 respondents, 20 (31.7%) indicated having a formal TQM program and only these were used for the analysis regarding the business and organisation performance measures. The organisation's experience of TQM ranged from 1 to more than 10 years. The fifty percent (10) of the TQM deploying organisations had less than 3 years since the commencement of their TQM program. Forty percent had more than 3 years but less than 6 years, while only one organisation had the experience in the range of 6-10 years and only 2 (10.0 per cent) had more than 10 years of TQM implementation. The results are indicative of the reluctance of SME's to adopt TQM.

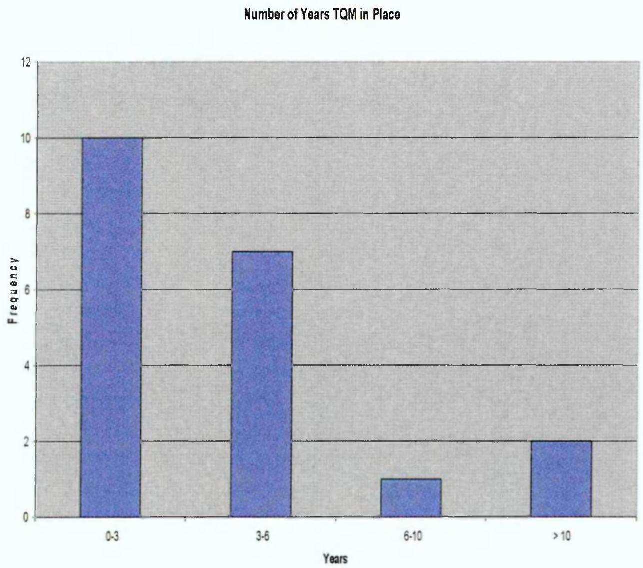


Figure 6.16 Number of Years TQM in Place

6.3.6.1 Levels of TQM Implementation

Table 6.8 shows the factors in quality management construct for the TQM and non-TQM deploying organisations in the sample. For each of the ten TQM constructs underlying the TQ-SMART model the level of TQM advancement in TQM and non-TQM deploying organisations can be reflected by the initial score of each construct and the average of the ten constructs as the overall indicator. The distribution of the mean score for this indicator and for all ten constructs is divided into three bands, high (score of 4 to 5), medium (3 to < 4) and low (1 to < 3), derived from the TQ-SMART model.

Table 6.8: Descriptive Statistics and Results of Internal Consistency Analysis

Implementation Construct	Number of items	TQM Organisations (n=20)			Non-TQM (n= 43)		KMO[c]
		Mean	Rank	sd[b]	Mean	Rank	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. EC	3	4.10	1	0.940	2.92	3	0.689
2. AQP	3	3.27	4	1.083	2.50	6	0.478
3. CF	4	3.80	2	1.150	3.06	1	0.801
4. SF	3	3.07	6	1.130	2.50	7	0.645
5. BM	3	2.60	10	1.386	2.12	9	0.709
6. TRA	4	2.65	9	1.257	2.55	5	0.673
7. OO	3	3.17	5	1.356	2.93	2	0.767
8. EE	4	3.05	8	1.310	2.23	8	0.845
9. ZD	3	3.43	3	1.489	2.92	4	0.665
10. ME	4	3.05	7	1.134	2.11	10	0.776

a - The scores for each construct are on a scale of 1-5,
b- Ranking based on the mean values, 1 as most important factor/construct and 10 as the least

Column 8 of the above table shows the KMO values of the ten constructs. The coefficients for all the constructs are greater than 0.50 and this indicates that the sample was adequate for factor analysis. Further detailed explanation are provided in section 6.10.2.

Table 6.9 Scoring the Levels of TQM Implementation within the sample

Number of Organisations		Average Score ($\sum$TQMI)	RAI	TQM Level
TQM	Non-TQM			
2	1	4.0 to 5.0	0.8 to 1.0	High (H)
12	19	3.0 to < 4.0	0.6 to < 0. 8	Medium (M)
6	23	1.0 to < 3. 0	0.2 to < 0.6	Low (L)
20	**43**	Total Sample of 63 Organisations		

Table 6.9 reports on the levels of TQM implementation within the sample. Based on the computation of the Total Quality Management Indices (TQMI) for all the organisations, only two TQM deploying organisations fell into the high level TQM band representing 10 per cent of its group. This is in contrast

to only one Non-TQM organisation representing a mere 2.32 per cent. The next level was the medium one in which 12 TQM deploying organisations representing 60 % achieved the medium levels of TQM Implementation as opposed to 19 representing 53.5 per cent for non-TQM deploying organisations. Thirty percent of the TQM deploying organisations were classified as having a low level of TQM, on a comparative basis the majority (23) representing 53.4 per cent of Non-TQM deploying organisations were in the low level category

Based on the analysis of the TQM Indices of the ten implementation constructs, the average values for each deployment construct were computed for the two groupings, namely TQM and Non-TQM deploying organisations: These constructs were:

- Training (TR)
- Employee Empowerment (EE)
- Executive Commitment (EC)
- Quality Philosophy (QP)
- Customer Focus (CF)
- Supplier Focus (SF)
- Measurement (ME)
- Benchmarking (BM)
- Open Organisation (OO)
- Zero Defects (ZD)..

Table 6.8 presents a summary of descriptive statistics showing the mean and standard deviation whereas the statistics for the individual items or variables are in Tables 5D and 6D in Appendix D.

6.3.7 Exploration of Clusters

The sample of 63 UK Constructional related SMEs was used to explore different types of TQM levels existing within the Industry. The TQM practices in these UK Constructional related organisations were classified according to the characteristics they possessed. All of the 10 identified constructs both hierarchical and non-hierarchical cluster procedures are used in this study.

- Analysis of agglomeration
- Dendrogram

To explore the possibility of TQM taxonomy, the 63 respondents were cluster-analysed over the ten TQM constructs using a Euclidean, hierarchical, single-linkage clustering algorithm. The results of the analysis are plotted on a Dendrogram shown in Figure 6.17 shows the results of the hierarchical cluster analysis for the 63 cases. The horizontal axis in the graph denotes the linkage distance. This procedure produced three groups based on the TQM levels as shown in Table 6.9. Group 1 was those with Low Levels of TQM (mean TQM = < 3.0), whereas Group 2 were Medium (mean = > 3 < 4) and Group 3 were High (mean = > 4.0) Levels of TQM respectively.

The criteria used in the choice of sub groups were as follows;

(a) examination of sharp changes in error sum of squares when the number of clusters were changed, and
(b) Visual inspection of the dendogram.

HIERARCHICAL CLUSTER ANALYSIS FOR ALL ORGANISATIONS

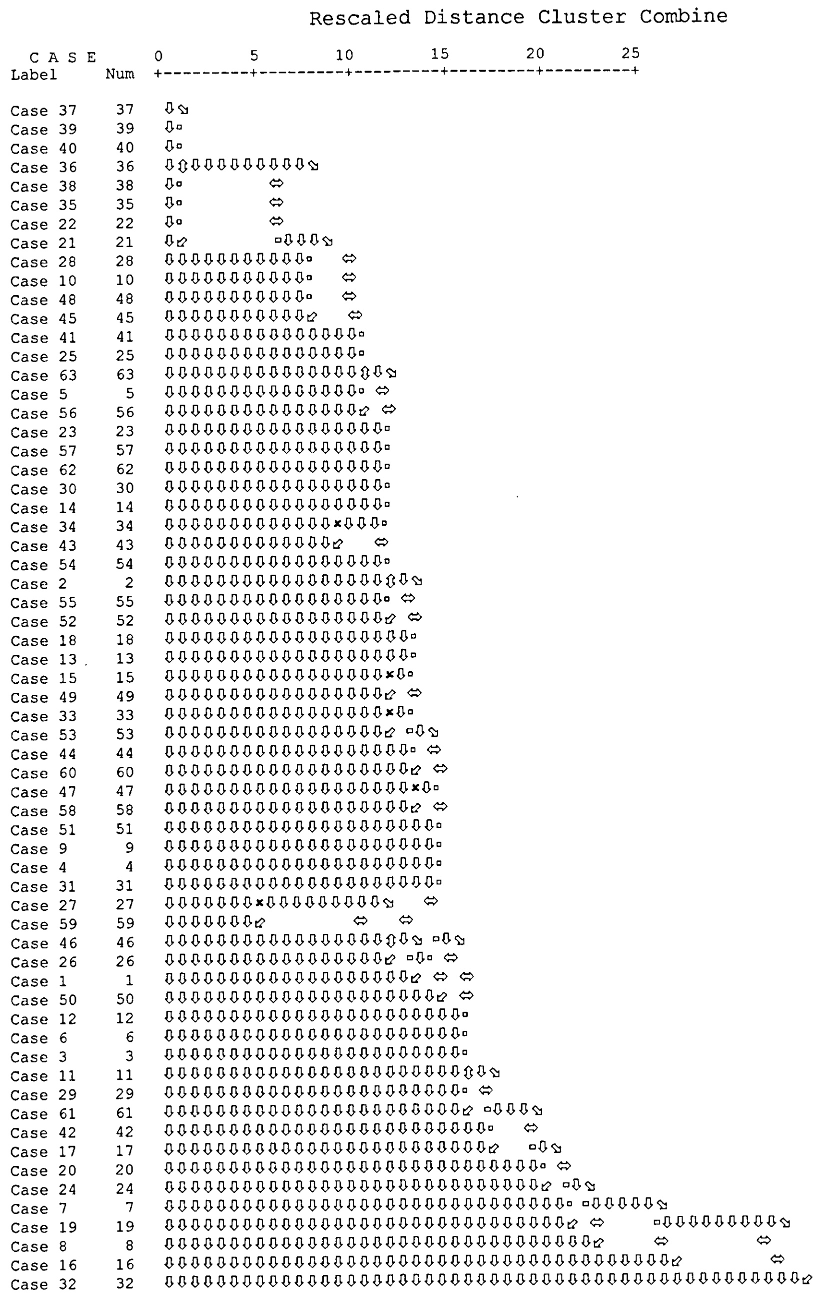


Figure 6.17 Dendrogram using Single Linkage

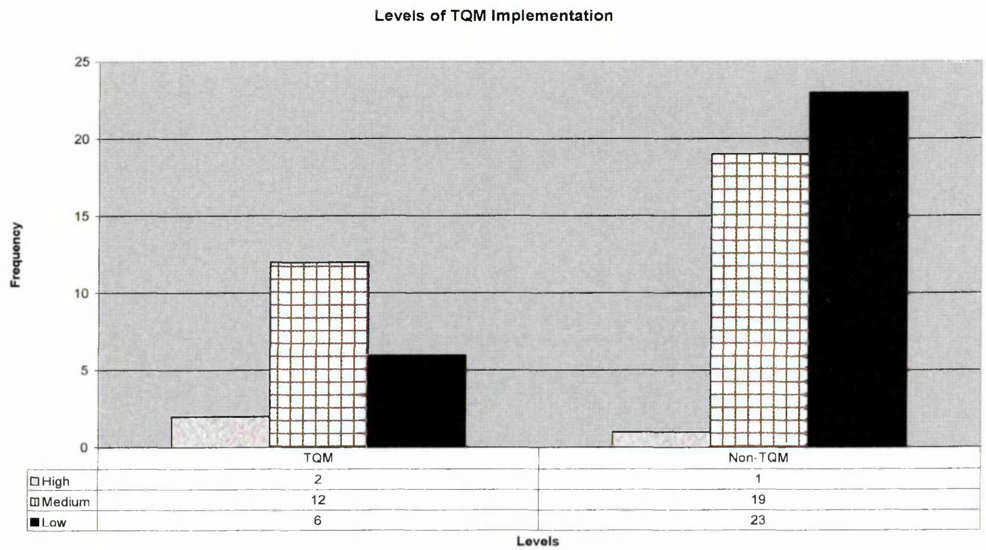


Figure 6.18: Classification of Levels of TQM

6.3.8 Impact of the Union on TQM Implementation

The implementation of TQM can equally be affected by employee relations. Literature review showed that organisations with trade unions had a major impact on the internal culture of a firm. For example, a unionised work force can limit the effectiveness of such TQM elements as flexible work assignment, merit based promotion rules and formal performance appraisals. (Kochan et al, 1986). In order to address this aspect the following question was posed: "Is your organisation unionised?"

Table 6. 10 Implementing TQM x Union Present Cross Tabulation

Criteria	Union Present			Total
	Yes	No	Partly	
Implementing TQM Yes	1	16	3	20
No	1	39	3	43
Total	2	55	6	63

The findings from this survey indicated that the absence of the union had no impact on whether an organisation implemented TQM or not. As Table 6.10 indicates, approximately 87% of the respondents had no union present whereas the minority, 2 (3.2%) had the union present. However these findings should be treated with caution as the impact of unions varies according to the type of Industry. The notion of shop floor representatives is more synonymous within the manufacturing environment, as studies by McCabe (1999) found. TQM not only presented management with dilemmas and contradictions but posed danger to trade unions. However the studies by McCabe (1999) were conducted in the manufacturing environment. Furthermore, according to Sureshchandar et al (2001) argues that the omission of the role of the union and extent of TQM implementation could be that the industrial relations issues were outside the sphere of the expertise of TQM gurus. This assertion is supported by McCabe et al 1999

6.3.9 Impact of Organisation Size on TQM Implementation

One of the objectives of the study was to investigate the impact of organisation size on TQM implementation. Therefore the sample was classified into small and medium sized organisations where small had less than 100 employees and medium was more than 100 but less than 500. Hence the purpose was to test the hypotheses about the differences between the two groups of organisations. Following similar studies (Ahire and Golhar, 1996; Deshpande and Golhar, 1994) the hypotheses were tested using one-tailed.

Results and Discussions

The results of these tests are summarised in Tables 6.11, 6.12 and 6.13. For each TQM deploying constructs, the tables provide the mean score, standard deviation, and t-value.

Table 6.11 summarises the responses from small and medium sized UK construction-related TQM deploying organisations and are also shown graphically in Figure 6.19. For each construct, the table provides mean score, standard deviation and the *p*-value or *t*- value. The results lead to several interesting insights.

Table 6.11 shows a summary of the descriptive statistics for the variables examined from the small-sized and medium sized TQM deploying organisations.

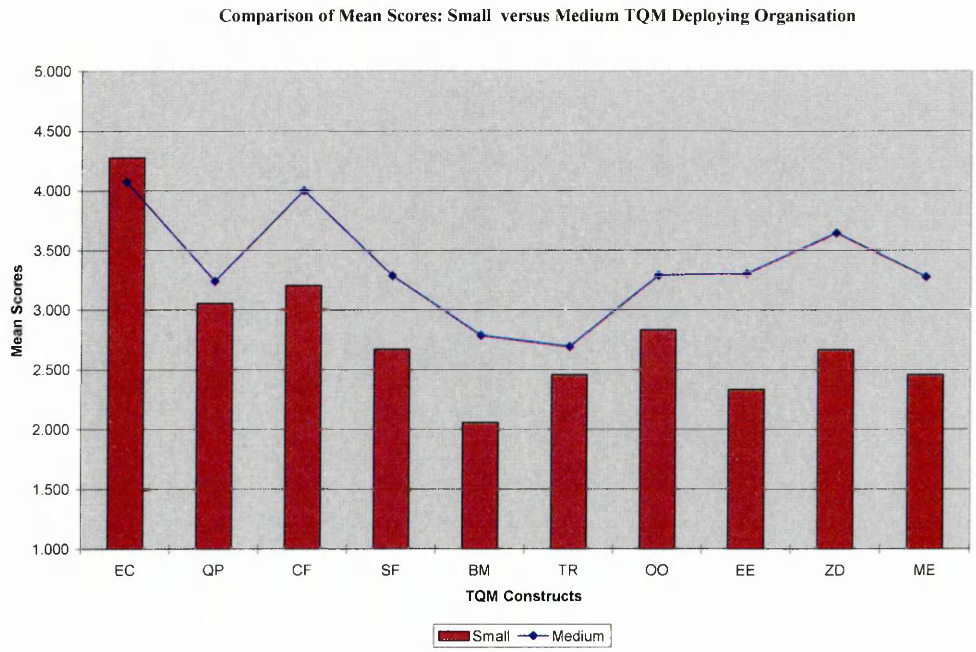


Figure 6.19 Differences in Organisation Size within TQM deploying Organisations

With the exception of Supplier Focus, no statistically significant differences between small and medium sized construction related organisations were observed.

The better Supplier Focus observed by medium-sized organisations could be explained by enhanced collaboration with the suppliers. Executive Commitment was slightly higher in small-sized (mean = 4.27) than medium-sized (mean = 4.071) organisations. For the remaining constructs the medium-sized organisations had medium levels of TQM implementation (mean>3.0) apart from Benchmarking (mean = 2.785) and Training (mean = 2.693) which had low levels of TQM implementation.

This finding is hardly surprising as usage of Benchmarking is low within the SMEs and in particular the Construction Industry (McCabe, 2001; Dattakumar and Jagadeesh, 2003). However the results of this study indicate that UK

Construction related SMEs are beginning to realise the importance of process management strategies. The results demonstrate that size is not critical factor in the effective implementation of TQM elements (H_{5-1} through H_{5-10})

Table 6.11: Mean Score Comparison of Medium and Small TQM deploying Organisations (n=20)

Factors	Small (n = 6)		Medium (n =14)		*t*-value
	Mean[a]	sd[a]	Mean[a]	sd[a]	
Executive Commitment	4.27	.9509	4.071	.729	.462
Adopting the philosophy	3.06	.8549	3.239	.722	-.458
Customer Focus	3.21	1.123	4.000	.747	-1.584
Supplier Focus	2.67	.3651	3.286	.836	-2.301**
Benchmarking	2.06	1.453	2.785	1.181	-1.084
Training	2.46	1.345	2.693	1.012	-.383
Open Organisation	2.83	1.572	3.287	1.189	-.633
Employee Empowerment	2.33	1.506	3.304	.910	-1.468
Zero Defects	2.66	1.521	3.643	1.082	-1.425
Measurement	2.46	1.259	3.275	1.206	-1.346

a) The scores for each construct are on a scale of 1 through 5
b) H_{5-1}: The levels of Executive Commitment in small-sized UK TQM deploying organisations is higher than that in medium-sized organisations

Note: * $p<0.05$, ** $p<0.01$ and *** $p < .005$ for t-values for path coefficients > 1.65 are significant < 0.10, (> 1.96, significant < 0.05 and t-values >2.58, significant < 0.01)

Executive Commitment

There is no statistical difference (at p<0.01) between small-sized (mean = 4.27) and medium-sized (mean = 4.071) organisations. This reveals that the UK Construction related TQM deploying organisations of all sizes generally perceive executive commitment in the same way. However, the small size of the standard deviation for the medium sized organisations (s.d = 0.729) shows the existence of relatively good understanding among the medium sized UK constructional related organisations of the role of executive commitment in TQM implementation. Managers of Medium-sized UK Construction related organisations put more emphasis on committing fully to a quality program, actively championing their quality program and actively communicating the quality commitment to employees. In summary the medium-sized organisations emphasised the "3C_S" more than the small-sized organisations.

Adopting the Quality Philosophy

Statistically there is no difference (at $p<0.01$) between small (mean=3.06) and medium-sized (mean=3.24) organisations. This reveals that the UK Construction related TQM deploying organisations of all sizes generally perceive adopting the Quality Philosophy in the same way. This means that perception of adopting the Quality Philosophy as a quality improvement practice varies with the implementation of TQM in the SMEs. The medium sized UK Constructional related SMEs put more emphasis on including the quality principles in their vision and mission statements, on an overall theme based on their quality programs and entering the EFQM Excellence Model award competition.

Customer Focus

However it is interesting to note that small-sized TQM deploying UK constructional related organisations scored Customer Focus as the second most important (mean = 3.21). This finding is similar to Ahire and Golhar (1996) and Gustafsson et al, (2003) who found small organisations to be more Customer oriented. Powell (1995) reported similar medium levels of Customer Focus (mean = 3.98) for the high performing cluster of manufacturing and service TQM deploying organisations.

Hypothesis $\mathbf{H_5}$ states that the advancement of the ten TQM constructs is different between medium and small TQM deploying UK constructional related organisations. Respondents were asked to rate on a Likert scale of 1-5 (where 5 were highly advanced and 1 was low), the rate of advancement on the 10 TQM deployment constructs.

This hypothesis was tested by Discriminant Analysis. In this case since there were only two sample groups, namely small and medium, DA yielded only one function (dimension). This function yielded a chi-square of (p=0.000) with 10 degrees of freedom which was significant.

Table 6.12 displays the standardized weights of the ten deployment constructs. If the weight is positive, it means that medium construction related TQM deploying UK organisations are relatively stronger than smaller organisations. If the weight is negative, it means small organisations are relatively stronger. If the weight is close to zero, it means there is no difference. Kuei et al (1995) adopted a similar approach in their study of the association between quality management practices and organisation climate.

Table 6.12: Standardized Weights for the 10 TQM Deployment Constructs Structure Matrix

Deployment Construct	Function 1
Customer Focus	.372
Employee Empowerment	.357
Supplier Focus	.342
Zero Defects	.326
Measurement	.273
Benchmarking	.235
Open Organisation	.142
Executive Commitment	-.106
Adopting Quality Philosophy	.098
Training	.086

Table 6.12 shows the Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions variables ordered by absolute size of correlation within function. The interpretation of DA is that medium TQM deploying **organisations** outperform the small-sized construction-related organisations in the TQM deployment expect for executive commitment in which they are slightly stronger (function = -0.106). The group centroids of smaller organisations on this function equal -1.717, and the medium organisations equals 0.736. The interpretation of the DA is that medium deploying construction organisations placed more emphasis on customer focus, supplier focus, zero defects and

measurement. Further evidence in support of Table 6.12 was provided in Figure 6.16 in which the mean score comparison is illustrated graphically. It is evident that the medium-sized construction-related organisations outperform the small-sized on all but one construct of "Executive Commitment".

In order to address how the research contributes to the application and development of TQM within SMEs, the following factors were taken into consideration; Industry effects and organisation size. Measurement model fit indices was carried out based on the size of the organisation. TQM deploying organisations were classified in two groups depending on the number of employees. These were Macro (less than 10 employees), Small (more than 10 and less than 99) and Medium (100 to 499).

Analysis:

A series of propositions were addressed in order to satisfy the deficiencies highlighted:

- 6.1 The levels of model constructs are not affected by organisation size
- 6.2 The levels of model constructs are not affected by competition within the industry, bargaining powers of the suppliers

Contingency analysis

Examining the invariance of the levels of the 10 deployment constructs across the subgroups based on the organisation size, TQM duration, and competitive complexities tested the propositions. In order to test the invariance of the deployment construct levels, a MANOVA analysis was conducted.

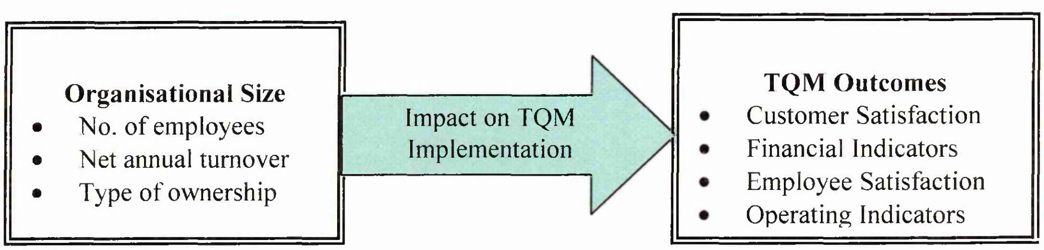


Figure 6.20: Influence of Organisation Size on TQM Outcomes

According to Taylor (1997) very few studies have being written about the influence of organisation size on TQM outcomes. This research redresses the imbalance by specifically conducting the MANOVA analysis on the UK Construction related SMEs.

Using a similar method used by Raju and Lonial (2002), a validation check was performed to see whether the ten deployment constructs were not just surrogate measures of organisation size, as one could argue that the medium sized organisations would be more likely to have higher ratings on the ten deployment constructs. A comparison of the ten constructs between the two different types of UK TQM and non-TQM Constructional related SMEs was conducted using a median split for the organisations in terms of number of employees. The ten deployment constructs were indicated by the summated scores or average weights of each variable representing the construct.

A comparison was made of the organisation size and the total mean score. The total score was taken as the sum of the ten deployment constructs and the 15 organisation performance measures. The figure below shows a line chart of the organisation size versus mean total score. The mean total score of organisations employing between 249-500 employees was slightly above average.

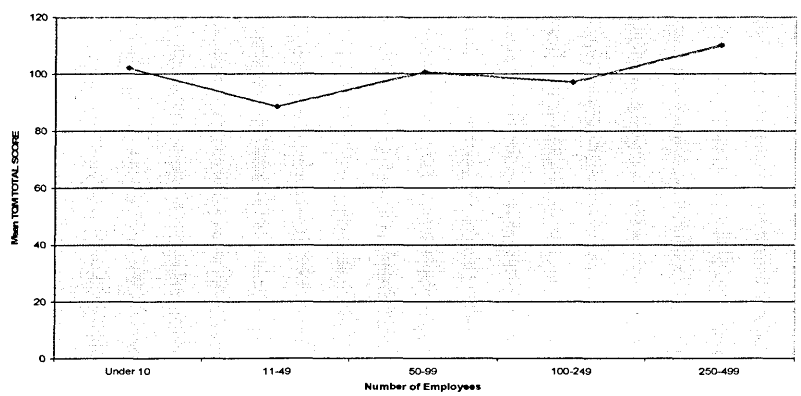


Figure 6.21 Total TQM Mean Score according to Organisation Size

The findings based on the above Figure 6.21 indicate that there is little difference between the number of employees and the extent of TQM implementation. All the TQM deploying organisations scored above 80. However caution should be exercised as to how organisation size is measured. According to Kimberly (1976) cited in Goldschmidt and Chung (2001), organisation size has been measured in different ways – number of employees, physical capacity measures, assets value, and magnitude of output transactions.

6.3.10 Discussion of Impact of Organisation Size on TQM Implementation

Other Analysis

According to Williams et al (2003), research in Organisational behaviour and human resources management often investigates moderation, in which the strength of the relationship between an independent variable and a dependent variable depends on the third variable, termed as a moderator variable. In this case, Organisation size could be taken as the moderator variable.

Three methods were considered for the analysis of the moderating effects. These were splitting the sample, hierarchical moderated regression and structural equation modelling. The following sub sections discuss the methods on detail.

1. Splitting the Sample (Sub-Grouping)

This entailed splitting the sample on the moderate variable and comparing the correlations between the independent and dependent variables across the sub-samples. This generated the small and medium-sized samples from the Organisation moderating variable maturity of TQM, two cases were generated, namely experienced and less experienced.

2. Hierarchical Moderated Regression

Independent and moderator variables are entered first followed by their product, and the amount of increment in variance explained by the product term provides evidence for moderation. This second method is better than the first as it avoids the loss of information and statistical power created by splitting samples, and can accommodate different combinations of continuous and categorical moderating variables.

3. Structural Equation Modelling (SEM)

Methods for moderation parallel the sub grouping and moderated regression approaches. The method involves the creation of subgroups (TQM v non-TQM, Experienced v Less Experienced, Small v Medium) based on the moderating variables and use multi-sample techniques. By testing the equivalence of the ten structural parameters (gammas λ and betas β) i.e. loading factors and error measurement across the two sub-groups, differences in these parameters across groups would constitute evidence for moderation.

Curkovic (2003) provides the rationale behind the structural equation modelling (SEM) attractiveness as it provides a straightforward method of dealing with multiple relationships simultaneously while providing statistical efficiency, and its ability to assess relationships comprehensively providing a transition from exploratory to confirmatory.

Sousa and Voss (2002) identified some deficiencies of past studies in the quality performance models as follows:

- Lack of clarity in clearly situate studies within the practice performance model by indicating which parts of the model the studies are addressing.
- Clear definition of "quality"
- Increase the understanding of the means by which Quality Management effects are generated

- More research into the linkages between several QM practices
- Interaction between QM and other best practice
- One important factor in the practice performance model needs to be further researched, namely time lags between the implementation of QM practice and performance

Lee (2004) classified TQM elements into two groups

1. Those that are independent of the size of firms
2. Those that related to the size of firm and may be more difficult for small manufacturers to employ.

According to Lee (1992, 1998) citied in Lee (2004), the six elements relating the first group are;

- Customer focus
- Top Management Commitment
- Quality Data and Reporting
- Training
- Role of Quality department
- Employee Involvement

These elements were deemed attainable by small manufacturers as much as large firms without substantial difficulty. The three elements that relate to size are; Process Management, Product / Service Design and Supplier Quality Management

6.3.10 Impact of TQM Maturity on TQM Implementation and Outcomes

The interpretation of the impact of the Implementation of TQM associated with the maturity drew some interesting findings. First as with the learning curve, it was hypothesised that the experienced TQM deploying UK Constructional related SMEs exhibited a high level of advancement of the ten TQM constructs compared with the less experienced TQM deploying UK Constructional related SMEs.

Table 6.14 represents the mean scores on the deployment of the TQM constructs. Statistically there were no differences (at $p < 0.01$) between less experienced and experienced TQM deploying organisations in all the constructs apart from employee empowerment and measurement. This reveals that the less experienced and experienced UK Construction related SMEs generally perceived Executive Commitment, Customer Focus, Supplier Focus, Benchmarking, Training, Open Organisation, and Zero Defects whereas they perceived Employee Empowerment and Measurement differently with experienced (mean = 3.56), less experienced (mean = 2.50) and for Employee Empowerment, the less experienced (mean = 2.60) and experienced (mean = 3.43).

However contrary to the notion that TQM maturity would result in a higher degree of the TQM implementation was rejected in three of the constructs. These were Executive Commitment, Supplier Focus and Training. In order to ascertain the degree to which the observation of those constructs declined as opposed to improving the gap between the less experienced and experienced was taken as three years. This is supported in literature (Ahire, 1996).

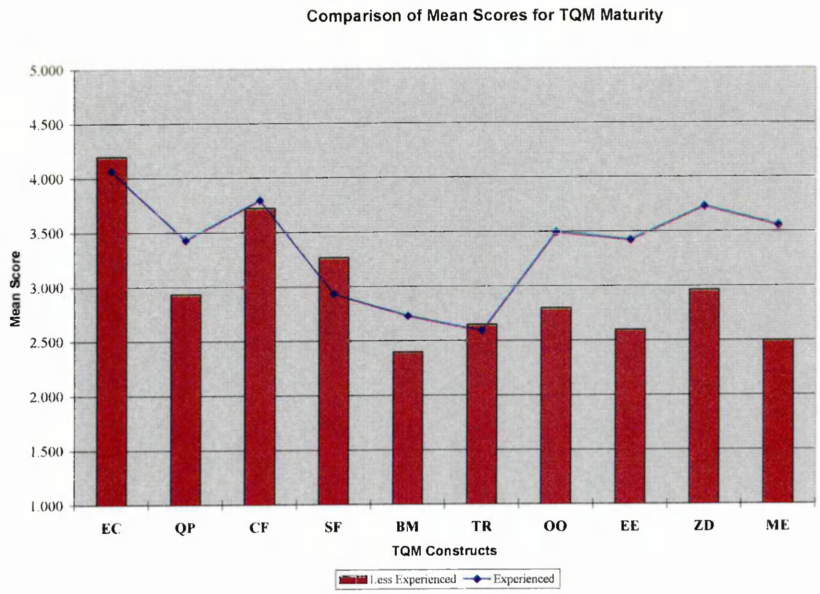


Figure 6.21-1 Differences in TQM Maturity within TQM deploying Organisations

6.3.11.1 Degrees of Decline in the Implementation of the Construct

The slope in the three Figures (6.22 through 6.24) shown as the extent of degree of decline can be computed using simple trigonometry. The angle is equivalent to the degree of decline and the bigger the value, the more the decline. Using the differences in the mean score as plotted on the Y-axis and dividing that by the 3 year gap generated, the following values for Executive Commitment, (ϕ_{EC}= 2.29^0), Supplier Focus (ϕ_{SF}= 18.0^0), and Training (ϕ_{TR}= 0.95^0) could be determined. The values are obtained as follows; Executive Commitment Degree of Decline = ΔMean Score / 3 Years = (4.20-4.08) / 3 = 0.04, therefore the formula used can be summarised as follows:

$$\textbf{Degree of Decline (DoD)} = \frac{\textbf{Change in the Mean } (\Delta) \textbf{ Score}}{\textbf{Difference in years of TQM Maturity}} \qquad \textbf{Equ 6.9}$$

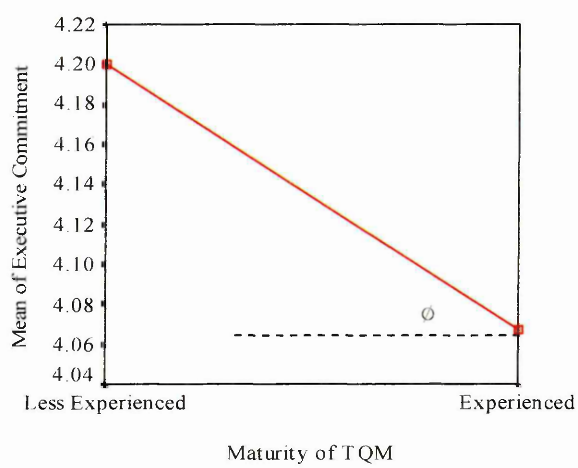


Figure 6.22: Degree of Decline for the Executive Commitment Construct

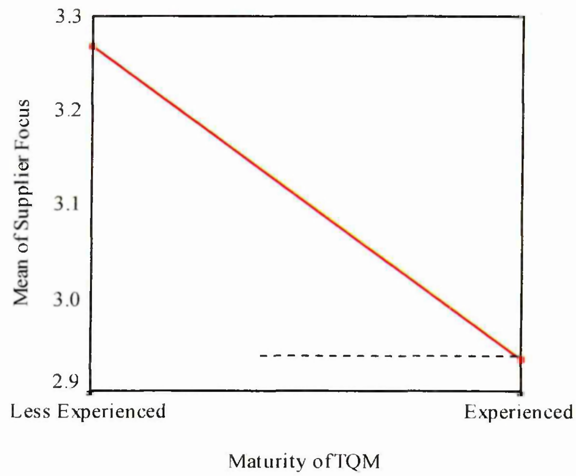


Figure 6.23: Degree of Decline for the Supplier Focus Construct

The Implications of the Findings were as follows.

1. With the TQM Implementation maturing, complacence for the executive commitment seeps in as they are comfortable, as it was hypothesized that executive commitment would increase with time. However, this is not the case with the UK Construction related SMEs. On a positive side, the actual degrees of decline is minimal compared with that of Supplier Focus ($\emptyset_{SF}$= 18.0^{0}). The implication of this finding is that the Supplier Relations do not improve over time for the UK Construction-related SMEs. This is very consistent with literature on Supply Chain Management within the Construction Industry (Holits et al, 2000 ; Akintoye et al, 2000; Egan, 1998)

Training Construct

On the training construct, there is not any remarkable difference with the training aspirations of organisations relative to the time since the implementation started. This could be attributed to the cost associated with training which rules out the need for that. Alternatively some of the new employees may bring with them the necessary skills in problem solving and quality principles. The major finding is that time does not change the "training ethos" of UK Constructional related SMEs, as it is associated with cost. This implies that UK Construction related SMEs do not change attitudes with respect to training. On the contrary, as organisations grows, the needs of training become apparent as indicated in Table 6.11.

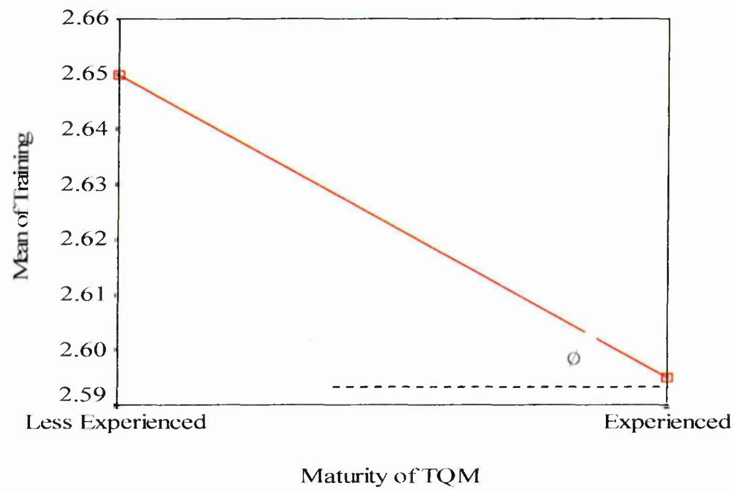


Figure 6.24: Degree of Decline for the Training Construct

Medium sized TQM deploying Construction related SMEs had a higher execution (mean = 2.693) of the training construct than the Small-sized TQM (mean = 2.46) deploying organisations. Infact, apart from the Executive Commitment construct, the Medium-sized outscored the small-sized TQM deploying organisations.

The findings reported are different from Ahire (1996) who observed that various TQM implementation elements would be more extensively implemented in more TQM experienced firms as compared to less experienced TQM firms. On the contrary, the less experienced UK Constructional related TQM deploying SMEs had slightly extensive implementation of the three constructs namely Executive Commitment, Supplier Focus and Training. The finding promoted the intuition for the sub hypothesis that TQM excellence not only lies with organisation size but also partially affected by time factor. The findings were contrary to the organization learning theory which proposes that the implementation effectiveness of TQM will increase with TQM maturity in the firm (Ahire and

Dreyfus, 2000) and that of the learning curve, which states that the longer the firm remains in operation, the better is the learning of management knowledge and experience. Sohail and Hoong (2003). According to Garvin (1993), this is associated with an organisation's ability to explore the unknown and to identify and pursue novel solutions which can be equated to innovation. This inevitably can lead to a sustainable competitive advantage. Motawa et al (1999).

One of the objectives of the study was to investigate the Impact of TQM maturity (age) on the implementation of TQM and is illustrated as Path D in the research conceptual framework shown in Figure 2.3. Hendricks and Singhal (2001) observe that TQM literature does not provide much theoretical or empirical guidance on what should be the appropriate length of time in examining performance. On the other hand Reed et al (1996) note that where empirical work such as this considers firm performance and time in a manner that is similar with publication of financial data (information) i.e. annual reports and accounts for publicly quoted companies, then the time lag can be taken as the year after commencement of TQM strategy and publication of annual data.

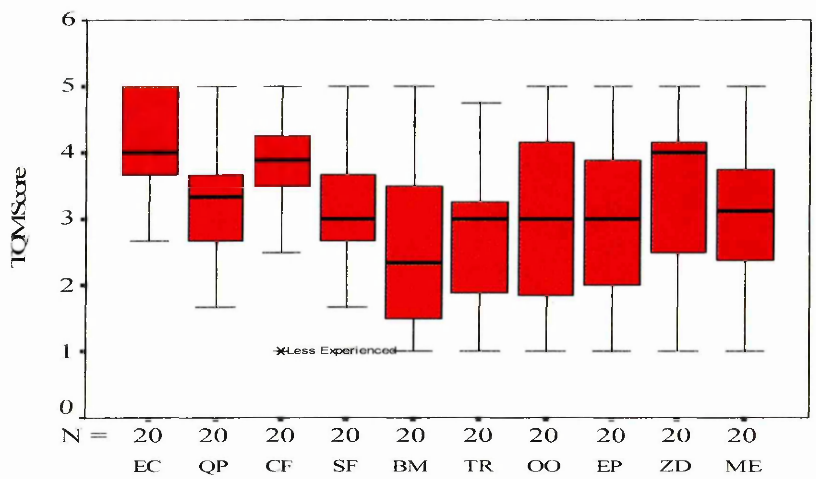


Figure 6.25 Box and Whisker plots showing the variation of the mean scores for the Less Experienced and Experienced TQM deploying organisations

In order to isolate the effects of the time lag between inception and improvement on the degree of use of quality management practice, a cut off point between experienced and inexperienced organisations was introduced. For the purpose of this study, a three year period was taken to be the demarcation between the less experienced and experienced, or early adopters and later adopters.

6.3.12 Analysis of Time Lag between Inception and Improvement

In order to address the analysis of the time lag between inception and improvement, a subgroup analysis of the measurement model fit indices was carried out based on the TQM duration. TQM deploying organisations were classified in two groups depending on the number of years TQM was in place. The classification of organisations based on Ahire and Dreyfus (2000) is as follows; Recent TQM implementers (3 or few years of TQM) and Experienced TQM implementers (more than 3 years of TQM). In order to isolate the effects of the time lag between inception and improvement on the degree of use of quality management practice, a cut off point between experienced and inexperienced organisations was introduced. Sousa (2003) argues that with sufficient time elapsed to allow for the adoption of a practice; plants or organisation they are able to make a sound cost-benefit assessment of the practice's use.

Table 6.13: Mean Score Comparison of Less Experienced and Experienced TQM Deploying Organisations (N=20)

Factors	Less Experienced (n =10)		Experienced (n =10)		*t*-value
	Mean	sd	Mean	sd	
Executive Commitment	4.20	.819	4.07	.782	.372
Adopting the philosophy	2.93	.751	3.44	.686	-1.557
Customer Focus	3.73	1.050	3.80	.832	-.177
Supplier Focus	3.27	.813	2.93	.734	.964
Benchmarking	2.40	1.062	2.73	1.498	-.573
Training	2.65	1.075	2.60	1.164	.110
Open Organisation	2.80	1.326	3.50	1.218	-1.229
Employee Empowerment	2.60	1.324	3.43	.874	-1.644
Zero Defects	2.97	1.282	3.73	1.205	-1.381
Measurement	2.50	1.106	3.56	1.204	-2.051
Average Mean	3.005		3.379		

a) The mean scores for each construct are on a scale of 1 through 5
The t values in Table 6.14 are used to test whether the mean values for the less Experienced are different from Zero

Table 6.14: Coefficient of Variation Comparison of Less Experienced and Experienced TQM Deploying Organisations (N=20)

Factors	Less Experienced (n=10)			Experienced (n =10)		
	Mean	sd	CV	Mean	sd	CV
Executive Commitment	4.20	.819	19.50	4.07	.782	19.21
Adopting the philosophy	2.93	.751	25.60	3.44	.686	19.94
Customer Focus	3.73	1.050	28.15	3.80	.832	21.89
Supplier Focus	3.27	.813	24.86	2.93	.734	25.05
Benchmarking	2.40	1.062	44.25	2.73	1.498	54.87
Training	2.65	1.075	40.56	2.60	1.164	44.76
Open Organisation	2.80	1.326	47.36	3.50	1.218	34.80
Employee Empowerment	2.60	1.324	50.92	3.43	.874	25.48
Zero Defects	2.97	1.282	43.16	3.73	1.205	32.30
Measurement	2.50	1.106	44.24	3.56	1.204	33.82

To limit the number of calculations it was decided to apply one assessment criteria using a high mean value of 4.20 and the lowest standard deviation of 0.751 as this combination would generate the lowest value of the Coefficient of Variation (CV = 17.88%) for the less experienced and for the experienced organisations. Each TQM deployment construct can be compared to the assessment by multiplying the mean scores and standard deviation with the following adjustment factors computed in Table 6.14

Based on the mean scores from the above table, the TQM deployment constructs can be ranked in their order of importance for the less experienced as follows;

- Executive Commitment
- Customer Focus
- Supplier Focus
- Zero Defects
- Adopting the Quality Philosophy
- Open Organisation
- Training
- Employee Empowerment
- Measurement

- Benchmarking.

For the Experienced TQM deploying organisations

- Executive Commitment
- Customer Focus
- Zero Defects
- Measurement
- Open Organisation
- Adopting the Quality Philosophy
- Employee Empowerment
- Supplier Focus
- Benchmarking
- Training.

Based on the values in Table 6.14, the coefficient of variation (CV =16.85%) for the Experienced TQM deploying organisations is generated based on the highest mean score (mean = 4.07) which is for the Executive Commitment construct and the lowest standard deviation (std=0.686) which is for adopting the Quality Philosophy Construct. Each of the mean score and standard deviation results in Table 6.14 are divided by the two constant values (mean =4.07 and std = 0.686) indicated in the shaded boxes in Table 6.14. This produces the adjustment factors (AF) presented in Table 6.15.

Table 6.15: Adjustment Factor (AF) Comparison of Less Experienced and Experienced TQM Deploying Organisations (N=20)

Factors	Less Experienced (n=10)			Experienced (n =10)		
	Mean	sd	AF	Mean	sd	AF
Executive Commitment	1.00	0.917	100%	1.00	0.877	100%
Adopting the philosophy	0.697	1.00	100%	0.845	1.00	84.5%
Customer Focus	0.888	0.715	88.8%	0.933	0.825	93.3%
Supplier Focus	0.778	0.924	92.4%	0.719	0.935	93.5%
Benchmarking	0.571	0.707	70.7%	0.670	0.458	67.0%
Training	0.630	0.698	69.8%	0.638	0.589	63.8%
Open Organisation	0.660	0.566	66%	0.859	0.563	85.9%
Employee Empowerment	0.610	0.567	61%	0.842	0.784	84.2%
Zero Defects	0.707	0.585	70.7%	0.916	0.569	91.6%
Measurement	0.590	0.679	67.9%	0.875	0.569	87.5%
Average Mean	3.005			3.379		

The values of the coefficient of variation are plotted to illustrate the differences between the Experienced and Less Experienced in the deployment of TQM Constructs. In this analysis, the lower the value of the CV, the better the organisation is at the implementation of the TQM deployment constructs. From Figure 6.26, it is evident that the **Difference in years of TQM Maturity** Experienced TQM organisations outscores the Less experienced in all but one construct.

The usage of the variation coefficient in this study is similar to Thiagarajan and Zairi (1998) though their approach was named variation ratio. However, it was never applied to compare two different groups within the same sample. From Table 6.14.2, the adjustment factor for each construct ranges from 0 to 100%, and the value of 100% always represents the least critical. The coefficient of variation is then plotted to compare the experienced and less experienced and this is illustrated in Figure 6.23.

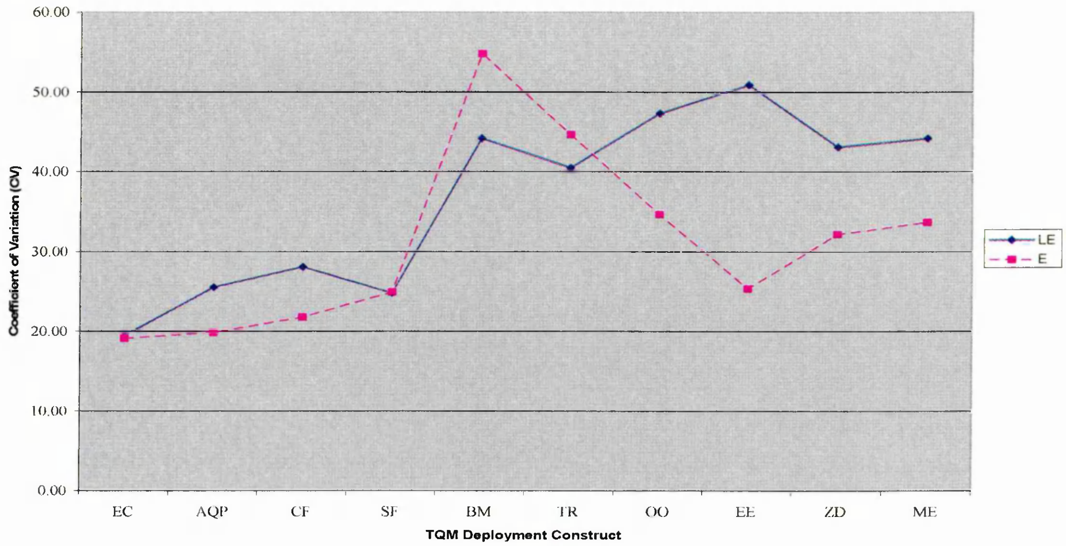


Figure 6.26: Coefficient of Variation Comparison for the Experienced and Less Experienced.

6.3.11.2 Impact on the Levels of Model Constructs

In order to ascertain the time lag between inception and improvement the relationships between the ten deployment constructs and the quality outcomes were examined. Using the framework of Raju and Lonial (2002), such lagged effects cannot be tested upon a cross sectional study such as this one. Although it's acknowledged that the best option would be to revisit the organisation after a year of implementation, this would constitute a longitudinal approach of which the limitations are clearly stated in Chapter One. However it is still feasible to conduct the analysis based on the organisation size or the number of years TQM has been in place. Using Structural Equation Modelling (SEM) techniques, the validation is provided indicating that the 10 deployment constructs were not just a function of organisation size.

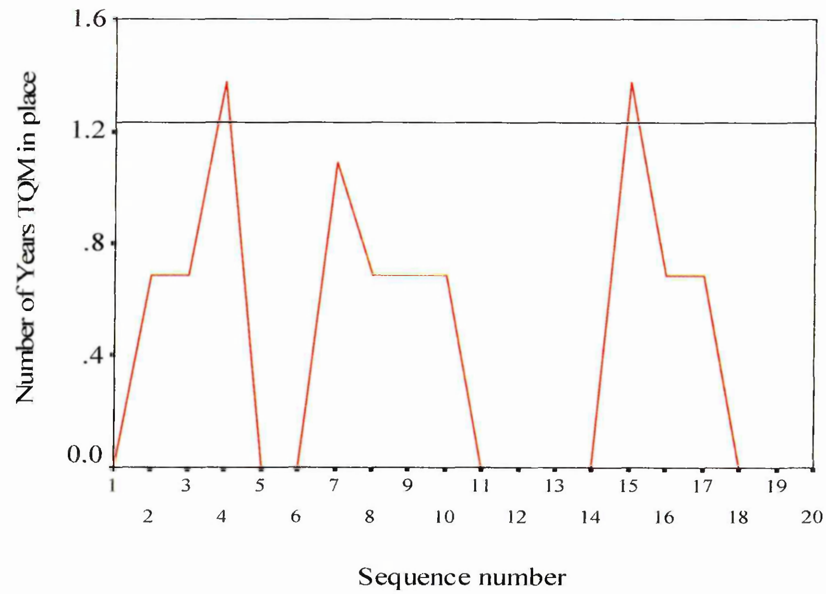


Figure 6.27 Transformation of the TQM Number of Years into Natural Log

6.3.12.2 Results of Time Lag Analysis

Results from Canonical Discriminant Analysis

Hypothesis H_{9-1} to H_{9-10} states that experienced TQM deploying UK Construction related SMEs exhibited a higher level of advancement of the ten TQM constructs than less experienced organisations.

Respondents were asked to rate on a Likert scale (of 1-5 where 5 were highly advanced and 1 was low) the rate of advancement on the 10 TQM deployment constructs. This hypothesis was tested by Discriminant Analysis (DA). The ten TQM constructs shown in Table 6.16 were entered as predictors. One discriminant function (dimension) was identified since there were only two sample groups, namely experienced and less experienced. This function yielded a chi-square of 11.399 ($p=0.327$) with 10 degrees of freedom which was significant. Therefore, the hypothesis was supported.

The first canonical discriminate function had an Eigenvalue of 1.403 and it explained 100% of the variance. The overall canonical correlation was 0.764. The test of the function yielded a Wilks Lambda of 0.416.

Table 6.16: Standardized Weights for the 10 TQM Deployment Constructs Structure Matrix for Experience vs. Less Experienced

Hypothesis	Deployment Construct	Function 1
H_{9-1}	Measurement	.437
H_{9-2}	Employee Empowerment	.350
H_{9-3}	Quality Philosophy	.332
H_{9-4}	Zero Defects	.294
H_{9-5}	Open Organisation	.262
H_{9-6}	Supplier Focus	-.205
H_{9-7}	Benchmarking	.122
H_{9-8}	Executive Commitment	-.079
H_{9-9}	Customer Focus	.038
H_{9-10}	Training	-.023

Table 6.16 shows the pooled within-groups correlations between discriminating variables and standardized canonical discriminate function variables ordered by absolute size of correlation within function.

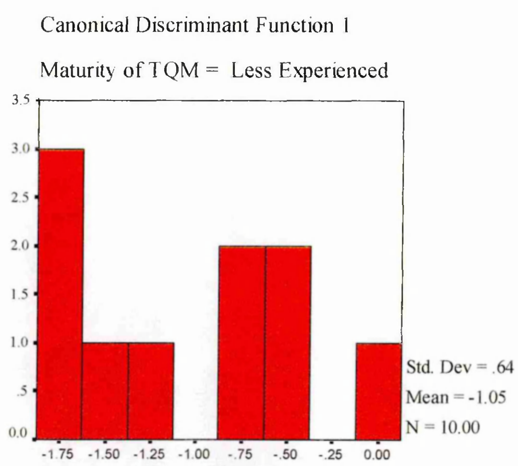


Figure 6.28: Based on TQM deployment Constructs for Less Experienced SMEs

In Figure 6.28, the shape of the histogram should approximately follow the shape of the normal curve. The histogram is acceptably close to the normal curve. One way of examining the relationship between the ten deployment variables and the discriminant variates is to look at the structure matrix, which gives the canonical variate correlation coefficient. These values can be compared to factor loadings in the regression analysis.

Table 6.17 displays the standardized weights of the ten deployment constructs. If the weight is positive, it means that medium construction related TQM deploying UK organisations are relatively stronger than smaller organisations. If the weight is negative, it means small organisations are relatively stronger. If the weight is close to zero, it means there is no difference.

Table 6.17: Standardized Weights for the 10 TQM Deployment Constructs
Standardized Canonical Discriminant Function Coefficients

Hypothesis	Deployment Construct	Function 1
H_{5-1}	Executive Commitment	-.785
H_{5-2}	Quality Philosophy	.524
H_{5-3}	Customer Focus	.188
H_{5-4}	Supplier Focus	.855
H_{5-5}	Benchmarking	.334
H_{5-6}	Training	-.478
H_{5-7}	Open Organization	-1.163
H_{5-8}	Employee Empowerment	1.149
H_{5-9}	Zero Defects	.852
H_{5-10}	Measurement	-.213

Table 6.17 shows the pooled within-groups correlations between discriminating variables and standardized canonical discriminant function variables ordered by absolute size of correlation within function. The interpretation of DA is that experienced TQM deploying organisations outperform less experienced in only six areas. These are Quality Philosophy, Customer Focus, Supplier Focus, Benchmarking, Employee Empowerment and Zero Defects. The group centroids of less experienced and experienced SMEs on this function equalled -1.049 and 1.049 respectively. These centroids are simply based on the summary of canonical discriminant functions, the first 1 canonical discriminant yielded an Eigenvalue of 1.403

with 100% variance and 100% cumulative variance. The canonical correlation was 0.764.

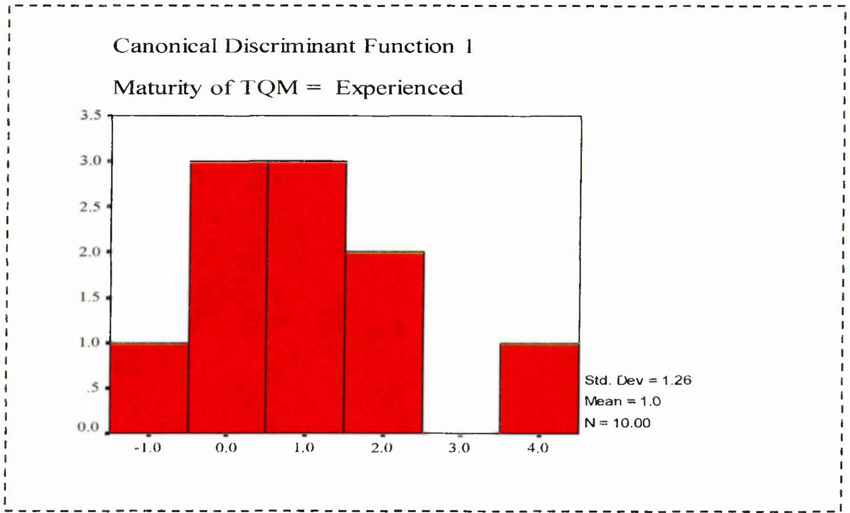


Figure 6.29: Based on the TQM deployment constructs of Experienced Organisations

In Figure 6.29, the shape of the histogram should approximately follow the shape of the normal curve. The histogram is acceptably close to the normal curve

Figure 6.25 provided a summary of the ten deployments constructs. The descriptive findings of the TQM constructs of the experienced UK constructional related SMEs are shown in Figure 6.30. It can be observed that the mean scores range from 4.00 to 2.20 with reasonable dispersion about the measure of central tendency. For present purposes, a total quality management index needs to be constructed for each respondent organisation.

Explanation of the Box and Whisker Plot

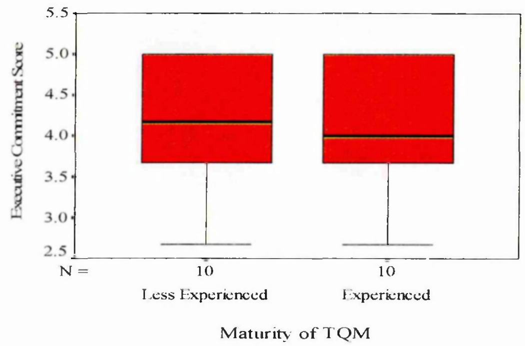


Figure 6.30: Box and Whisker plots showing the variation of the Executive Commitment scores for the less experienced and experienced TQM deploying SMEs.

The shaded area in the box is the interquartile range (IQR) that contains 50% of all the cases and the dark line is the mean. Box plots are used to provide visual representations of distributions.

6.3.11.3 Other Methods of Time Lag Analysis

Other methods considered are the usage of total quality management index (gap) between early implementers and experienced implementers. Furthermore time is considered in the model (see Forza and Fillippin, 1998). Secondly time lag between the variation in a casual and the consequent variation of the caused construct is not great. Time lag is considered in this TQ-SMART model as evidenced by the inclusion of indirect path which emanates from the executive commitment and reaches the organisation performance variables through various intermediate variables.

The work by Reed et al (1996) presents the framework of analysing the time lag effect.

They argue that as opposed to critics of TQM who highlight the lack of immediate benefits, they present the valid reasons as to why the benefits of

TQM are far from instantaneous. The major issue being that uncertainty and firm orientation both exist on continua where both continua are undimensional. Uncertainty ranges between high and low, and orientation ranges between customer and operations.

6.3.13 Discussion of Time Lag Analysis

Studies on time-lag analysis present mixed findings and can be summarised into two categories. Firstly there is a difference between early adopters and late adopters (i.e. Powell 1995; Taylor and Wright 2003; and Reed et al 1996). Secondly there are those claiming that there is no difference between early adopters and late adopters. Jones et al (1997) in their study of impact of time on benefits received for those seeking ISO 9000 certification could not find any differences between the longer-certified companies and recently certified.

- **Impact of Time on Benefits Obtained**

Powell (1995) acknowledged the existence of time-lag between implementation and consistent performance advantages, however his data did not permit such analysis. According to Taylor and Wright (2003), time-lag analysis is best served by longitudinal studies. In their study they asked specific questions as to whether higher levels of perceived TQM success were associated with size of organisations and the length of time since adoption of TQM. On the other hand, Reed et al (1996) argued that time-delay between TQM Implementation and performance will be longer for firms with an operations orientation, than those with a customer orientation.

Lai and Cheng (2001) in exploring the quality initiatives within the Hong Kong setting acknowledged the importance of time-lag i.e. delayed effects of quality management implementation on quality outcomes. Sousa (2003) argues that with sufficient time elapsed since the adoption of a practice; plants or organisations are better able to make a sound cost-benefit assessment of the practice's use. However, Williams et al (2003) recommends exercising caution as a series of questions need clarification. For example, would the actual change in the financial performance indicator or independent variable be associated with the known outcome of that variable?

- **Importance of Time Lag Analysis**

It is acknowledged that the ability to address questions concerning change permits the researcher;

(a) to step closer to the causality issue than is the case with test among static level levels of the variable. This is the case of such a study as this which is cross sectional.

(b) to make more accurate judgment about the effectiveness of some purposeful change initiative or about some event (e.g. TQM deployment) known to bring change (i.e. Improvement in efficiency and effectiveness, better communication with suppliers).

However there is potential for the TQ-SMART to be used in future application of the latent growth modelling (LGM)

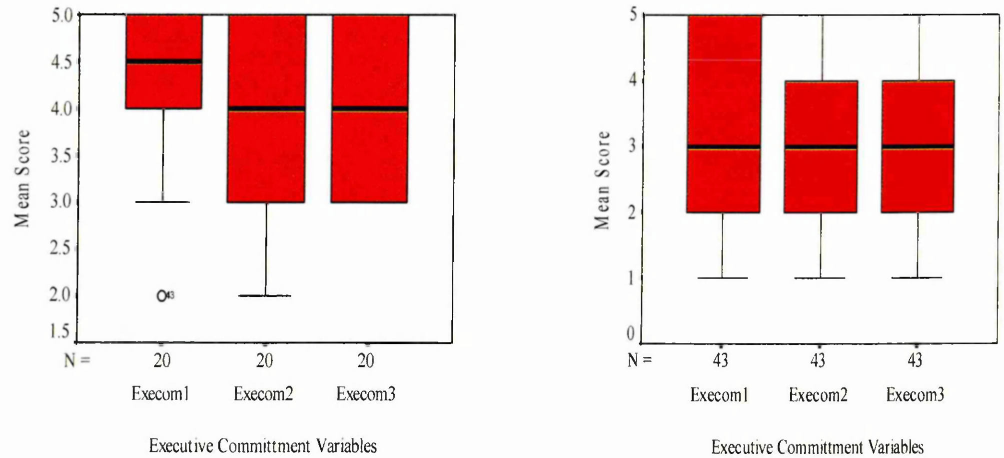
6.4 Descriptive Statistics of the TQM Deployment Constructs

It is acknowledged that the easiest way to see data is by plotting a graph. Furthermore the first stage in any data analysis is to explore the data collected to identify any patterns within it. According to Field (2000), this is usually achieved by looking at descriptive statistics such as the mean, mode, and median. The median of the data is also reported as it is the more appropriate measure of central tendency for ordinal data than the mean. Furthermore, Forza (2002) states that ordinality affords the researcher to run the data and is not a measure of the ability to manipulate the data arithmetically. This can be achieved by using Box and whisker plots. The next sub sections present the results of exploring the data for the descriptive statistics of the ten TQM deployment factors for TQM and non-TQM organisations.

6.4.1 Executive Commitment

The highest possible score for executive commitment was 15, (n * w) where (n= 3; number of variables in the executive dimension, and w = 5; the highest score on the Likert scale of 1-5 in the dimension. The measurement produced a mean executive commitment dimension of 10.11, with a median of 10 and a mode of 11. Examination of the scores in Table E4 (Appendix E) showed that the sum of all the scores in executive commitment was 637 (67.40 %) out of a highest possible sum of 945. It indicates that the UK Constructional SMEs are on average committed to the deployment of TQM. The same sample was split into TQM and Non-TQM deploying organisations. For TQM deploying organisations, out of a possible highest score of 15 a mean executive commitment dimension of 12.36, with a median of 12.5 and a mode of 14 was determined.

Figure 6.31 presents box and whisper plots showing variation for the TQM and non-TQM deploying organisations. Figure 6.31(a) shows the median for the three variables which make up the Executive Commitment construct for the 20 TQM deploying organisations in the sample, and it is evident that the first variable had a mean of 4.5 with the second and third having an equal mean of 4.0 thus the total median equals a summation of the three means.



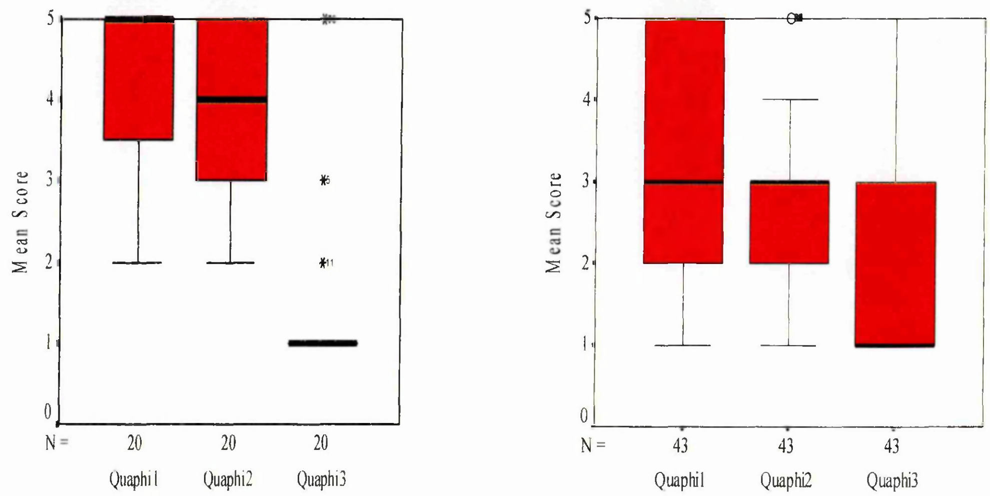
(a) TQM Deploying (b) non-TQM Deploying

Figure 6.31: Box and Whisker Plots showing the variation of the mean scores for TQM and non-TQM deploying organisations for the Executive Commitment Dimension

From Table E2, (Appendix E), the sum of all the scores in the executive commitment dimension was 246 out of a possible 300 which represents 82.3% of the highest possible sum. On the contrary, the Non-TQM organisations had the following scores; mean (9.069), median (9.00) and mode of 9.00. Table E3 in Appendix E presents the scores for the non-TQM deploying and indicates that the sum of all the scores was 390 out of a possible 645 representing 60.0%. On a comparative basis, TQM deploying organisations outperformed the Non-TQM organisations in terms of having a high executive commitment.

6.4.2 Adopting the Quality Philosophy

For TQM deploying organisations, out of a possible highest score of 15 in adopting the Quality Philosophy dimension, the measurement produced a mean adopting the quality philosophy 9.75, a median of 10 and a mode of 10. The sum of all the scores in adopting the quality philosophy was 195 out of a highest possible sum of 300 which represents 65.0% of the highest possible sum. Non-TQM deploying organisations had the following scores: mean of 8.023, median of 7.00 and mode of 8.00. The sum of all the scores was 345 out of a possible 645 representing 53.48 %. On a comparative basis TQM deploying organisations outperformed non-TQM. The total sample had a total score of 540 (57 %) out of a possible 945.



(a) TQM Deploying (b) Non-TQM Deploying

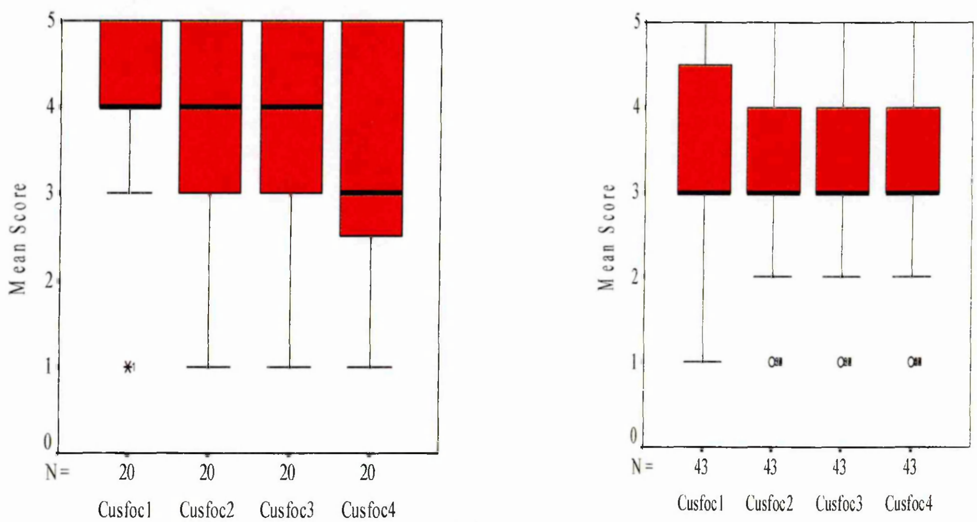
Figure 6.32: Box and Whisker Plots for Adopting the Quality Philosophy Construct

An examination of Fig 6.32a reveals some interesting observations regarding the degree of compliance to entering the EFQM Excellence Model award competition. The results indicate that UK TQM deploying Construction related SMEs are less likely to enter or use the EFQM EM as indicated (mean = 1.00) by the third variable of adopting the quality philosophy construct. However, Fig 32(b) indicates a better response for non-TQM (mean = 1.75) and at least 50 percent of the scores were within the interquartile with scores ranging from 1 to 3. The shaded box in Fig 6.32b for the third variable indicates this.

The Box plot in Fig 6.32b shows that the second variable (Quality Philosophy 2) contains outliers. ANOVA is robust to unequal variance with groups of near equal size, however as they are unequal observations between the TQM (20) and non-TQM (43), in this case, the one way ANOVA procedure is used to set the robust F statistics.

6.4.3 Customer Focus

Customer focus construct for TQM deploying organisation measurement produced a mean of 15.05, a median of 15.5 and a mode of 11. The sum of all the scores as shown in Table E2 (Appendix E) in adopting the customer focus dimension was 303 out of a highest possible sum of 400. This represents 75.25 % of the highest possible sum. UK Non-TQM deploying organisations had the following scores; mean of 13.116, median of 12.00 and mode of 12.00. The sum of all the scores as illustrated in Table E3 (Appendix E) was 564 (65.58 %) out of a possible 860 . On a comparative basis TQM deploying organisations outperformed Non-TQM.



(a)

TQM Deploying

(b) non-TQM Deploying

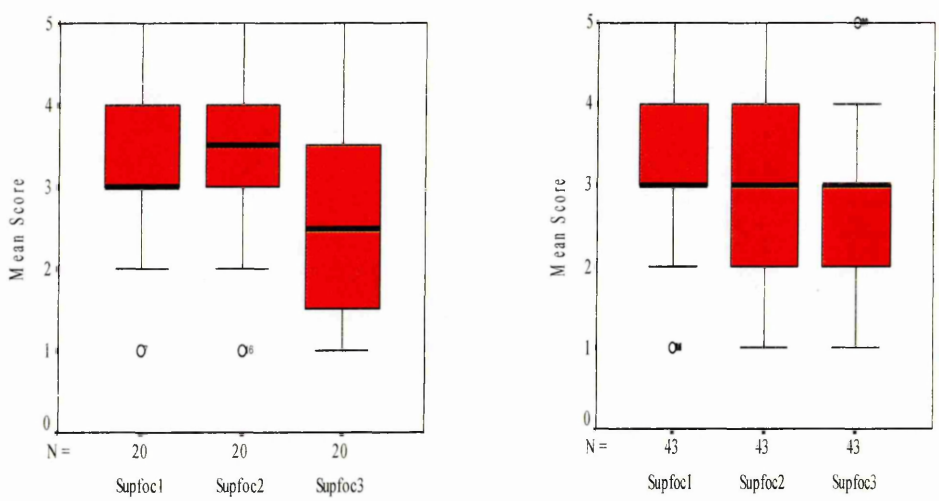
Figure 6.33: Box and Whisker Plots for Customer Focus Construct

The total sample had a total score of 865 (68.65 %) out of a possible 1260. It can be concluded that both types of organisations were more customer-oriented. This is hardly surprising as the basis of any TQM program is normally that of satisfying the customer or meeting the customer requirements.

6.4.4 Supplier Focus

Supplier focus dimension for TQM deploying organisation measurement produced a mean of 9.15, with a median of 9.0 and a mode of 8.0. This dimension had a standard deviation of 3.39 suggesting that TQM deploying organisations were relatively closer in terms of their supplier orientation. The sum of all the scores as shown in Table E3 (Appendix E) in adopting the supplier focus dimension was 183 out of a highest possible sum of 300 which represents 61.00 % of the highest possible sum.

On the other hand, the UK Non-TQM deploying organisations had the following scores: mean of 8.744, median of 9.00 and mode of 9.00. The sum of all the scores was 376 out of a possible 645 representing 58.29 %. On a comparative basis TQM deploying organisations outperformed Non-TQM. The total sample had a total score of 559 (59.15 %) out of a possible 945. This suggests that the UK construction related SMEs were not very supplier oriented.

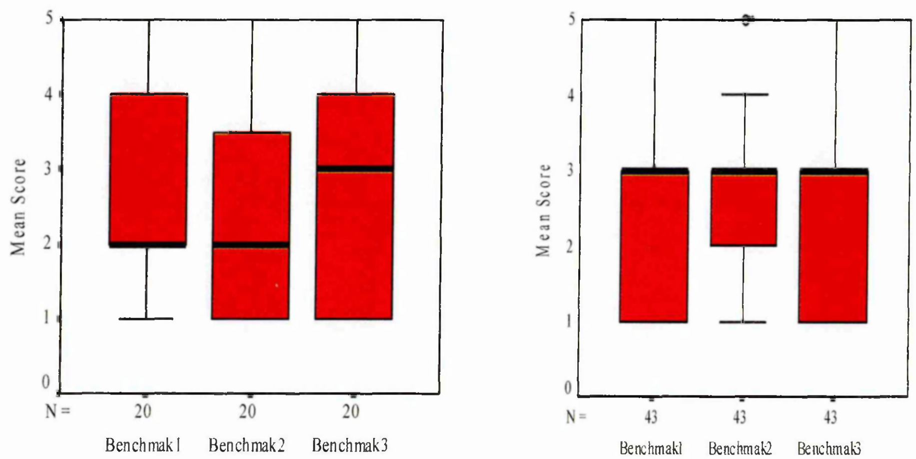


(a) TQM Deploying (b) non-TQM Deploying

Figure 6.34: Box and Whisker Plots for Supplier Focus Construct

6.4.5 Benchmarking

In terms of the benchmarking dimension, both types of organisations were below average in terms of performance. For TQM deploying organisations, out of a possible sum of 300, they scored 152 representing 50.66 %. The mean value was 7.60, with a median of 6.5 and a mode of 4.0. This dimension had a standard deviation of 3.92 suggesting that TQM deploying organisations were more sparely distributed in terms of benchmarking. The sum of all the scores for Non-TQM deploying was 333 (51.62 %) out of a highest possible sum of 645. The following scores were achieved: a mean of 7.743, median of 9.00 and mode of 9.00.



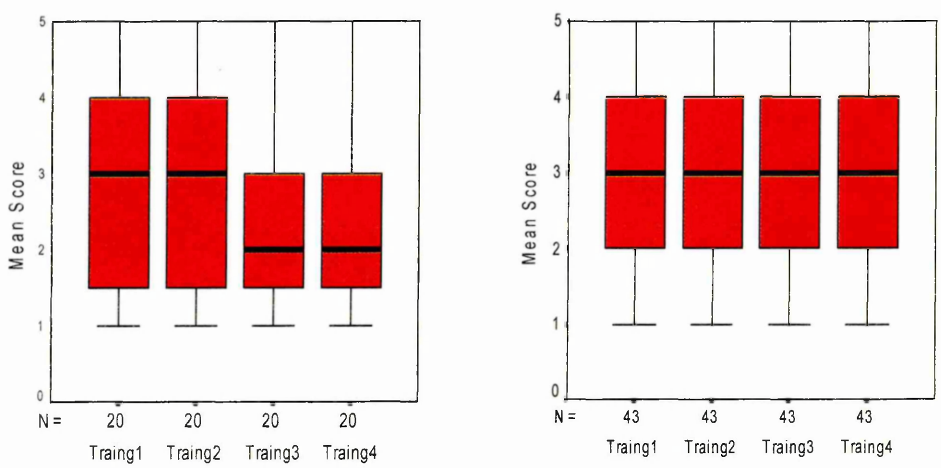
(a) TQM Deploying (b) non-TQM Deploying

Figure 6.35: Box and Whisker Plots for Benchmarking Construct

On a comparative basis, Non-TQM deploying organisations marginally excelled over their TQM deploying counterparts. This finding is consistent with other studies such as McCabe, 2001; Dattakumar and Jagadeesh, 2003, McAdam and Kelly, 2002 which suggest that benchmarking is rarely applied or practised in SMEs. The types of benchmarking the respondents were asked to rate their organisations were of three types namely: functional, internal and generic.

6.4.6 Training

Training dimension for TQM deploying organisation measurement produced a mean of 10.45, a median of 10.5 and a mode of 12.0. This dimension had a standard deviation of 5.04 suggesting that TQM deploying organisations were more sparely distributed in terms of the training dimension. The sum of all the scores in this dimension was 209 out of a highest possible sum of 400 which represents 52.25 % of the highest possible sum. However, UK Non-TQM deploying organisations had the following scores; mean of 11.3953, median of 12.00 and mode of 12.00. The sum of all the scores was 490 out of a possible 860 representing 56.97 %. On a comparative basis TQM deploying organisations were outperformed by Non-TQM. The total sample had a total score of 699 (55.47 %) out of a possible 1260.



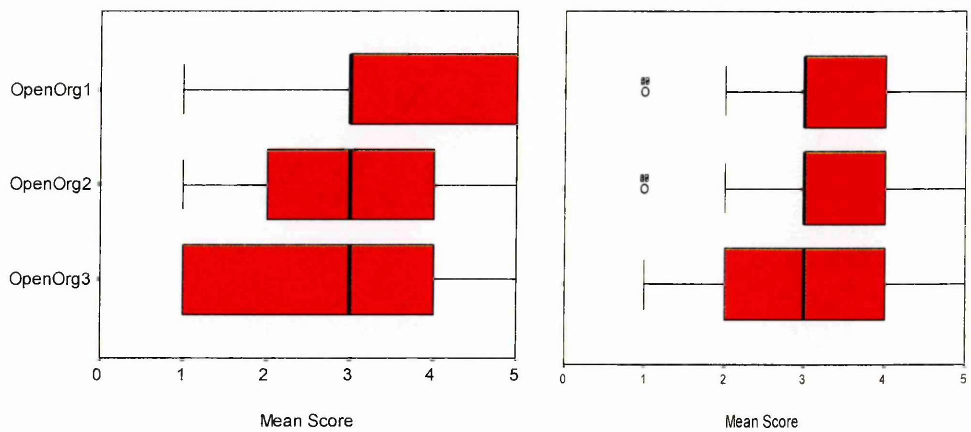
(a) TQM Deploying (b) non-TQM Deploying

Figure 6.36: Box and Whisker Plots for Training Construct

This suggests that the SMEs in the UK construction industry were below average in terms of training their management and employees in quality principles and problem solving techniques. Some reasons for this trend were explored in detail in the sub section on the training construct in this Chapter.

6.4.7 Open Organisation

Open organisation dimension for TQM deploying organisation measurement produced a mean of 9.45, with a median of 9.0 and a mode of 6.0. This dimension had a standard deviation of 4.074 suggesting that TQM deploying organisations were more sparely distributed terms of open organisation dimension. The sum of all the scores in this dimension was 189 out of a highest possible sum of 300 which represents 63.00 % of the highest possible sum. On the other hand, the UK Non-TQM deploying organisations had the following scores; mean of 9.418, median of 9.00 and mode of 9.00. The sum of all the scores was 405 out of a possible 645 representing 62.79 per cent.



(a) TQM Deploying (b) non-TQM Deploying

Figure 6.37: Box and Whisker Plots for Open Organisation Construct

On a comparative basis TQM deploying organisations were outperformed by Non-TQM. The total sample had a total score of 594 (62.85 %) out of a possible 945. This suggests that the SMEs in the UK construction industry were below average in terms of having an open culture.

6.4.8 Empowerment

Empowerment dimension for TQM deploying organisation measurement produced a mean of 12.15, a median of 12.0 and a mode of 10.0. This dimension had a standard deviation of 5.04 suggesting that TQM deploying organisations were more sparely distributed terms of employee empowerment dimension. The sum of all the scores in this dimension was 243 (60.75 %) out of a highest possible sum of 400. On the other hand, the UK Non-TQM deploying organisations had the following scores: mean of 11.9767, median of 12.00 and mode of 12.00. The sum of all the scores was 515 out of a possible 860 representing 59.88 %. On a comparative basis TQM deploying organisations were outperformed by Non-TQM.

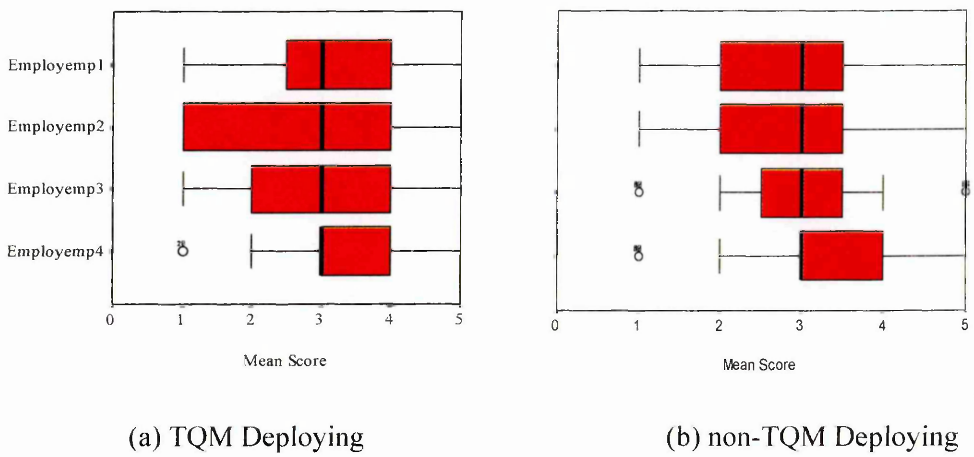


Figure 6.38: Box and Whisker Plots for Employee Empowerment Construct

The total sample had a total score of 758 (60.15 %) out of a possible 1260. This suggests that the SMEs in the UK construction industry were above average in terms of empowering their employees.

6.4.9 Zero Defects

Zero defects dimension for TQM deploying organisation measurement produced a mean of 10.05, with a median of 10.0 and a mode of 10.0. This dimension had a standard deviation of 4.35 suggesting that TQM deploying organisations were more sparely distributed terms of zero defects dimension. The sum of all the scores in this dimension was 201 (67.0 %) out of a highest possible sum of 300. On the other hand, the UK Non-TQM deploying organisations had the following scores: mean of 9.4156, median of 9.00 and mode of 9.00. The sum of all the scores was 405 out of a possible 645 representing 62.79 %.

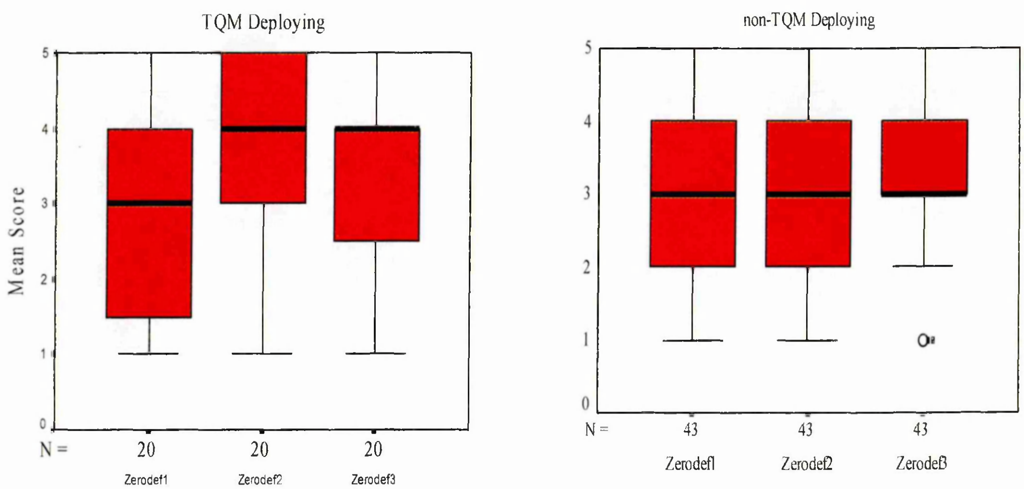
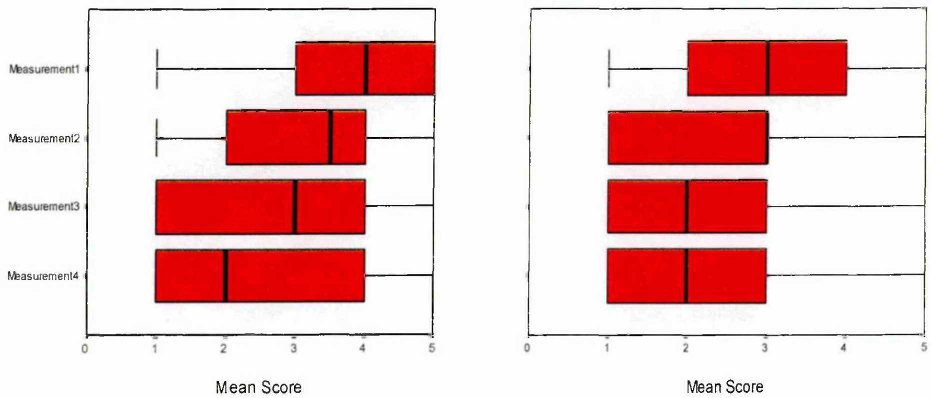


Figure 6.39: Box and Whisker Plots for Zero Defects Construct

On a comparative basis TQM deploying organisations outperformed the Non-TQM organisations. The total sample had a total score of 606 (64.12 %) out of a possible 945. This suggests that the SMEs in the UK construction industry were above average in terms of applying the zero defects principles.

6.4.10 Measurement

Measurement dimension for TQM deploying organisation measurement produced a mean of 12.1, with a median of 12.5 and a mode of 10.0. This dimension had a standard deviation of 5.85 suggesting that TQM deploying organisations were more sparely distributed terms of measurement dimension. The sum of all the scores in this dimension was 242 (60.5 %) out of a highest possible sum of 400. On the other hand, the UK Non-TQM deploying organisations had the following scores; mean of 9.883, median of 10.00 and mode of 6.00. The sum of all the scores was 425 out of a possible 860 representing 49.41 %.



(a) TQM Deploying (b) non-TQM Deploying

Figure 6.40: Box and Whisker Plots for Measurement Construct

On a comparative basis TQM deploying organisations were outperformed by Non-TQM. The total sample had a total score of 667 (52.93 %) out of a possible 1260. This was the lowest score of all the dimensions suggesting that UK Construction SMEs were below average in terms of applying statistical process control techniques and other related measurement tools. A comparison of this finding with other studies is provided in this Chapter under the measurement dimension sub section.

6.5 Discussion of the Descriptive Statistics for the TQM Deployment Constructs

Given the descriptive statistics described in Section 6.4, this section now presents the discussion of the results from subsection 6.4.1 through 6.4.10

6.5.1 Executive Commitment Construct

The role of senior management or top leadership commitment is well argued as a requirement for the implementation of any change. Among the pioneers of TQM such as Deming, Juran and Crosby, the message comes across clearly. The findings from the questionnaire survey indicated that the Executive Commitment was considered to be the most important factor (mean = 4.10) among the TQM deploying organisations. This is hardly surprising, as the finding is consistent with the major management literature on TQM and the role of leadership or senior management commitment. On the other hand non-TQM deploying organisations had ranked this factor third (mean = 2.92). Typical responses from Non-TQM deploying organisations ranged from having difficulties with the word "program"; and instead organisations were committed to providing quality. Leadership is possibly the most important element in TQM. It appears everywhere in organisation. Leadership in TQM requires the manager to provide an inspiring vision, make strategic directions that are understood by all and to instil values that guide subordinates. The executive commitment construct as a whole has a reliability alpha (α) of 0.9339 while the three variables earned reliabilities alphas (α) of 0.897, 0.866 and 0.767 respectively

6.5.2 Adopting the Quality Philosophy

This construct had three variables relating to quality principles in the mission statement and vision, an overall theme based on a quality program and finally entering an EFQM award competition. For TQM deploying organisations the first two variables were ranked 4th (mean = 4.05) and 5th (mean = 4.00). Both TQM and non-TQM deploying organisations ranked this variable the lowest. Other respondents questioned the concept of entering such an award. These findings are consistent with Yusof and Aspinwall (2001), and Sun and Cheng (2002), who state that most of these assessment programs, are tailor-made for large organisations. Taylor and Adair (1994) who completed studies of SMEs in Northern Ireland drew similar conclusions. One of the major reasons for the slow uptake in continuous improvement techniques by SMEs is due to lack of knowledge of such concepts. Wilkes and Dales (1998) found that though SMEs are in general aware of the existence of the EFQM model, they simply do not fully understand how they can derive the benefits from the self-assessment against criteria. There is also confusion among SMEs in the interpretation of the EFQM and TQM; whereas the latter is a self assessment award, as the findings of this research indicate, some constructional related SMEs organisations opt not to implement TQM on the basis of having the EFQM. For example, the Quality Director with 14 years of employment when asked to provide a definition of TQM commented:

> TQM was dropped 3-5 years ago. We currently use EFQM to measure ourselves internally.

Statistically there is a significant difference between TQM deploying organisations (mean = 3.27) and Non-TQM deploying (mean = 2.50). The small size of the standard deviation (sd = 0.94) shows the existence of advancement among the TQM deploying organisations that there is a need for an overall theme based on a quality program.

6.5.3 Customer Focus Construct

Both TQM and Non-TQM deployed organisations ranked this factor highly. It is not surprising that for Non-TQM, this was ranked first as these organisations that opt not to have a formal TQM program could have a different approach altogether. Irrespective of TQM or not, organisations acknowledged the importance of a customer oriented approach. Four practices relating to customer focus were listed in the questionnaire and respondents were asked to indicate on a 5-point scale (1= least advanced, 5=highly advanced) to what extent were they advanced in the customer focus practices.

Customer orientation is one of the single most important principles of TQM philosophy. The rationale behind this according to Brah et al (2002) is the belief that customer satisfaction is the most important requirement for long-term organizational success and that it requires the entire organization to be focussed on the customer's needs. On the other hand, the results of this research could be interpreted differently when the argument presented by Lemak and Reed (2000) is taken into account. They contend that TQM cannot be viewed as a generic set of activities that apply equally in all service situations. Furthermore, studies by Robson et al (2002) found that a quality and customer enabler to be the most significant enabler to achieve greater impact on performance and sustainability. Indeed, customer focus is clearly important to both manufacturing and service sectors. Brah et al (2002) acknowledge that defining customer needs is more complex in services than manufacturing because of the involvement of customers in the production process. This finding is consistent with Gustafsson et al (2003) who found customer orientation to be stronger and the most important quality practice among the smaller service organisations. Equally from the UK perspective, Tsang and Antony (2001) found "Customer Focus" to be the most important factor in their study of 25 UK Service Organisations. The implication of this is that irrespective of the industry, customer focus is important.

6.5.4 Supplier Focus Construct

Three variables relating to supplier focus were listed in the questionnaire and respondents were asked to indicate on a 5-point scale (1 least advanced, 5=highly advanced) to what extent they were advanced in the supplier focussed practices. One respondent stated that "we demand quality, how it is achieved is up to the supplier, if they don't want to lose our business". The literature review suggests that TQM can only be successful if others contributed towards the effort. This calls for supply chain partnership as advocated by Egan (1998).

Supplier focus dimension can be equated to vendor quality management, and as Motwani (2001) notes, many organisations now support, at least in theory, the need to work more closely with their suppliers. Tsang and Antony (2001) contribute by stating that selecting a quality supplier can also help the quality of products or services. They contribute further by stating another reason for low supplier management is because service organisations are more likely to be interactive with customers, . Both TQM and Non-TQM deploying organisations ranked this dimension lowly, with the means of 3.07 for TQM and 2.50 for non-TQM. This equates to ranking of importance 6^{th} and 7^{th} (out of 10) respectively. The individual variable which calls for suppliers to adopt a quality program was ranked 30^{th} and 34^{th} for both types of organisations. This finding is consistent with Akintoye et al (2000) who acknowledge that the construction industry has been relatively slow to adopt supply chain as a management strategy. They further posit that the problems in implementing successful supply chain collaboration and management within the UK construction industry can be attributed with an inappropriate traditional culture and unique features of the organisational structure. Kathawala and Abdou (2003) argue that the services industry is characterized differently than manufacturing as sales are intangible, and depend more on people's education, experience, and ethics. Furthermore, Powell (1995) found that supplier relationships are vital for product organisations than service ones.

6.5.5 Benchmarking Construct

Three variables and practices relating to benchmarking were listed in the questionnaire and respondents were asked to indicate, on a 5-point scale (1=least advanced, and 5= highly advanced) the extent to which each of these were implemented in the organizations. Appendix A shows the mean rank corresponding to each practice. All the three practices were lowly ranked in both types of organizations. The lowest ranked practice was researching best practice of other organizations.

The least ranked construct (mean = 2.60) for TQM deploying organisation was benchmarking. This is hardly surprising, as this finding is consistent with those of McCabe (2001) who observed that benchmarking only applies to big organisations. Their study dealt with SMEs based in the West Midlands, their results are indicative of the general trend as reflected by the findings of this study whose sample was drawn from the UK Construction Industry. The overall conclusion is that, benchmarking though vital to the general principles pertaining to TQM implementation is still widely practised by large organisations. The other notable reason could be the fact that it is relatively a new concept for the construction industry. The supporting evidence can be found in the literature review which indicated that little research has been done in this area especially specific application related studies. Furthermore, in the recent research by Dattakumar and Jagadeesh (2003), construction industry was not listed in the specific areas of application of benchmarking, though reference is made to the work of Lema and Price (1995) which describes benchmarking and explores applicability to the construction industry. However, the literature search conducted by Dattakumar and Jagadeesh (2003) was limited to Journal articles as there is evidence of management writing on benchmarking in construction, notable among those is by McCabe (2001)

Carpinetti and De Melo (2002) emphasised the importance of benchmarking practice as a means to promote continuous improvement in organisational performance. Yasin (2002) argues that benchmarking can and should be utilized as an essential element of a comprehensive TQM strategy. Yasin (2002) posits that benchmarking especially when used in association with TQM and continuous improvement is thought to have its place in today's business organisations. One of the solutions specifically tailored for SMEs is suggested by McAdam and Kelly (2002) who recommend the usage of generic benchmarking in addition to the development and application of the Business Excellence Model. In doing so, the combined usage could address the internal people management and development issues. Thiagaragan et al (2001) proposed a framework for organisations contemplating a TQM initiative and among the implementation guidelines they recommend the use of self-assessment tools and other mechanisms to track and improve performance gaps. In particular they propose competitive benchmarking against primary competitors and informal benchmarking and other forms of information sharing with organisations in different sectors. Construction related organisations could learn from this . While appreciating the reasons forwarded for its lack of applicability, there is a lot of potential in benchmarking. However the Construction Industry might draw comfort from the fact that lack of implementation and applicability of benchmarking is not restricted to them alone. Similar studies conducted among US manufacturing organisations by Kumar and Chandra (2001) speculated that not all organisations were interested in applying for the Malcolm Baldrige Award when conducting benchmarking. Their findings can be compared to this study where no single construction-related SME has ever won the converted EFQM Excellence Model award. This again could be due to lack of participation. As observed by The ECI (1996), benchmarking had been applied by a small number of large international companies in the construction industry since the mid 1980's; however it is now being recognised as a useful tool in the Construction Industry.

6.5.6 Training

The decision to implement TQM commits an organisation to a continuous process of development. This calls for the training of every employee including senior management in order to cope with, not only the current demands, but also the requirements created by the development process. In the survey the respondents were asked to rate their advancement in training management quality principles, employees in quality principles, problem solving skills and teamwork. For TQM deploying organisations, these four variables were the least ranked out of 34. Table 2D in Appendix D illustrates the ranking of all the variables. The findings reflect the actual state of the construction industry as regards qualified personnel in quality management. Atkinson (1990) laments 'the spectre of major skills shortages continues to haunt the construction industry'. He suggests "the confusion stems from the increasing polarisation within the industry between management and the co-ordination side of the construction, and the specialist skills side" It advocates training as crucial to developing cultural change. Tan (1997) purports that for TQM to work: the workforce must not only be trained, but must be "trusted" to make informed decisions on how to improve the work process continuously. According to Arditi and Gunaydin (1997), another reason for the difficulty to train workers in particular craft labour in the Construction Industry can be attributed to its transient nature.

Training plays a pivotal role in the implementation of TQM (Dwyer, 2000). However it's not just any training, as Davig et al (2003) posits that specific training for quality often plays a critical role in the success of a quality programme. It is worth pointing out that their studies were set in the manufacturing environment; therefore one can conclude that regardless of the type of industry, training is still vital. They further point out that not only will training improve performance of all employees but also it instils a sense of importance and self worth.

Motwani (2001) suggests where SPC is practised, training in statistical methods must be included. Mehra et al (2001) acknowledge that as TQM demands that people change working practices, then for example working in "teams" requires skills such as problem-solving, human relations, writing and oral expressions. The findings of this study on the other hand indicate that training is not widely practised within the SMEs. As suggested by Reed et al (2000) training is seen as a vehicle for only teaching the skills needed for producing quality products and services, but it is also a means of communicating a philosophy.

6.5.7 Open Organisation Construct

It is suggested that less bureaucracy often conflicts with the programme. TQM is built on a foundation of ethics, integrity and trust. Both types of organisations acknowledge this fact as evident from the mean values and the open organisation variables. TQM deploying organisations ranked this aspect 11th whereas Non-TQM 14th. According to management theory and existing dichotomous as proposed by various researchers (Watson and Chileshe, 1998; Watson and Korukonda, 1999) SMEs need to adopt the mechanistic structure as opposed to organistic, if implementation of any nature is to succeed. Furthermore culture can be described as glue that binds the activities and efforts of people to the workplace (Temtime and Solomon, 2002)

Tsang and Antony (2001) argue that organisations need to create a culture where all the employees should participate in the quality awareness programmes and quality improvement projects relevant to their own workplace. However the findings of the authors were predominant in the power and water supply companies.

6.5.7.1 Mechanistic Vs Holographic

In the modernist organisation the relationships between the tasks are of a mechanistic nature and there exists a high degree of linear relationship between the organisational tasks. Within the Post-Modernist organisation high levels of group work exist, each with a correspondingly high level of autonomy. The overriding linking force binding these empowered groups together is the organisational culture. This form more readily suits the reality of today's environment because organisations and markets are 'messy things' and not linear. However one must not forget that building a shared culture and conception of the world takes a great deal of time and effort. It is the author's view that culture is the `DNA' of organisations and this must be genetically engineered to provide the required organisation. Culture is the fundamental building block. Traditionally in most organisations the existing culture is based upon mistrust and the utilisation of frequent sanctions by senior managers. Beyer et al (1997) note that mechanistic control as opposed to organic ideology of the process is required for the fast implementation of TQM.

6.5.8 Employee Empowerment Construct

The major scores for this construct have been highlighted in the early part of the chapter. From the ranking point of view there were no significant differences between both types of the organisations who ranked it 8^{th}. Dainty et al (2002) suggested empowerment and related teamwork concepts be evaluated at two interrelated levels at individual employee empowerment and organizational empowerment and teamwork within the project supply chain. Motwani (2001) advocated specific measures of employee empowerment to include the extent of employee interaction with customers and the extent to which employee suggestion systems are being used. The importance of employee empowerment or involvement is further highlighted by Brah et al (2002) who posits that empowerment improves worker satisfaction and quality of work life, which improves the workers productivity. Mehra et al (2001) contend that empowerment gives a sense of "ownership" which is also a critical element found in literature. Bergman and Klefsjo (1994) citied by Nilsson et al (2001) argue that one of the main conditions for successful quality practices is to engage everyone in the improvement process. In order to understand the concept of empowerment, one has to know what empowerment actually means. Conger and Kanungo (1987) define empowerment as a

'process of enhancing feelings of self-efficacy among organization's members through the identification of conditions that foster powerlessness and through their removal by both formal organizational practices and informal techniques of providing efficacy information'.

In order to address the issues of empowerment in general, Cassell et al (2001) suggest that the larger customer may demand that the SME meet certain criteria for Human Resources (HR) standards, in order to achieve "favoured supplier" status. In their studies wide-ranging employee development, empowerment, and de-centralised decision making were identified as one of the HR practices under the generic function of development. In summary, even though the comparison is between organisations within the same industry, Huq and Stolen (1998) found that the service industry still lags behind the manufacturing industry in terms of empowering its workers. Scarnati and Scarnati (2002), observed that empowerment provides significant advantages throughout the organisation such as making people feel vital to the success of the organisation and it places people at the centre of the circle than on the fringes. Finally it builds commitment and a sense of belonging.

6.5.9 Zero Defects Construct

This dimension or construct deals with organisations having an announced goal of zero defects, a programme for continuous reduction and a plan to reduce rework. The survey results indicate that even though the average score for TQM deploying (mean = 3.43) with a medium value for the coefficient of variation (CV = 43.61), while the non-TQM had the following (mean = 2.92) and a slightly lower variation (CV=39.97), there was no significant difference between both types of organisations. This is evident from their ranking of importance, TQM deploying ranked the zero defect constructs 3rd out of 10, whereas their Non-TQM counterparts ranked it 4th. The conclusions to be drawn are that regardless of whether constructional related organisations have a formal TQM program, they do have some formal programs and plans in place. What needs to be explored is whether those plans do materialise into action.

6.5.10 Measurement Construct

The measurement dimension had four variables ranging from the measurement of quality in all performance areas, the usage of charts and graphs to monitor performance, usage of appropriate statistical methods and the fourth variable was the training of employees in statistical principles with the following mean values of 3.6, 3.25, 2.75 and 2.5 and standard deviation values of 1.465, 1.372, 1.482 and 1.538 respectively. On the question of employee training in statistical methods for measuring and improving quality, some respondents had no inclination of what statistical methods meant. Taylor and Convey (1993) believe there are three key rules essential to successful performance measurement systems: identify critical success factors, linking performance measurement to critical success factors and only measuring factors that can be controlled.

These findings are consistent with Kanji and Asher (1996) who acknowledge that there are several reasons for this rare use of statistical methods in SMEs. According to their findings, management in small companies generally do not have the sufficient theoretical knowledge to see the potential of using statistical tools. It is further interesting to note that these findings relate to the manufacturing environment which is renowned for its application of statistical process control. It can then be argued that the findings of this study are therefore consistent with the literature and research pertaining to the lack of usage of statistical tools among constructional related Sme's. Measurement is necessary to conduct against a series of indicators, both internal and external (Tsang and Antony, 2001). Even recent studies as shown by Rungasamy et al (2002) who identified the critical success factors for SPC within UK SMEs found among other reasons for its non applicability:

- time constraints,
- not culturally ready for SPC,
- management decision, not aware of SPC for short run and
- lack of awareness of the benefits of SPC.

Again it is interesting to note that these studies were among the manufacturing environment.

6.6 Correlation Matrix

As shown in the data analysis map in Fig 6.1, having presented the descriptive statistics in section 6.4 and its discussion in section 6.5, the next step in the micro level analysis is the presentation of the correlation analysis. The following sub sections 6.6.1 through 6.6.10 presents the results and discussion of the correlation analysis. The correlation coefficient is defined as "a numerical measure of the degree of agreement between two sets of scores". The correlation matrix for each individual construct is included to demonstrate that the convergent validity is achieved through the high correlation between variables.

The Table D16 in Appendix D show correlation between different variables and the level of significance (p).

6.6.1 Executive Commitment

The variables for the executive commitment are well assigned as indicated by the high correlations among themselves with a highest correlation coefficient is 0.8681 between variable 1 and variable 2. Therefore it can be concluded that the relationship between 'a top executive decision to commit fully to a quality program' and 'a top executive actively championing the quality program' is highly correlated. It is suggested that organisations that are fully committed to a quality program are able to champion or highlight their quality program ($r=0.8681$, $p<0.01$) and communicate to the employees ($r=0.743$, $p<0.01$). The three variables equally had a high correlation with other variables. The results indicate that organisations that were fully committed to the quality program were able to reflect and adopt the quality principles in their mission and vision statements ($r=0.806$, $p<0.01$). In addition they have an overall theme based on a quality program ($r=0.774$, $p<0.01$) and have an open, trusting organisational culture ($r=0.457$, $p<0.01$), with less bureaucracy ($r=0.493$, $p<0.01$) and use of empowered work teams ($r=0.388$, $p<0.01$)

6.6.2 Adopting the Quality Philosophy

The UK Construction related SMEs generally felt the need for the Quality Principles to be included in their mission and vision statement. This should be strongly associated with the overall theme based on the Quality program ($r = 0.744$). However, no significant relationship with entering a European Foundation for Quality Management Excellence Model Award Competition ($r=-0.003$). Similarly the relationship between having an overall theme based on the Quality Program and the EFQM EM was weak ($r=0.1260$).

6.6.3 Customer Focus

The direct personal contacts with Customer correlated highly with the other three variables in the Customer Focus constructs. The highest being actively seeking customer inputs to determine requirements ($r=0.8457$), followed by using customer requirements as a basis for quality ($r=0.7140$), and the least was involving customers in product or service design (r=0.5392). As observed from the Table D16 (Appendix D), the correlations were in the range 0.5392 to .8457 which was quite high. The patterns of the correlation suggest that for UK Construction related SMEs adopting a customer orientation approach to gain market advantage must focus on increasing their personal contacts with customers in order to seek and use the customer's requirements effectively. The lowest correlation obtained for involving customers in product design is hardly surprising due to the nature of the Construction Industry. Any changes to the requirements during the Construction phase would constitute variation.

6.6.4 Supplier Focus

As indicated in the data analysis map in Figure 6.1, one of the preliminary analyses involved the correlation analysis. The results of the correlation among the variables of the Supplier Focu Construct are presented in Table D16 and the following is a discussion of the results. As stated in the literature review, generally the supply chain management is poorly adopted within the Construction Industry. The correlations between the Supplier Focus Construct ranged from 0.4204 to 0.6990 with the highest between requiring the suppliers to meet stricter quality specifications and requiring them to adopt a quality program (r = .0.6990). The notion of working more closely with suppliers that should lead them to adopting a quality program was low (r = 0.4204). However the association was moderate when the relationship between working more closely with suppliers would lead to requiring them to meet stricter quality specifications.
(r=0.5222).

6.6.5 Training

An interesting observation in Table D16 (Appendix D) is that the significant correlation coefficient between the management training in quality principles and employee training in quality principles (r = 0.8614) is the highest. This suggests that UK Construction-related SMEs cannot afford to ignore either training of Management and Employees in quality principles.

6.6.6 Benchmarking

The correlations between the Benchmarking Construct ranged from 0.6434 to 0.8145 with the highest between researching best practice of other organisations and visiting other organisations to investigate best practices first hand. (r = .0.8145). All the correlations were above the 0.5 mark indicating the importance of all the variables.

6.6.7 Open Organisation

The correlations between the Open organisation Construct ranged from 0.8084 to 0.8308 with the highest between having less bureaucracy and use of empowered work teams (r = 0.8303). All the correlations were above the 0.8 mark indicating the importance of the entire variable. Furthermore, the Open Organisation exhibited a higher relationship among the variables. This finding is significant as it supports the study by Greasley et al (2003) who recognised teamwork and leadership as the key components of effective empowerment.

6.6.8 Employee Empowerment

The correlations between the Employee Empowerment Construct ranged from 0.6935 to 0.8208 with the highest between increased employee autonomy in decision making and the increased employee interaction with customer and suppliers. (r = 0.8208). All the correlations were above the 0.6 mark indicating medium and high ranges of interaction among the variables.

6.6.9 Zero Defects

The highest correlation among the variables of the Zero Defects construct was between having a program for continuous reduction in defects and a plan to drastically reduce rework ($r = 0.7930$). The lowest in the medium range was that between an announced goal of zero-defects and a plan to drastically reduce rework ($r = 0.5270$). Therefore management must be committed to communicating the goal of quality and zero defects for the plans to work effectively.

6.6.10 Measurement

The strength of the relationships among the variables were all high expect the medium one ($r = 0.479$) between measurement of quality performance in all areas (variable 31) and employee training in statistical methods for measuring and improving quality (variable 34)

6.7 Descriptive Statistics of the Advocated Benefits

This sub section presents the findings of the benefits gained through the Implementation of TQM. As highlighted in the flow chart in Figure 6.1, this leads on from sub section 6.6 which presented the descriptive statistics of the critical success factors.

The advocated benefits of TQM were investigated by the questionnaire in part three. Questions 12 to 18 explored whether the implementation of TQM had provided the TQM deploying organisations with a sustainable competitive advantage and the respondents answers are shown in Fig 6.41. The illustration is indicated by the percentage of respondents that stated whether they had received the full potential of these benefits.

The data analysis methods used in this subsection are basic statistics at the macro level where the frequency distribution is reported and correlation analysis using the chi-square tests was undertaken. The Pearson's R and Spearman's correlation are also reported.

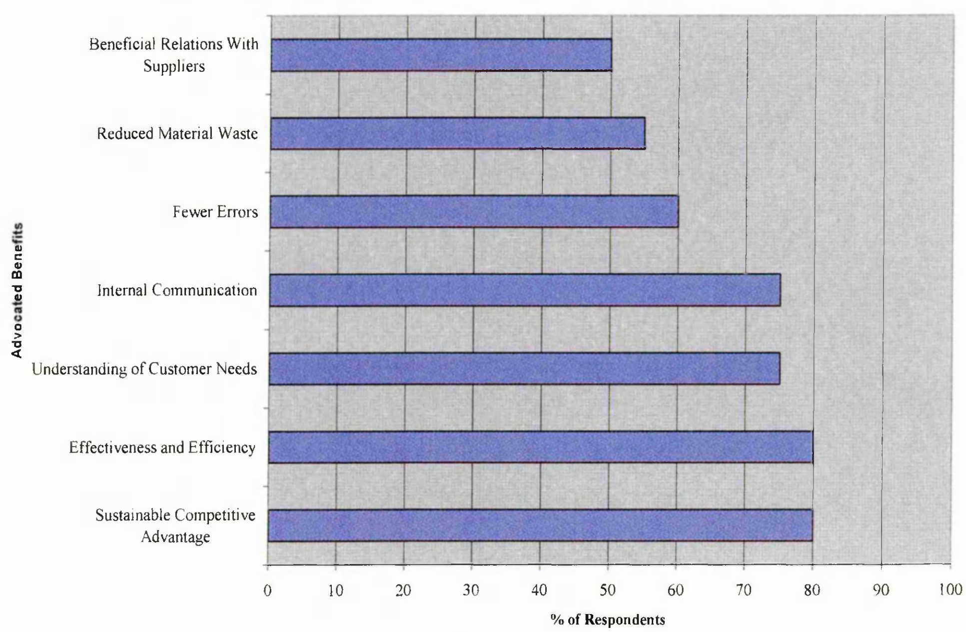


Figure 6.41: Advocated benefits of TQM identified by respondents

A cross tabulation was performed on the business activity and implementing TQM. The major objective of this was to establish who among the respondents by their business activities had actually implemented TQM. The results of cross tabulation of implementing TQM and business activities indicates that in terms of frequency, the majority were Main Contractors (17 in number or 85%), followed by 2 Sub-Contractors (10%) and 1 Management Contractor (5%).

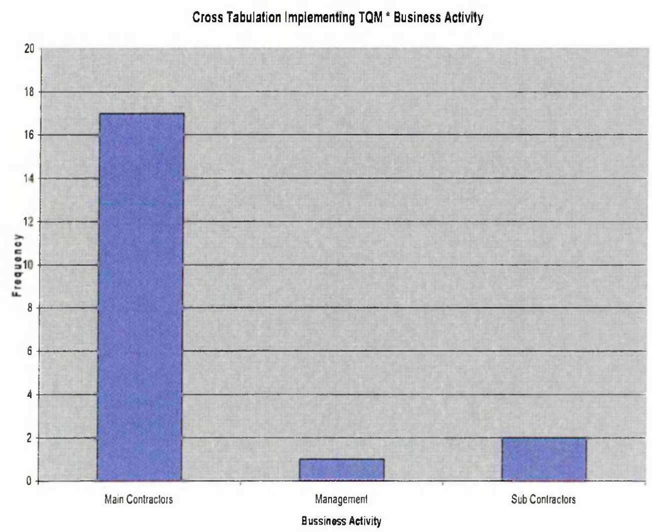


Figure 6.42: Cross Tabulation of TQM and Business Activity

The majority of the respondents (80.0 per cent) agreed that TQM provided a sustainable competitive advantage, whilst a minority (15 %) felt that it did not provide that advantage. Similar findings were in terms of improving the effectiveness and efficiency of the organisations with the majority (80.0 %) agreeing and the minority (20 %) disagreeing. On the question of improvement in understanding of customer requirements and improved internal communication, the two drew similar results with 75 % agreeing and 25 % not achieving the benefits.

6.7.1 Discussion of Advocated Advantages associated with the Implementation of TQM

6.7.1.1 Sustainable Competitive Advantage

This benefit had the highest (80%) number of respondents clearly indicating that TQM does lead to achieving a sustainable competitive advantage. Chapter Four explored the merits of competitive advantage. As argued by Reed et al (1996), through the concept of "Customer Focus", increased revenues can arise from establishing market advantage, which is dependent on being market driven. This is described as responding to customer needs and competitor offering, the latter through benchmarking. The evidence presented suggests that through the implementation of TQM, Contractors and others involved in the process can achieve the desired sustainable competitive advantage. However caution must be exercised as the UK construction related SMEs must be aware of the sources of advantage such as superior skills, superior resources and superior controls. Furthermore, Organisations should be aware that the sources of competitive advantage only are those that meet the stringent conditions of value, rareness, immobility, and barriers to imitation (Fahy, 1996). The majority (75%) of the main contractors reported improved sustainable competitive advantage, while the minority (10%), didn't have any benefits. This finding is consistent with Powell (1995) who showed that TQM adopting firms obtained competitive advantage over firms that did not adopt TQM. This is also supported by Tsang and Antony (2002) who found the application of TQM resulted in improving customer satisfaction which also resulted in increased competitive advantage.

6.7.1.2 Effectiveness and Efficiency

The majority of the respondents (70%) who reported that the effectiveness and efficiency was improved were main contractors (n=14), with the remaining 5% contractors, (n=1) and suppliers (n=1). The remaining 15% who reported no benefits were main contractors (n=3) and 5% of the suppliers (n=1).

The effectiveness and efficiency relates to the reduction of costs and increased revenues. In order to illustrate the difference between different terms used in the context of Process Management and Benchmarking. Figure 6.43 provides an illustration of the terms effectiveness and efficiency.

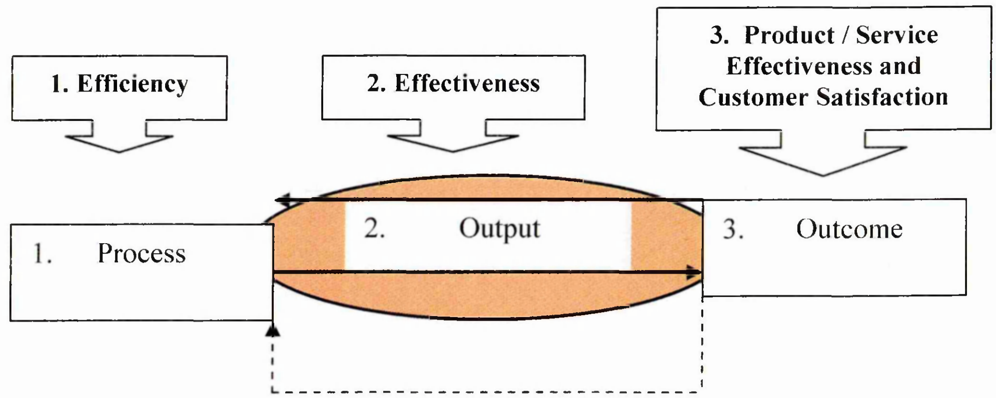


Figure 6.43 Three Types of Measure for a Process
(Adapted from Pupius, 2003)

1. Efficiency can be described as the resources consumed in the process relative to minimum possible levels.
2. Ability of a process to deliver products or services according to specifications
3. Outcome or Product / Service effectiveness and Customer Satisfaction can be described as the ability of outputs to satisfy the needs of customers.

One of the terms of reference in the Egan Report (1998 and 2002) was to improve the effectiveness and efficiency of the Industry. The majority of the respondents (80%) considered the implementation of TQM led to that improvement. This is supported by Rust et al (1994) citied in Raju and Lonial (2002) who observed that quality affects the financial performance of organisations in two different ways. Firstly it affects profitability by reducing costs and secondly improves customer loyalty and helps to attract new customers. This approach can be found in the seminal work of Reed et al (1996) as discussed in Chapter Four. The work hinges on organisations being either customer oriented or process oriented. Lemak and Reed (2000:71) defined the TQM component of process efficiency as simply the ability to reduce process cost and identified the concept of continuous improvement as the main tool for improving efficiency.

Due to temporal issues which affect the time lag studies, Chi squared statistics were carried out on the effectiveness and efficiency results in regard to the time of application and level of improvement. Although not significant (χ^2=1.434, df = 2, p = 0.488) cross tabulations show that those UK Constructional related SMEs who had implemented TQM for more (less) than three years (n=10) felt that the effectiveness and efficiency had improved. Thus the results indicate that TQM is an effective technique for improving efficiency over time. Pearson R analysis produced a strong correlation, (R = 0.229), and was supported by a high Spearman correlation (Rho = .157) and the linear by linear of 0.993 (df =2).

6.7.1.3 Understanding of Customer Needs

Customer focus is one of the key concepts upon which TQM is built. Tsang and Antony (2002) ranked "customer focus" first in order of importance. The statistical analysis in the comparison between the Experienced and Less Experienced UK TQM deploying organisations also rated Customer Focus as the most important construct.

6.7.1.4 Internal Communication

As observed by the European Construction Institute (The ECI, 1996), effective communication must be up, down and across the project organisation. Furthermore, it was regarded as one of the key concepts for Total Quality to succeed. Therefore the results obtained in this study are encouraging as the majority (80%) of the TQM deploying organisations felt that the implementation of the program actually lead to improved communication. Juran's (1988) triple role concept that was explored and examined in Chapter Five (Figure 5.8) clearly identified how the client, designer and constructor would benefit carrying out the three roles of the customer, processor and supplier.

6.7.1.5 Fewer Errors

One of the major problems facing the industry is the amount of rework attributed to the errors made in the client's requirements, design or the actual process of construction. Chapter Three presented the statistics which attributed 60% of the failures and faults in the Construction Industry to the Construction phase of the process, therefore the fact that 60% of the respondents felt TQM resulted in fewer errors must be encouraging for UK Constructional related SMEs in pursuing the TQM Implementation. The construct of Zero Defects used in this study would contribute to the aspirations and scope for sustained improvement as envisaged in the Egan (1998) report where a reduction by 20% of defects on handover per year was being seen as a positive indicator. In particular the variables in the Zero Defects construct as used in this study included principles such as an announced goal of zero-defects, a program for continuous reduction in defects and a plan to drastically reduce rework. All these being in line with Egan's (1998 and 2002) scope for sustained improvement. The majority of the respondents who reported this benefit were the Main Contractors (n=10, 50%), Management (n=1, 10%), and Sub-Contractors (n=1, 10%). Conversely 25 % of the Main Contractors (n=7) and 10% of the Sub-Contractors didn't achieve the reduction in fewer errors

6.7.1.6 Material Waste

Although the literature review suggests that implementation of TQM does result in fewer errors and material waste, it could result in stronger and more beneficial relationships with suppliers. The findings of this study are equally consistent with that. On the issue of reduced material waste, there was little difference with 55 % agreeing and the rest (45 %) disagreeing. Other studies (such as Mann and Kehoes, 1994; Terziovski and Samson, 1999; and Zhang, 2000) have shown that TQM provides benefits such as waste reduction. In a study by Lee (2004) within the small manufacturers in China, one of the most significant benefits expected from TQM implementation was reduced waste.

6.7.1.7 Beneficial Relations with Suppliers

In terms of stronger and more beneficial relationships with suppliers, the results were equally split (50 % agreeing and 50 % disagreeing). The concept of Supply Chain Management is still novel within the Construction Industry. Despite Egan's (1998) views that the supply chain is critical to driving innovation and to sustaining incremental and sustained improvement in performance, 50% of respondents could not appreciate the full benefits. This is supported by Holit et al (2000) who note that long-term supply chain arrangements are still rare in Construction. In order to ascertain if there were any differences between the respondents since the majority 55 (87.30%) were contractors and minority 2 (3.175%) were suppliers, a one way ANOVA procedure was conducted. As suppliers are included in the construction process chain, closer relationships with the contractor would benefit both parties. This would entail replacing the usual adversarial relationships with co-operative agreements, and the project costs would be reduced (ECI, 1996:209). In the study by The European Construction Institute, this concept of closer relationships with the suppliers, customers and contractors was termed as "Alliancing". Establishing supplier relationships have a profound effect on the outcome of the project as the performance of the whole supply chain impacts not only contract profitability for all parties, but also how the completed building meets the client's justifiable expectations of cost, quality and functionality (Holti et al, 2000). According to Barlow and Jashapara (1998), Supplier collaboration through "partnering" plays an important role in promoting innovation and learning at an individual, team and organisational level.

6.7.2 Summary

Generally there is disagreement as to whether the Implementation of TQM can result in reduced material waste, in fewer errors and produce stronger and more beneficial relationships with suppliers. These findings are consistent with the literature review. However, despite the statistics obtained in this study, the benefits of implementing TQM has a positive contribution in improving internal communication, achieving sustainable competitive advantage, understanding of customer needs and most importantly, improving the effectiveness and efficiency of the industry.

The findings of this sub section relating to the advocated benefits are consistent with literature. This found that TQM provided benefits in internal efficiency measures, such as waste reduction, lowered costs of quality or improvement in time and operations of the process, and also benefits in the external relationships of the organisations: customer satisfaction and supplier satisfaction (Escrig-Tena, 2004: 629)

The implication of the finding as illustrated in Chapter Three is that suppliers contribute to approximately 10% of the failures and faults in the Construction Industry which calls for the integration of the suppliers in the process, either by including them through "working more closely" or requiring suppliers to meet quality specifications. Furthermore, according to Holti et al (2000), the products and services provided by the companies in the supply chain typically account for over 80% of the total cost of construction projects. The need for supplier relationships is raised by various authors such as Ghobadian and Gallear (1996) who identified that Small and Medium sized enterprises (SMEs) were often suppliers of goods and services to larger organisations, therefore in order to remain competitive, they would have to consider the application of TQM due to the increasing demand for higher quality from the larger organisations.

The theoretical background on the issue of time-lag is included in this section when ascertaining the time of implementation to the advocated benefits. Though descriptive statistics such as correlation and cross tabulations, the TQM deploying organisations were divided into Experienced and Less Experienced in relations to how long the TQM programme had been in place. Furthermore, statistics such as the Chi-square differences in the reporting of the advocated benefits were examined. Though competitive advantage had been decomposed into the four TQM content components as illustrated in Chapter Three, Reed et al (1996) recommends a dual standard in order to achieve sustainable competitive advantage. That is by keeping closer to the customer, and ahead of the competition. Evidence of competitive advantage should manifest itself through increased profitability. Therefore the findings of the TQM success (BOPI) are correlated with the benefits and the Experienced and Less Experienced TQM Deploying Constructional related SMEs.

6.8 Descriptive Statistics and Macro Level Analysis of TQM Measurement of Success and Organisation Performance

The assessment of TQM measurement and organisation performance is discussed in the following sub section. Drawing heavily on Brah et al (2002), the TQM performance was split into primary and secondary measures. The definition of the primary measurement was that they follow directly from the actions taken during TQM implementation. Whereas the definition of secondary measures were business and financial performances as they were a consequence of the implementation of TQM. Both the secondary and primary measures were subjected to Analysis of Variance (ANOVA), Cronbach alpha (α) coefficient reliability tests and the computation of the correlation matrix. Following on from the Data Analysis Map in Figure 6.1, this sub section is structured as follows, first the results at the macro level are presents, and these include the descriptive statistics, correlation matrix and the internal consistency.

The correlation matrix is employed to test hypothesis which postulates significant positive or negative relations between two variables (Forza, 2002). This can be determined using Spearman's rank order, Kendall's rank order correlation (tau) or Kendall's coefficient of concordance (w). The method is used for each stated business and organisation performance indicator. Prior to calculating the correlation coefficient, the data was screened for outliers which can cause misleading results. The Kolmogorov-Smirnov 'z' was calculated from the data and showed that the test distribution was normal. Having established the discovery stage of the financial performance measures, the next step was the micro-level analysis which employs various fine grained methods such as Structural Equation Modelling (SEM), MANOVA, Hierarchical Moderated Regression, and ANOVA. Due to the small number of performance scales, the approach undertaken was to examine each performance measure under the micro and macro level analysis separately.

The following sub section presents a brief discussion of the operational measures.

6.8.1 Operational Measures for TQM and the Business and Organisational Performance (BOPI)

The business and organisation performance measure was designed to capture the potential benefits of implementing TQM for the UK Construction related SMEs. The average responses for the dimension was taken as the overall performance measurement. For example, the financial performance had five items and the performance score was calculated by averaging the five items. Because the various dimensions did not have a common underlying meaning, the performance index was treated as a formative scale.

The four organisation and business performance constructs, financial performance, employee relations, customer satisfaction and operating indicators had each item measured by summing up the score, shown as total score in Figure 6.48. This procedure gave higher scores to performance indicators where the respondents agreed. For example, of the financial performance construct in Figure 6.44, internal and external efficiency item had the highest score of 70. Given the mode of data analysis described in sections 6.8 and 6.8.1, the following sub sections present the results of the descriptive statistics.

6.8.2 Financial Performance Indicators

The results of the descriptive statistics are summarised in Table E22 (Appendix E). For each business and organisation performance indicator, the table provides the overall mean, standard deviation and variance.

6.8.2.1 Descriptive Statistics

The TQM deploying organisations indicated a mean overall of 15.10, with a median of 16.0, and a mode of 15.0. The standard deviation was 7.093 and a high variance of 50.3053 indicating that the organisations were not converging in terms of their overall financial indicators performance. Two of the organisations obtained the possible highest overall financial performance score of 25. The overall sum of scores was 302 out of a possible highest sum of 500. This is 60.40 % indicating that TQM deploying organisations have achieved the benefits in terms of Market Share, Sales per Employee, Return on Assets, Internal and External Efficiency and Return on Sales and Profitability. Based on the mean values and computed scores, the items representing the financial indicators are shown graphically in Figure 6.44.

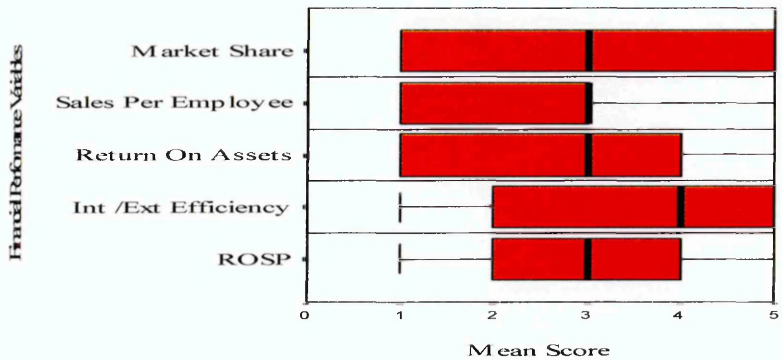


Figure 6.44 Box and Whisker Plots showing variation of the mean scores for the Financial Performance Variables

Examination of the box and whisker plot for the financial performance variable indicates no outliers, that is the data points (mean scores) were all within the main body and tails.

6.8.2.2 Correlation Matrix

A correlation matrix between the financial performance indicators and its components is shown in Table E16, Appendix E. The items in the financial performance scale were highly correlated with each other thus demonstrating discriminant validity. The correlation coefficient ranges from -1 to + 1, with -1 indicating strongly negatively correlated and + 1, strong positive correlation. The highest correlation was between market share and sales per employee ($r = 0.8788$, $p < 0.01$), implying that an increase in sales per employee leads to a high market share. The lowest correlation ($r = 0.6932$) was between the internal and external efficiency variable with market share. The implication drawn is that a reduction in the internal and external efficiency of the employees or organisation for that matter would have a significant impact on the overall market share. The other correlations were all positive and are hypothesised in literature. For example sales per employee is high correlated to the return on assets (r = 0.8592) and that market share is also linked to the return on assets (r = 0.8356).

6.8.2.3 Internal Consistency

The financial performance indicators were subjected to the internal consistency analysis and the 5 items representing the financial performance indicator scale generated a high reliability coefficient (α = 0.9495) with an acceptable coefficient of concordance (W = 0.0261). The Cronbach value was greater than 0.7 which is the recommended cut off value by Nunnally (1978), therefore indicating a high internal consistency in the financial performance measure.

6.8.2.4 ANOVA

The performance measurement of TQM was subjected to ANOVA. This enabled the study to clarify whether or not the opinions of the different Quality Managers were the same for a variety of issues. Table 6.18 shows the "F-Statistic" which is based on the F-ratio or value which tests the null hypothesis that all groups have the same mean. Apart from the financial indicator which had F ratio of 3.029, the remaining indicators for the employee relations, customer satisfaction and operating indicators were 2.3004, 1.1325 and 2.8705 respectively which were > 0.05

6.8.3 Employee Relations Indicators

6.8.3.1 Descriptive Statistics

The employee relations indicator had an overall mean of 9.40, a median of 9.0, and a mode of 8.0. The standard deviation was 4.40 indicating that the organisations were not converging in terms of their overall financial indicators performance. None of the organisations obtained the possible highest overall employee relations score of 20. The highest score obtained was 16.0 and this was achieved by two organisations. The overall sum of scores was 188 out of a possible highest sum of 300. This is 62.66 % indicating that TQM deploying organisations have achieved the benefits in terms of employee satisfaction, attendance, number of useful suggestions and employee turnover. Based on the mean values and computed scores, the items representing the employee relations were ranked and Figure 6.45 shows the individual item's scores and their performance indices.

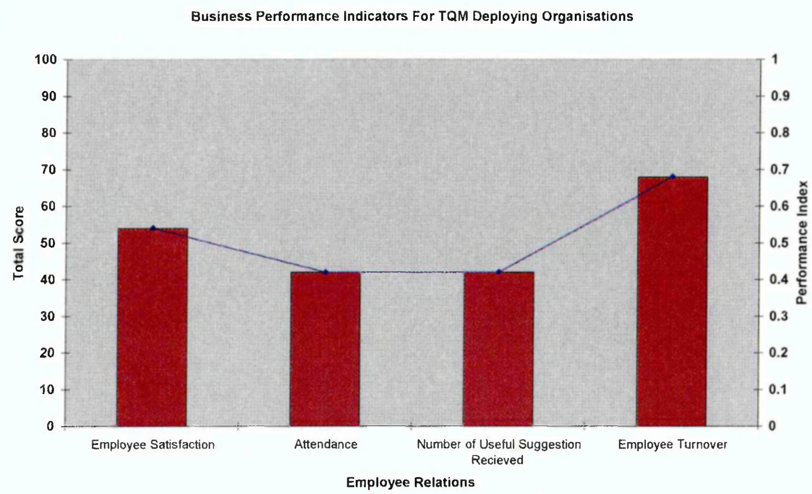


Figure 6.45: Item Score for the Employee Relations Indicator

6.8.3.2 Correlation

The variables for the employee relations were well assigned as indicated by the high correlations (Appendix E Table E16) among themselves. It was further observed that the highest correlation coefficient was 0.728 which represents the relationship between employee relations 1 and 4. It was hardly surprising that this was between 'employee satisfaction' and 'employee turnover' ($r = 0.728$, $p < 0.01$). The lowest correlation was between employee satisfaction and attendance ($r = 0.474$, $p = 0.035$), implying that a demoralised workforce leads to low attendance by employees. Another conclusion to be drawn from the correlation matrix was that when organisations take heed of the useful suggestions received, there is an increase in employee turnover (r =

0.611, $p < 0.01$), better attendance ($r = .535$, $p = 0.015$, $p < 0.05$). It could be seen that that employee satisfaction was highly correlated to attendance ($r = 0.599$)).

6.8.3.3 Internal Consistency

The reliability analysis of employee relation's indicator can be found in table E11 (appendix E). The reliability coefficient of 4 items was very high ($\alpha = .8388$) with an overall high standardised item alpha ($\alpha = .8389$). The high alpha indicates that the employee relations scale was reliable. The standardised item alpha coefficients are presented to ensure that high alpha scores are not obtained simply as a result of a large number of items (Jashapara, 2003)

6.8.3.4 ANOVA

Cochran's Q is a non parametric test of hypothesis that several related dichotomous variables have the same mean. From the Friedman ANOVA test, Kendall's coefficient of concordance was W = 0.0361and the p value was 0.0724. A Cochran – Q test revealed that certain benefits of Employee Relations are less frequent than others, Q (df =3) = 1.408, (p =0.240230 > 0.000). Table F28 in Appendix F presents the degrees of freedom (df), F ratio mean square and the $\chi^2 = (1.4089)$. It was evident that these were narrowly achieved by TQM deploying organisations.

6.8.4 Customer Satisfaction

6.8.4.1 Descriptive Statistics

Customer satisfaction had an overall mean of 9.60, a median of 9.0, and a mode of 11.0. The standard deviation was 4.635 indicating that the organisations were widely spread in terms of their overall customer satisfaction indicators. None of the organisations obtained the possible highest overall employee relations score of 15. The highest score (192) out of a possible 300 obtained was achieved by six organisations. This is 64.00 %

indicating that TQM deploying organisations have achieved the benefits in terms of overall satisfaction, customer complaints and customer retention. Based on the mean values and computed scores, the items representing customer satisfaction were ranked and Table E14 in Appendix E shows the individual items scores and their rankings. The above findings indicate that the implementation of TQM does lead to customer satisfaction which is consistent with the findings in the literature.

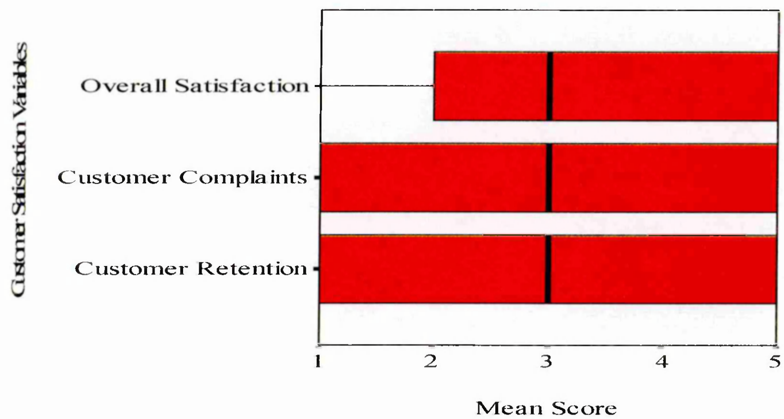


Figure 6.46: Box and Whisker Plots showing variation of the mean scores for the Customer Satisfaction Variables

Given the descriptive statistics presented in this sub section 6.8.4.1, the following section and the results in Table E22 (Appendix E) examines the correlations for the customer satisfaction indicator.

6.8.4.2 Correlation

The results of the correlation analysis for the Customer Satisfaction indicator are shown in the Appendix E, Table E16. All the correlations were highly significant ($p > 0.01$) and based on the Kendall's tau-b. The highest correlation was between customer satisfaction and customer retention (r = 0.870), whereas the least correlation was from customer complaints and customer retention (r = 0654). The customer satisfaction and complaints was (r = 0.809)

6.8.4.3 Internal Consistency

The reliability analysis of customer satisfaction indicator can be found in Table E11 (appendix E). The reliability coefficient of the 3 items was an alpha of 0.9261 and standardised item alpha of 0 .9260

6.8.4.4 ANOVA

Cochran's Q is a non parametric test of hypothesis that several related dichotomous variables have the same mean. From the Friedman ANOVA test, the Kendall's coefficient of concordance was W = 0.0291 and the *p* value is 0.0724. A Cochran – *Q* test revealed that certain benefits of customer satisfaction are less frequent than others, Q (df =2) = 2.25, (p =0.3247 > 0.000). Table F30 in Appendix F presents the degrees of freedom, F ratio, mean square and the χ^2 =(2.25) it was evident that these were narrowly achieved by TQM deploying organisations.

6.8.5 Operating Indicators

6.8.5.1 Descriptive Statistics

The operating indicators in terms of reliability, timeliness of delivery and product lead time had a mean overall of 7.50, with a median of 9.0, and a mode of 11.0. The standard deviation was 4.0458 with a variance of 16.368 indicating that the organisations were widely spread in terms of their overall operating indicators. The highest score obtained was 15.0 and this was achieved by two organisations. The overall sum of scores was 148 out of a possible highest sum of 300. This is 49.00 % indicating that TQM deploying organisations have achieved below average in the operating indicators.

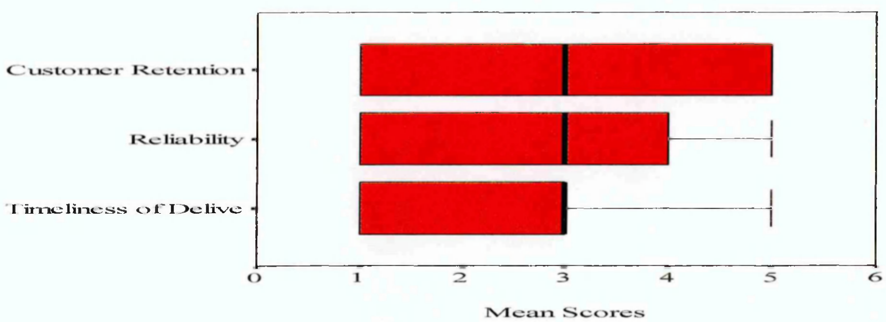


Figure 6.47 Item Score for the Operating Indicators

This could be attributed to the vagueness in the statement 'timeliness of delivery', as it could have a number of meanings by the customer. For example, was the project completed on time? And from the supplier's point of view, the interpretation could be construed as whether the Implementation of TQM had led to the materials being delivered on time to the appropriate customers. Based on the mean values and computed scores, the items representing the customer satisfaction were ranked and Table E14 (Appendix E) shows the individual item's scores and their rankings. The above findings indicate that the implementation of TQM does lead to customer satisfaction which is consistent with the findings in literature.

6.8.5.2 Correlation Matrix

This sub section presents the results of the correlation matrix for the operating indicator. Table E16 (Appendix E) shows that the strength of the inter-relationships among the variables were high (> 0.7). Based on the high correlation between the items in the operating indicator scale, convergent discriminant is demonstrated as the value range from .7657 to .8459. The highest correlation (r = 0.8459) was between the variable, timeliness of deliver and product lead time (PLT) indicating that organisations should be able to delivery the product to the customers within reasonable time as long as there is sufficient product lead time. This is of particular importance to the suppliers as it improves the chain management where the contractors to place their orders within reasonable time.

6.8.5.3 Internal Consistency

The results of the reliability analysis of the operating indicators had a high alpha (α = 0.9140) value with a standardised item alpha of 0.9138 (Table E22, Appendix E). This was above the acceptable value of 0.7, thus indicating the operating indicator to be reliable.

6.8.5.4 ANOVA

Cochran's Q is a non parametric test of hypothesis that several related dichotomous variables have the same mean. From the Friedman ANOVA test, Kendall's coefficient of concordance was W = 0.0381and the p value is 0.0724. A Cochran – Q test revealed that certain benefits of operating indicators were less frequent than others, Q (df =2) = 1.13 (p =0.3329 > 0.000). The mean standard deviation and the χ^2 =(1.13) It was evident that these were narrowly achieved by TQM deploying organisations.

6.8.6 Summary of the Business and Organisation Performance Indicators (BOPI)

Sections 6.8.1 to 6.8.5.4 presented the descriptive statistics for the four Business and Organisation Performance Indicators (BOPI). The internal consistency analysis using Cronbach's alpha method was computed for each performance scale using the SPSS-Version 11.0 statistical package. All the four performance dimensions were found to have high reliability. Apart from the employee relation indicator (mean = 2.47) and operating indicators (mean = 2.57), the summated mean score for the remaining two scales were above average (mean =,> 3.00). These are summarised in Table E10 (Appendix E) and shown in Figure 6.48 as a box and whisker plot.

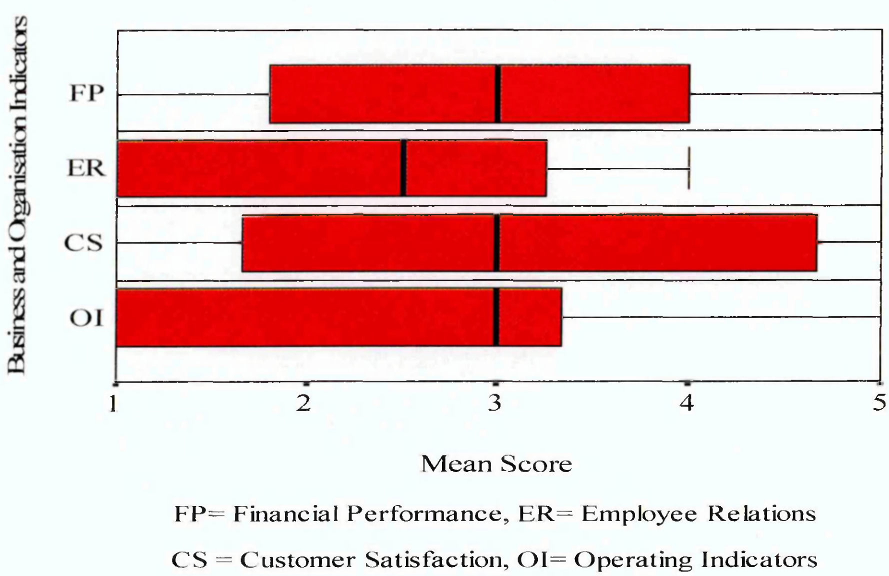


Figure 6.48 Box and whisker plot, comparing the distribution of results for the organisation performance indicators

Table 6.18: Path Analysis of TQ-SMART Model

Model			
Dependent Variable	***F***	**Probability**	
Constant	**5.0341**	**.0000**	
1. Financial Indicators	3.0290	.0225	< 0.05
2. Employee Relations	2.3004	.0869	> .0.05
3. Customer Satisfaction	1.1325	.3329	> 0.05
4. Operating Indicators	2.8705	.0690	> 0.05

These findings indicate that the null hypothesis cannot be rejected in favour of its alternative. This suggests there is a consensus between the groups (Main Contractors, Suppliers and Sub-Contractors) that implementation of TQM leads to an improvement in employee relations, customer satisfaction and operating indicators. On the other hand the null hypothesis for financial indicators can be rejected, as it suggests there is a difference of opinion among the TQM deploying respondents as to whether the implementation of TQM leads to improved market share and sales per employee. Further evidence is provided by the Friedman ANOVA test which generated Kendall's coefficient of concordance. Table F24 (Appendix F) summarises the ANOVA for the Business and Organisation Performance scale. A Cochran – Q test revealed that certain benefits of BOPI were less frequent than others, Q (df =19) = 5.03, p = 0.0266, > 0.000). The mean square (ms = 3.67) and the χ^2 = (11.00) indicating that these were narrowly achieved by TQM deploying organisations.

Table 6. 19: Inter Factor Correlations (Ψ)

Performance Indicators	FP	ER	CS	IR
FP	**1.00**			
ER	.859**	**1.00**		
CS	.945**	.864**	**1.00**	
OI	.683**	.778**	.832**	**1.00**

** Correlation is significant at the 0.01 level (2-tailed)

6.9 Descriptive Statistics of the Assessment of Competitive Environment

In order to explore the links between the business competitive environment in which the UK Construction-Related SMEs operated and the internal environment, the conceptual framework discussed in Chapter One was used. This investigated the impact of the competitive environmental factors on the implementation of TQM, and was illustrated by path E in Figure 2.3.

The external business environment is considered through the external variables as the competitive forces (Porter, 1990) and this in turn links to the field of Industrial Organisation. In order to achieve the aforementioned objective, respondents were asked to rate their organisations on the five competitive factors scale of 1 to 5 (where 5 is the most positive answer and 1 is the most negative answer). The results of the descriptive statistics are presented in Table 6.20

Table 6.20: Assessment of the Competitive Environment for TQM-Deploying (n=20) and non-TQM Organisations.

Competitive Factors (CF)	Mean Score		One Sample t
	TQM	**Non-TQM**	
CF1: The Organisation's Competitive Position[a]	4.00	3.59	23.629
CF2: The Bargaining Power of the Customers[b]	2.95	3.55	22.669
CF3: The Possibility (or threat) of New or Potential Competition[b]	2.63	3.24	20.210
CF4: The Ability to reduce Construction Uncertainties	2.79	3.32	23.530
CF5: Ability to Redefine Market Uncertainties.	2.63	2.76	20.314

Li and Ye (1999) used two frames of reference to describe the environment. Firstly, they divided the environment into different segments such as customers, competitors and governmental agencies. This according to them helped identify relevant factors in the environment. The second description of the environment was along a variety of critical characteristics. For ease of clarity, these are depicted in form of a flow chart shown in Figure 6.48-1

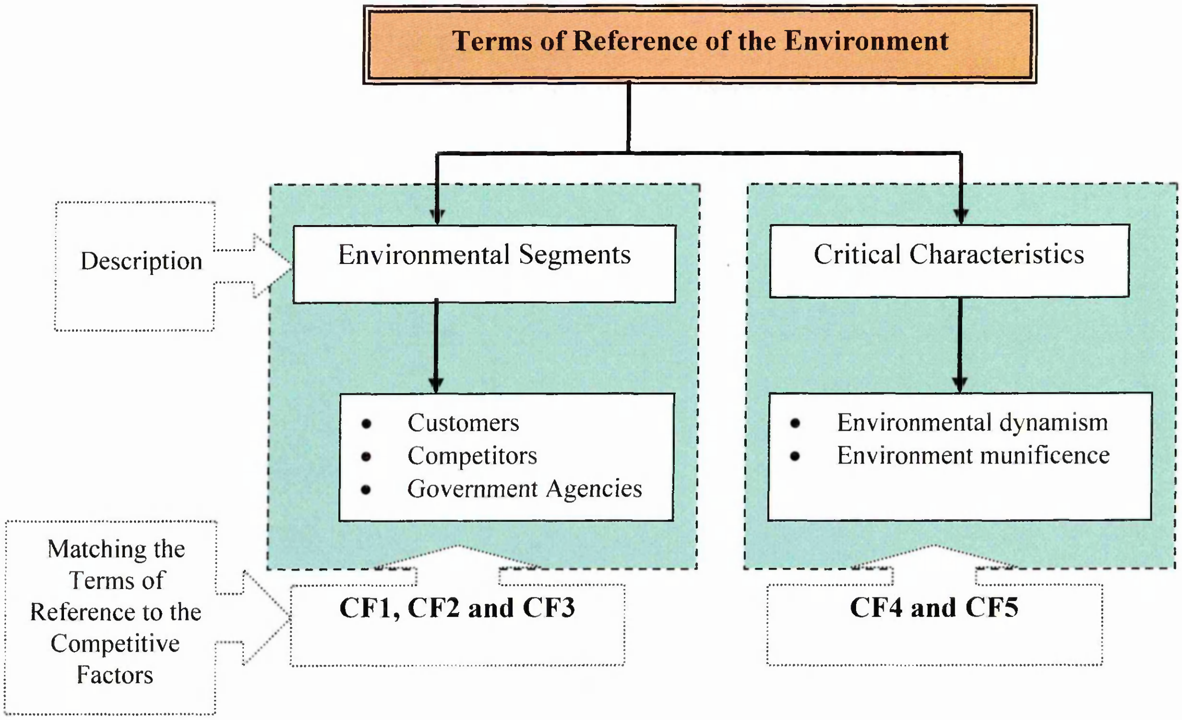


Figure 6.49: Terms of Reference of the Environment
(Source: adapted from Li and Ye, 1999)

Conceptualisation of the Environment

The environment segments helps to identify relevant factors in the environment, whereas environmental dynamism is the critical dimension of an organisation environment.

Environment dynamism involves the degree and instability of change in the firm's environment.

6.9.1 Confirmation of Environment Competitive Factors

The competitive Environment Factor Measurement instrument was subjected to structural equation modelling and yielded the following measures of fit between empirical data.

Measure	**Fit**
Chi-square $\chi^2 = 1.038$, df = 2, $p = 0.595$	Acceptable fit
χ^2 / df = 0.519	Overfit
GFI = 0.992	Acceptable fit
TLI = 1.072	Lack of Model Parsimony
RMSEA = 0.000	Acceptable fit

For the competitive factor measurement model results shown above, four of the five measures are acceptable and within range, suggesting that the data adequately fitted the model.

6.9.2 The Reliability Analysis for the Measuring Instrument

The Pearson correlation was computed for the five competitive factors and the results are shown in Table 6.21. From the analysis, the highest correlation (r =0.611) was between the competitive factor CF4 and CF5 which was significant at the 0.01 level. The ability to reduce construction uncertainties should be matched by redefining market uncertainties.

Table 6.21: Reliability Analysis for the Competitive Factors

Competitive Factors	CF1	CF2	CF3	CF4	CF5
CF1	1.000				
CF2	**.561** ** (.000)	1.000			
CF3	**.162** (.205)	**.187** (.142)	1.000		
CF4	**.282*** (.025)	**.208** (.103)	**.178** (.163)	1.000	
CF5	**.174** (.174)	**.104** (.416)	**.090** (.483)	**.611**** (.000)	1.000

** Correlation is significant at 0.01 levels (2 tailed)
* Correlation is significant at 0.05 levels (2 tailed)
( ) *p* value

The second strong correlation was found to be between the organisation's competitive position (CF1) and the bargaining power of customers (CF2). The organisation's competitive position was found to be highly correlated (r=0.561) as was the bargaining power of the customers.

The implications drawn from this result is that Organisation's competitive position affects its ability to redefine market uncertainties. There was very weak correlation (r=0.090) between the possibility (and threats) of new potential competition (CF3) and the ability to redefine market uncertainties (CF5) which was also not significant (p=0.483, >0.05). As it is relatively easy to enter the Construction Industry due to low capital requirements and the nature of sub-contracting, the UK Constructional related SMEs are encouraged to implement TQM as a safe net from any possible competition. As the TQM approach is customer focused, SMEs are bound to increase their revenues through reduced costs and improved customer satisfaction.

The competitive factors were also subjected to Discriminant Function analysis and Table 6.22 shows the Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions. The variables CF1 to CF5 are ordered by absolute size of correlation within function.

Table 6.22: Structure Matrix Standardized Weights of the 5 Competitive Factors

Competitive Force	Function 1
CF3-The possibility or threat of new or potential competition	.683
CF2-The bargaining power of your customers	.612
CF4-The ability of the organisation to reduce construction uncertainties	.599
CF5-The ability to redefine market uncertainties	.328
CF1-The competitive position of the company	.223

The hypothesis states that Industry factors or the competitive environment has an impact on the implementation of TQM. Respondents were asked to rate their organisation on the following competitive factors using a scale of 1 to 5 where 5 was the positive answer and 1 the most negative.

6.9.2.1 Inter-Relationships between the Competitive Factors

As asserted by Bennett and Smith (2002), the interrelationships between the competitive factors as important for assessment of the conditions that may favour firm performance. Table 6.21 indicates that all the correlations were significant.

6.9.3 Discussion of the Assessment of Competitive Environment Factors

Although most TQM deploying UK Construction related SMEs regard themselves as competitive (mean = 4.00 as shown in Table 6.20), they also realise the inability to reduce construction uncertainties. In general the majority of TQM deploying organisations felt the customers had little bargaining power. In order to compete within the competitive environment, most responding organisations felt they had little ability to redefine market uncertainties as it was outside their control. However it is interesting to note that SMEs, in particular TQM deploying ones, perceived the possibility or threat of new or potential competition as being low (mean = 2.63) whereas non-TQM scored this moderately medium (mean = 3.24). As global competition continues, all UK Construction related organisations must focus on the attention of its clients, as the Egan report (1998) notes. The implication to be drawn is that with TQM in place, UK Constructional related SMEs could enjoy the market advantage achieved through the customer orientation, hence through being loyal to their existing customers; they are likely to perceive the external threat from the potential newcomers as low.

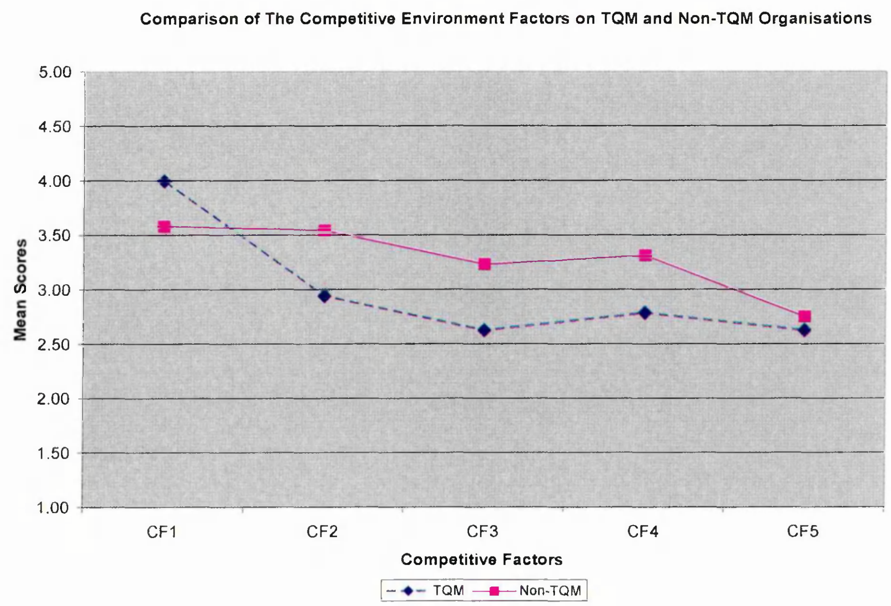


Figure 6.50: Mean Comparison of Competitive Environmental Factors

On the other hand, analysis of the competitive factors revealed that there was no significant difference between the means for the organisation's ability to redefine market uncertainties (CF 5). The competitive position (CF 1) for TQM deploying UK Construction related SMEs was higher than those of non-TQM deploying as evidenced in Fig 6.50. In contrast, the Non-TQM deploying organisations had a higher ability to reduce construction uncertainties (CF 3).

6.9.3.1 TQM and Environmental Uncertainty

According to Organisation theory literature, how firms react with their environment is important for performance. Sitkin et al (1994) argue that TQM should include two goals namely; control and learning. They draw their basis on the 'contingency theory'. They describe the goal of control as that of focussing on improving repetitive activities, whereas learning focuses on new product and process innovations. Furthermore the primary objective would be to find the perfect fit. Reed et al (1996) suggests best fit for control where uncertainty is low and concentrating on learning where uncertainty is high. One of the questions asked in this study was the ability of organisations to reduce construction uncertainties, and secondly redefining market uncertainties.

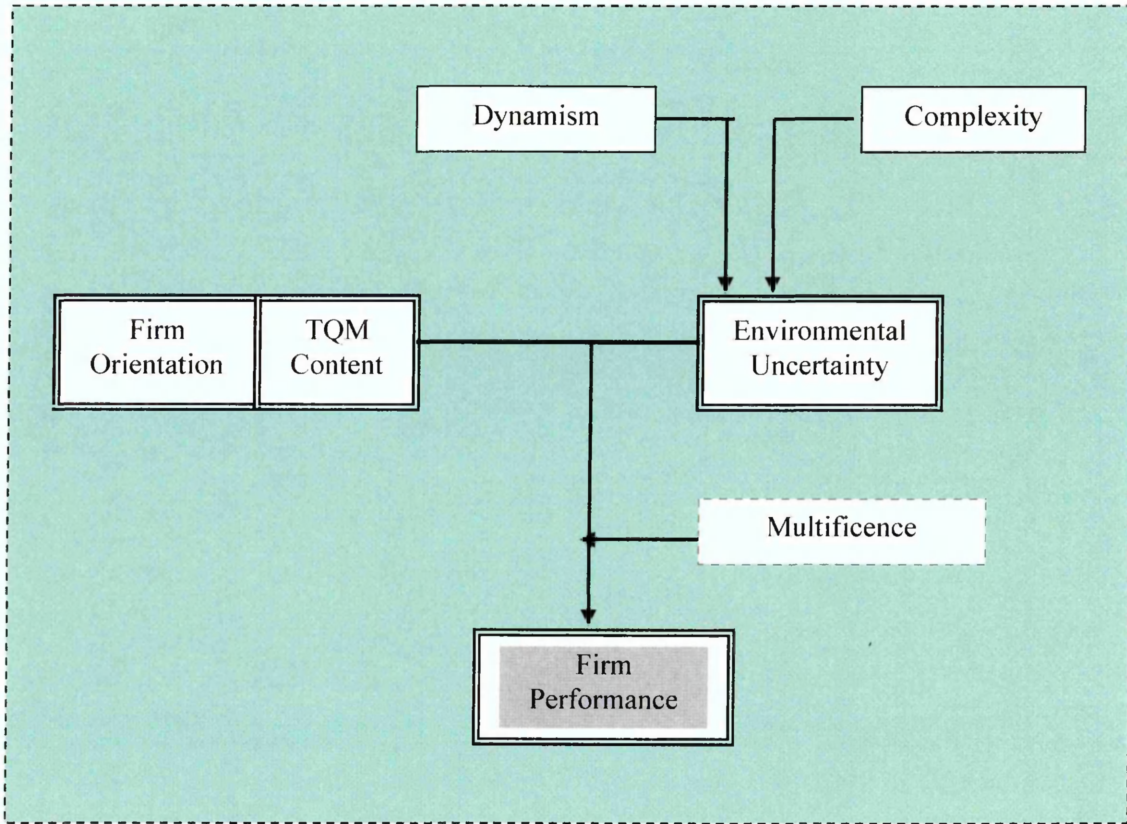


Figure 6.51 Orientation, TQM, Uncertainty, and Performance
(Source Reed et al 1996)

The work by Reed et al (1996) presents the framework of analysing the time lag effect. They argue that as opposed to critics of TQM who highlight the lack of immediate benefits, they present the valid reasons as to why benefits of TQM are far from instantaneous. The major issue being that uncertainty and firm orientation both exist on continua where both continua are un-dimensional. Uncertainty ranges between high and low and orientation ranges between Customer and Operations. The interpretation of Fig 6.52 is that for UK Construction-Related SMEs operating in high uncertainty need to focus on Customer Orientation and the concentration on learning provides the best fit and involves focussing on new products and process innovation. On the other hand, pursuing a Process Orientation is best suited in conditions of Low uncertainty and the strategy to adopt is concentrating on control in TQM which provides the most appropriate fit. The emphasis is on "doing it right the first time" i.e. zero defect mentality. According to Dooley and Flor (1998) in citing Anderson et al (1994) and Spencer (1994), TQM has both mechanistic (control) and organismic (adaptive learning) components.

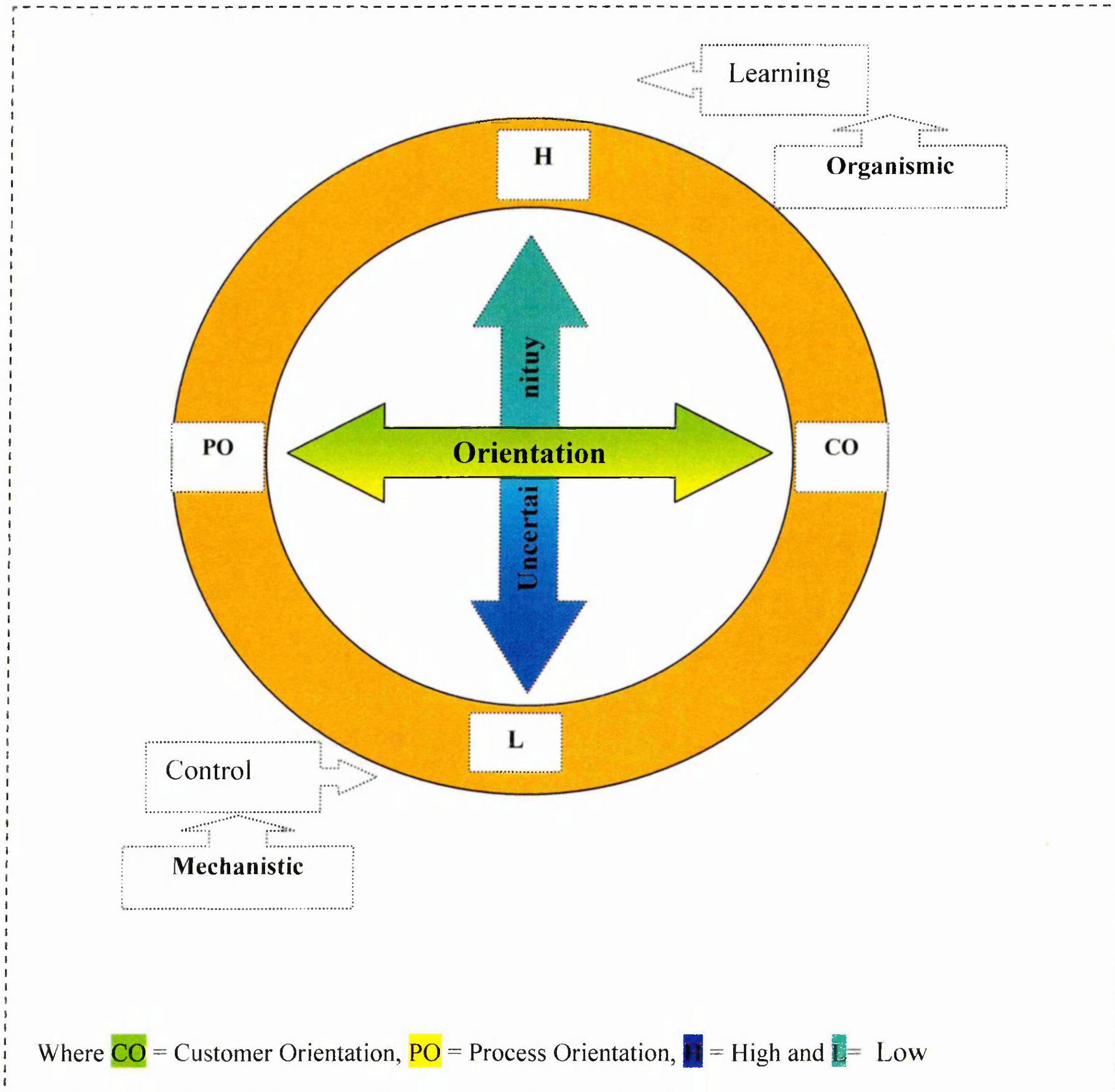


Figure 6.52: Author Interpretation of Reed et al (1996) Continua

According to Sitkin et al (1994), these learning components can being direct competition with the control components.

6.9.3.2 Time Lag Approaching Zero

Recent study by Jashapara (2003) provides support to the assertion that construction firms need to focus their organisational learning on efficiency and proficiency to achieve competitive advantage. Time lag after implementation of TQM for the appearance of either associated benefits or penalties will not only be significantly greater than zero. However Jashapara (2003) did not include a measurement instrument to ascertain the impact of the competitive environment forces, which is the strength of this study. The implications of Time Lag are that both continua are undimensional; uncertainty ranges between high and low. With low uncertainty, little change in product technology, and the in customer's need and demand is predictable.

6.9.3.3 Assigning the Scores to the Orientation-Uncertainty Matrix

Examination of Table 6.8 indicates that TQM deploying organisations had more than a medium level of Customer focus (mean = 3.80) and Zero Defects (mean = 3.43), while the non-TQM deploying UK Construction-Related SMEs had a medium level of Customer Focus (mean = 3.07) and a low level of Zero Defects (mean = 2.97). In order to ascertain the continua for uncertainty, the scores from Table 6.20 were used. TQM deploying UK construction related SMEs and their ability to redefine market uncertainty was below average (mean = 2.63). A similar value was determined for non-TQM SMEs (mean = 2.76).

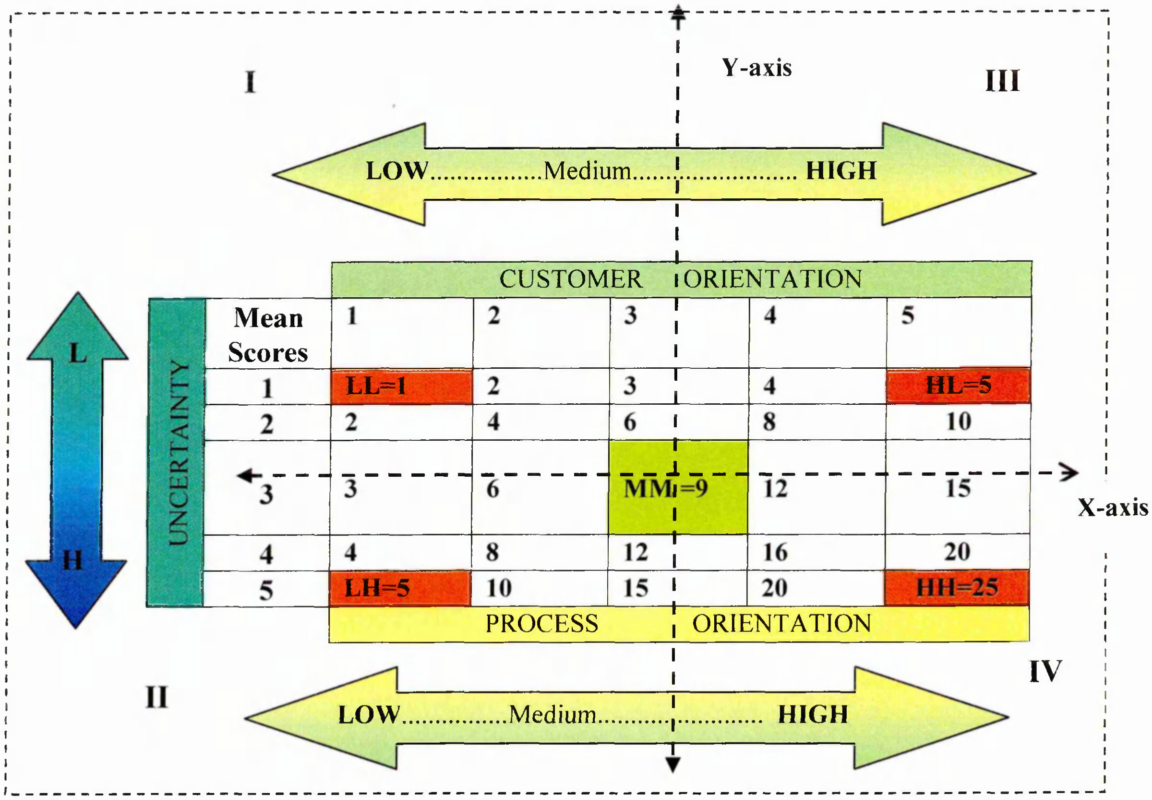


Figure 6.53: Scoring the Orientation-Uncertainty Matrix

Based on their customer focus (mean = 3.80) and uncertainty score (mean = 2.97), the TQM deploying UK construction-related organisations achieved a product score of 11.28. This was derived from multiplying the customer focus and zero defects scores (3.80*2.97 = 11.28) while non-TQM SMEs had a product score of 10.19 (3.07*2.63). Based on the scores, both the TQM and non-TQM fell within the fourth quadrant of the orientation-uncertainty matrix as illustrated in Figure 6.53. The finding indicates that the TQM deploying construction-related SMEs exhibited both a Customer and Process orientation. A simpler way of locating the organisations within the orientation-uncertainty matrix would be to equate the customer and zero defects scores as the X-axis and the results from Table 6.20 as the Y-axis, thus with the two co-ordinates, the UK construction-related SMEs could be plotted within the matrix to determine their orientation and uncertainty, thus decide which best fit to adopt, either the learning or control approach in order to determine the time lags.

The simple matrix presented in Figure 6.53 is a visual representation of the impact of the environment competitive factors on the customer and process orientation. The matrix takes the form of four quadrants (I, II, III, and IV) dissected by two dimensions. Along the horizontal axis the Customer and Process Orientation is distinguished through the continua of high and low. Along the vertical axis, the indicators of uncertainty (dynamism and complexity) are arranged from high to low. This matrix therefore facilitates the classification of criteria according to whether UK Construction-Related SMEs are Customer Oriented or Process-Oriented, and whether the uncertainty is high or low. As asserted by Li and Ye (1999), in an environment characterised by greater dynamism, top managers would experience greater uncertainty, or lack information related to the current state of their environment. Consequently, the x-axis may be viewed as Orientation continua and the y-axis as the uncertainty. Previous research has focussed on the extreme ends of either continua illustrated as the four shaded boxes marked with the following score ranges LL, HL, HH and LH representing each of the four quadrants.

A simple matrix was used to classify the Customer Oriented Organisation who operated in the uncertainty environment. Reed et al (1996) only focused on the end of the continua as shown in the matrix in Figure 6.53., the boxes with product scores of 1, 5, 5 and 25. From Figure 6.53, the score of 25 implies high uncertainty and a Customer or Process orientation which would suit the customer orientation approach and would be a complete match for TQM. This study has presented and contributed to the time lag analysis by using and including the middle ground where the UK Construction related SMEs could either pursue the Customer or Process Orientation.

By multiplying, the average value of the Customer focuses for TQM deploying and non-TQM obtained from Table 6.8 with the mean value for the environmental uncertainty which is obtained from Table 6.20 as the average of the competitive forces CF4 and CF5.

6.9.3.4 Summary of the Impact of the Environment Competitive Factors on TQM Implementation.

A cross tabulation was conducted among the TQM deploying organisations which considered the environment to have a low uncertainty. As postulated by various researchers (Reed et al, 1996; Hackman and Wageman, 1995), it was anticipated that the increase in income would be low. One of the objectives of this study was to identify the linkages between the attainment of a sustainable competitive advantage and the implementation of TQM. Bennett and Smith (2002) in citing the evolutionary economic arguments presented by Nelson and Winter (1992) formulated a set of hypothesis about the competitive positions of firms which seeks to assess the association between their specific characteristics as a firm and their local environment. They observed that SMEs could also attempt to diversify and increase its competitive advantage vis-à-vis other firms by strengthening its position in relation to its suppliers and customers in the supply chain. TQM contributes to it through its promotion of Supply Chain Management. However the empirical analysis conducted in this study showed that SMEs adoption of the "training" construct was low, and therefore would still face increasing competition levels. As advocated by Bennett and Smith (2002), competition levels decrease with the increasing skill level of the firm. They also identified that the higher the skill levels the higher the rate of innovation, the greater the specialisation and differentiation of the firm to others is expected. Therefore the competitive challenge from other firms should be lower according to Bennett and Smith (2002).

6.9.4 Discussion of the Impact of the Competitive Environment Factors on TQM Implementation.

One of the objectives of this study was to determine if they are any differences in quality management and quality outcomes across UK Construction Related SMEs, and if so, how and why they differ. As observed by Montes et al (2003), the research kind of growing interest is the one that tries to set out how TQM contents should be adapted to the objectives of the organisations. Reed at al (1996) defined TQM content which includes the following four components; Market Advantage, Product Design Efficiency, Product Reliability and Process Efficiency. The premise of orientation-uncertainty matrix is that organisations can either be customer oriented or operations oriented in order to have increased revenues and reduced costs through the four components of TQM. However in orienting the business to focus on TQM contents, the environment uncertainty which affects the results of the TQM implementation should be considered. This association can be traced using the following paths A→F as illustrated in the conceptual framework in Chapter three and reproduced for illustrative purposes.

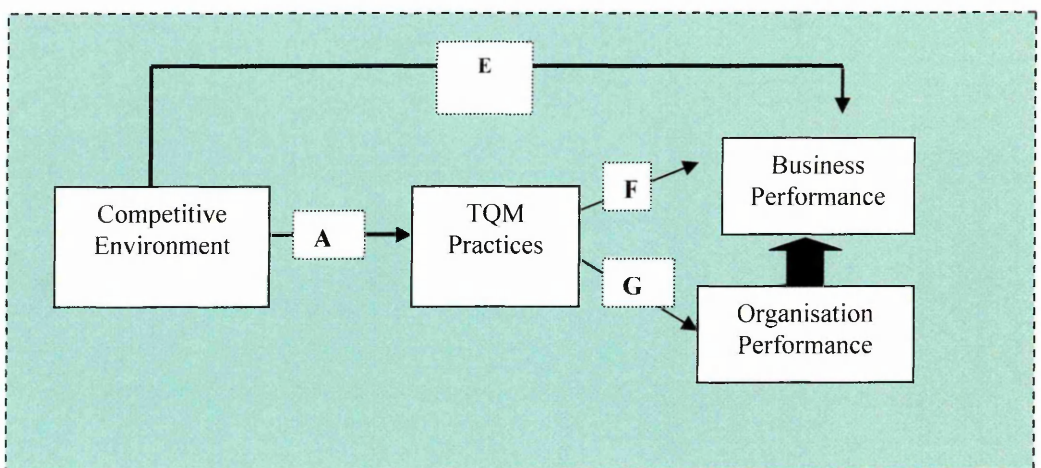


Figure 6.54: Impact of Competitive Environment on TQM practices and Organisation Performance.

A critical indication of the TQM implementation in an organisation is that, it can be influenced by the competitive factors, therefore it is expected the business and organisation performance of UK Construction Related SMEs to be moderated by the contextual factor of the environment as shown in the model (Figure 6.54)

6.10 Empirical Assessment of the TQ-SMART Instrument

Various methods for constructing instruments to measure social science variables have been developed by psychologists (Saraph et al 1989). The process used in this study re-developed measures of the critical success factors as shown in the flow chart (Figure 6.49).

The first Step in the scale development and refinement is to expound the theory and concepts that underlie a particular management concept. This is achieved through the review of literature, and identifying TQM Critical Success Factors and Constructs. The second step is designing a survey instrument by careful selection of the representative items which have been discussed in Chapters 2 and 5.

Steps 3 and 4 involve the pre testing of the instrument, modifying and refining it before finalising the instrument. Data collection is undertaken in Step 5. Step 4 was partly addressed in Chapter 5, in particular the rationale and justification of the Powell Instrument. The main objective of step 3 is the subjective or objective of experts in the field.

Step 6 shown by the dashed box (figure 6.55) comprises of various sub-steps and is main the focus of this sub-section. It is designed to use confirmatory factor analysis (step 6.1), test undimensionality (step 6.2), internal consistency (step 6.3) (which addressed the coefficient alpha and composite reliability); and validity (step 6.4) of the construct measures of critical success factors. The objective of steps 6.1 through 6.4 is to ensure operationalisation and standardisation. Step 6 uses the Confirmatory Factor Analysis (CFA) Approach as opposed to the EFA as earlier stated in Chapter Two. The major limitation of EFA is restated in that the items are assigned to those factors on which they load most substantially, whereas in contrast CFA overcomes the limitation of EFA by specifying a model priori, and testing the hypothesis that a relationship between the observed and the latent variables does exist.

After the revised model has been validated (Step 6), it is then used as a measurement instrument to assess the levels of quality initiatives and the business and organisational performance indicators. This forms the basis of step 7 which is covered in Chapter Seven. For each data, the critical success factors and the Total Quality Management Index are computed by using the formula shown as Equation 7.1. This takes into account the casual relationship (factor loadings) and mean scores of the corresponding variables.

The final step 7 will assess the validity of the TQ-SMART measuring instrument, and this aspect forms the basis of Chapter Seven in which demonstration of the assessment and monitoring properties of the instrument is provided.

6.10.1 Confirmatory Factor Analysis

According to Sureshchandar et al (2002), a critical aspect in the evolution of a fundamental theory in any management concept is the development of good measures to obtain valid and reliable estimates of the construct of interest.

The various steps involved in the development and validation of the measurement scale are shown by means of flow chart in Fig. 6.55. Issues in applying the instrument development and validation process illustrated were used to develop the TQ-SMART instrument that satisfies the requirements of reliability, validity and undimensionality.

The shaded box marked "**Step 6**" in Figure 6.55 contains the three-stage continuous improvement cycle which according to Chen and Paulraj (2004) lies at the heart of the instrument development process and addresses the issues of Confirmatory Factor Analysis. This is equivalent to scale evaluation illustrated in Figure 2.12 in Chapter Two. The following sub section describes the process undertaken to determine the requirements of the steps in the development process.

Undimensionality

This is a mandatory condition for construct validity and reliability checking. In order to check for undimensionality, a measurement model shown in Figure 6.56 is specified for each construct and confirmatory factor analysis is run for all the constructs.

6.10.1.1 Step 3. Content Validity

This can be examined at the level of the entire instrument and that of individual items (Hyrkas et al 2003). Content validity at the instrument level expresses how the instrument's sub-scale represents the target or content domain being measured. Content validity at the item level measures the target or content domain. This present instrument has been re-defined and developed based on the detailed analysis of the Powell (1995) instrument thus

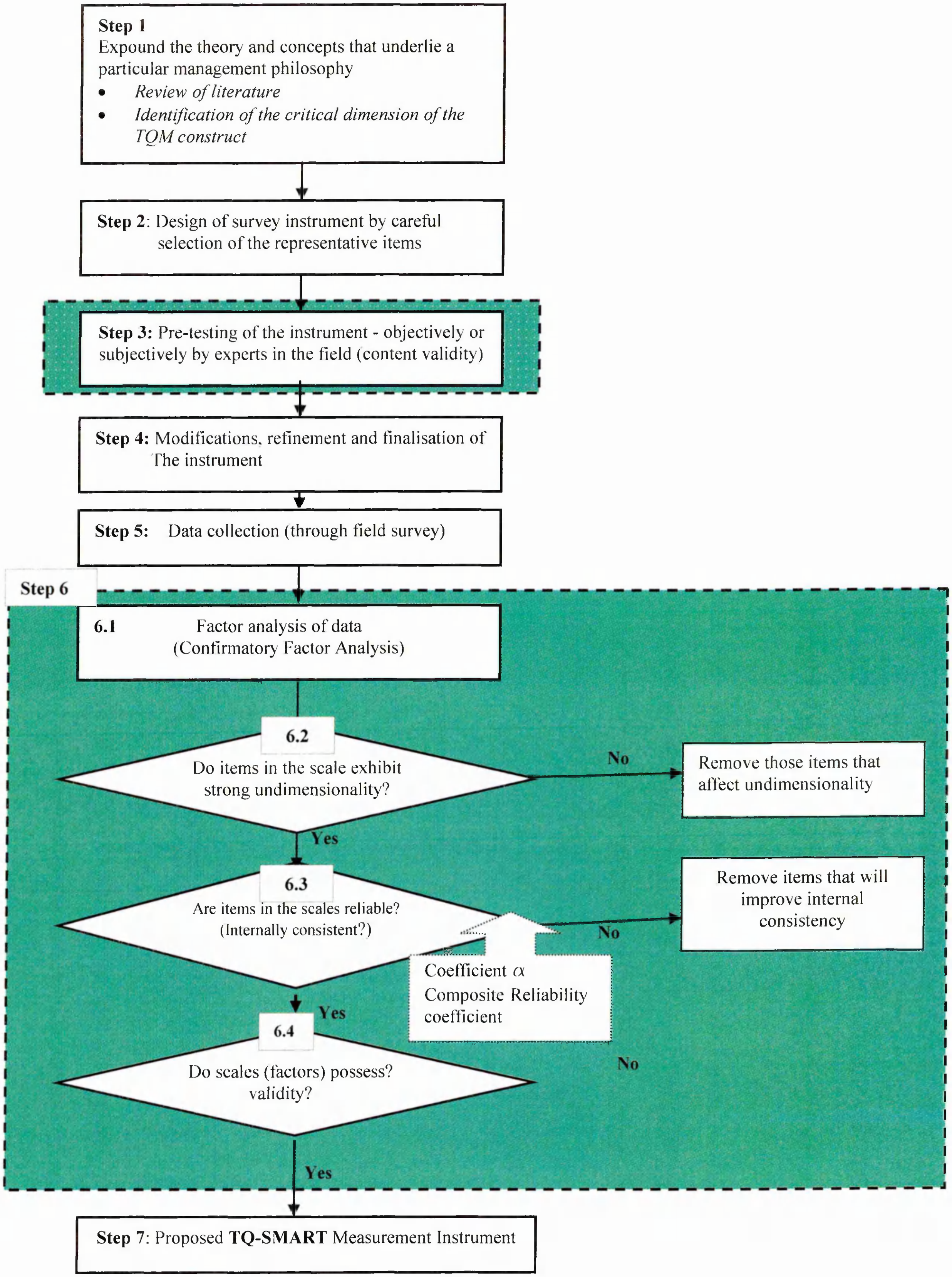


Figure 6.55: Development and validation of the measurement scale
(Source: Adapted from Sureshchandra et al, 2002)

ensuring validity as the instrument has been previously tested in the manufacturing and service industries. Prior to data collection, the content validity was established by grounding it in literature. Furthermore, content validity exists when the measurement of a multidimensional construct taps all of its constituent dimensions or at least all those that are relevant to the research question concerned (Sim and Sharp, 1998).

6.10.1.2 Step 4. Justification of the Powell (1995) Instrument

Justification for Selection

Motwani et al (1994) in justifying their usage of Saraph et al (1989) instrument,argued that this was used because the measures were empirically based and shown to be valid and reliable, and the instrument measured directly or indirectly all the critical success factors identified in their study.

Model refinement

According to Fagarasanu and Kumar (2002), in every situation there may be different modifications which are needed to address the uniqueness of each population studied. There are potentially four possible options involved in the refinement process. These are shown in Chapter Five (Figure 5.5) and are highlighted in "Step 4" of Figure 6.55, and involve the following methods;

- Scale Reduction
- Dropping Items
- Inclusion of New Items
- Revising Existing Items

The following subsection describes the refinement made to the Powell Instrument and uses the literature review to support the refinement.

- **Scale Reduction**

The first modification to the Powell Instrument involved the scale measuring the implementation of each practice. Powell utilised a scale involving a six-point interval scale (0-5) where 5 = highly advanced in implementation, 1 = have not begun implementation and 0 = do not intend to implement). This refinement did not use the last scale as it was argued that those not intending to implement would not even respond to the questionnaire, furthermore any scale having more than five on the Likert scale, risk the chance of losing information.

- **Dropping Items**

Model refining may entail splitting potentially confusing items. For example Lai and Cheung (2003) refined the Black and Porter (1996) instrument using that approach. Similarly in this study all the items relating to Manufacturing Flexibility were dropped from the instrument. Similarly, Raju and Lonial (2002) modified the instrument designed by Benson et al (1991) by first reducing the number of items from 26 to 19. Secondly the 19 items were modified to make them appropriate for the healthcare context since the original items had been used in Manufacturing/Service settings. Whereas Motwani et al (1994) used the Saraph et al (1989) instrument without any modifications or refinements as they were used in manufacturing.

The construct of process management was equally dropped as it was closely related to customer focus. Joseph et al (1999) dropped or modified 20 items from the original Saraph et al (1989) instrument and one of the reasons given was that some of the items were perceived by experts to be replications of other items. Fagarasanu and Kumar (2002) note that item deletion when conducted properly can enhance reliability and reduce the size of the questionnaire

The Construct of Manufacturing Flexibility with its seven associated variables was dropped from the instrument because the Powell Instrument states that

they are specifically meant for the Manufacturing setting. Therefore they are excluded from this study which was construction specific. Therefore it can be stated that the following items were dropped mainly for the following reasons:
1. Lack of relevance of items in the UK Construction related SMEs

- **Flexible Manufacturing Construct**
  1. Design for Assembly (DFA) or Design for Manufacturability (DMA)
  2. A flexible manufacturing system
  3. A just-in-time inventory system
  4. Cellular manufacturing
  5. Process capability studies
  6. Statistical Process Control
  7. Taguchi methods, or Design of Experiments (DOE)

The second construct dropped with its associated five variables was that of Process Improvement as the items included were more manufacturing specific. An examination of the instrument revealed that process management involved accounting for variation either through taking customer and supplier's requirements into account. These needs are already reflected in the Supplier Focus and Customer Focus.

- **Process Improvement Construct an its associated variables**
  1. A program to reduce order-process cycle time
  2. A program to reduce new product or service development cycle time
  3. A program to reduce overall product or service delivery times
  4. A program to reduce paperwork
  5. A program to find wasted time and costs in all internal processes

The Open Organisation construct had its four item scale reduced to three by dropping the following item "Frequent use of cross-department teams" as it was confusing for SMEs especially Sub-Contractors dealing on site. More so, usage of cross-department teams is prevalent in manufacturing oriented environments. However, the item is still valuable in respect to the learning element and it is addressed in the "training" and empowerment construct which leads to problem solving and contributes to the sharing of learning among team members.

- **Open Organisation**

  1. Frequent use of cross-department teams

With the dropping of the two constructs and one variable item from the open organisation construct, the revised instrument now had ten constructs with a total of 34 variables.

- **Revising Existing Items**

The third item of the second construct namely adopting the philosophy read as follows; "Entering a Baldrige Award competition". As this award is specifically meant for US organisations, it was changed to include the EFQM, thus the new revised item read as follows "Entering a European Foundation for Quality Management (EFQM) Award competition".

- **Renaming Existing Scales**

The Closer to Suppliers and Closer to Customers constructs were renamed Supplier Focus and Customer Focus respectively. The rationale behind the renaming was that the word "closer to" didn't capture the full extent of the relationship as it was distance oriented, and as such it provided a vague approximation. Alternatively the word "focus" is more emphasised and direct at the issue under consideration.

After the above refinements, the original Powell instrument with 12 constructs and 47 items now had 10 constructs with 34 items. Forker et al (1997) in refining the Saraph et al (1989) instrument dropped a total of 16 items from the original instrument; the dropping of 13 items is justified with the above reasons provided.

Method of Analysis

Motwani et al (1994) used Pearson's coefficient of correlation in analysing the strength of linear relationships between the dependent and independent variables.

6.10.1.3 Previous Studies Using the Powell Instrument

Other studies that have used the Powell (1995) Instrument are Dow et al (1999) who extended Powell's work albeit within the manufacturing environment and focussed on larger organisations. Their findings indicated that training and benchmarking were uncorrelated to performance.

Recent studies are by Sharma and Gadenne (2002) who used the Powell instrument in an inter-industry comparison of quality management practices and performance. Their sample included the service, manufacturing and construction organisations. The limitation, as with the Powell study was the small sample size of construction organisations (n=20). In addition the study was exploratory in nature and the data analysis utilised was regression. On the other hand, this study is different from the two mentioned as not only does it measure the direct and indirect effects of the TQM practices on the organisation performance, it utilised advanced structural equation modelling to address the weaknesses of measurement error not covered by the regression method. Secondly it specifically targeted the constructional related SMEs.

6.10.2 Reliability Analysis

Chapter Two identified four methods for assessing reliability of empirical instruments

- (1) test-retest method,
- (2) alternative form method,
- (3) split-halves method
- (4) the internal consistency method.

The limitations of each are presented in Table 2.2 and the advantages of the internal consistency method being on one time administration clearly stated. It is for this reason that Cronbach's alpha (α) was used to test the reliability of the instrument. As stated in Chapter 2, a measurement scale must be both reliable and valid. In order to achieve this Analysis of Variance was carried out for each of the scales and the results are presented in appendix F. All the F-ratios were extremely high values with small probabilities indicating that the total score was capable of distinguishing between responses to these other questions.

The KMO Statistic for the individual variables is indicated in Appendix D (Table D7). The statistic varies between 0 and 1. It is recommended that the value of KMO should be greater than 0.5 if the sample is adequate. (Field 2000). The above result of 0.788 indicates that the sample was adequate and that factor analysis was appropriate for this data. According to Brah et al (2002), the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy assesses the suitability of the sample for each unfactorial determination Barlett's measure tests the null hypothesis that the original correlation matrix is an identity matrix. It is important to examine the diagonal element of the anti-image correlation matrix and the value should be above 0.5. According to Ang et al (2000), a small value of MSA means that each variable cannot be predicted or explained by other variables without significant error; hence factor analysis may not be appropriate. Further guidelines are provided for

MSA values, where values in the 0.90s are marvellous; 0.80 are meritorious; 0.70 are middling; 0.60 are mediocre; 0.50 are miserable and less than 0.50 are unacceptable. (Norusis, 1997) From Table D7 (Appendix D), the MSA values ranged from 0.478 to 0.845. The small value of 0.478 was due to the scoring of the variable related to entering the EFQM Excellence Award competition; however this variable was not eliminated as it could be combined with those from the Executive Commitment. The overall measure of the TQ-SMART indicate that factor analysis would be appropriate.

Owing to the test of the item means (Hotelling $T^2 = 172.5988$, $F = 2.5308$, $P = 0.0060$) as indicated in Table F21 (Appendix F), it is clear that the item means are unequal. A useful method to approach construct validation is using confirmatory factor analysis (CFA). The following Table 6.23 shows the total variance explained from the factor analysis.

6.10.3 Results of Exploratory Factor Analysis

Table 6. 23 Total Variance Explained

Component	Extraction Sums of Squared Loading			Rotation Sum of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.051	38.385	38.385	13.051	38.385	38.385
2	4.289	12.614	50.999	4.289	12.614	50.999
3	2.830	8.325	59.324	2.830	8.325	59.324
4	2.374	6.982	66.306	2.374	6.982	66.306
5	2.033	5.979	72.286	2.033	5.979	72.286
6	1.684	4.954	77.240	1.684	4.954	77.240
7	1.534	4.512	81.752	1.534	4.512	81.752
8	1.219	3.584	85.336	1.219	3.584	85.336
9	1.138	3.347	88.683	1.138	3.347	88.683
10	0.963	2.834	91.517	0.963	2.834	91.517

According to the results of factor analysis, ten significant factors were found. The first factor explains 38.385 per cent of the total variance. The second factor explains 4.289 per cent and the remaining eight factors and their variance are indicated in table 6.23.

The results of the factor analysis indicated the ten factors extracted accounted for 91.57% of variance in responses. The constituent indicators of each of the ten factors extracted were explained in the previous Chapter.

6.10.4 Scale Evaluation Stage

The final stage involved confirmatory analysis (CFA) in evaluating construct validity and undimensionality. According to Fagarasanu and Kumar (2002), an instrument being reliable does not mean its valid, but in order to be valid an instrument must be reliable. Therefore the construct validity of the measures is supported by the empirical demonstration of (1) reliability, (2) convergent validity, (3) discriminant validity, and (4) nomological validity

6.10.4.1 Validity Analysis

According to Carmines and Zeller (1979), validity can be defined as the extent to which any measuring instrument measures what it is intended to measure. Even though this measurement instrument is based on a refined scale of Powell (1995), it is tested for validity in the construction environment context which is different from the manufacturing and service oriented industries. Cui et al (2003) used a similar approach in applying the SERVQUAL model to the Asian context, though in the banking sector. Despite the numerous studies on the measurement instruments used in the manufacturing industry, they are no substitute for information about applicability of these empirical scales in the Construction SMEs environment.

The three different methods of evaluating validity were earlier identified in Chapter Two as content validity, construct validity and criterion-related validity. A brief description of each method is also stated in Chapter three. In order to satisfy the confirmatory factor analysis, the following hypotheses were generated

H_{11}: TQ-SMART scale items converge into the ten latent constructs. In order of item appearance in the questionnaire and as shown in the Confirmatory Factor Analysis of TQ-SMART Measurement Model in Figure 6.53,

- items 1-3 assess the construct of executive commitment
- items 4-6 assess the construct of adopting the quality philosophy
- items 7-10 assess the construct of customer focus
- items 11-13 assess the construct of supplier focus
- items 14-16 assess the construct of benchmarking
- items 17-20 assess the construct of training,
- items 21-23 assess the construct of open organisation
- items 24-27 assess the construct of employee empowerment
- items 28-30 assess the construct of zero defects
- items 31-34 assess the construct of measurement.

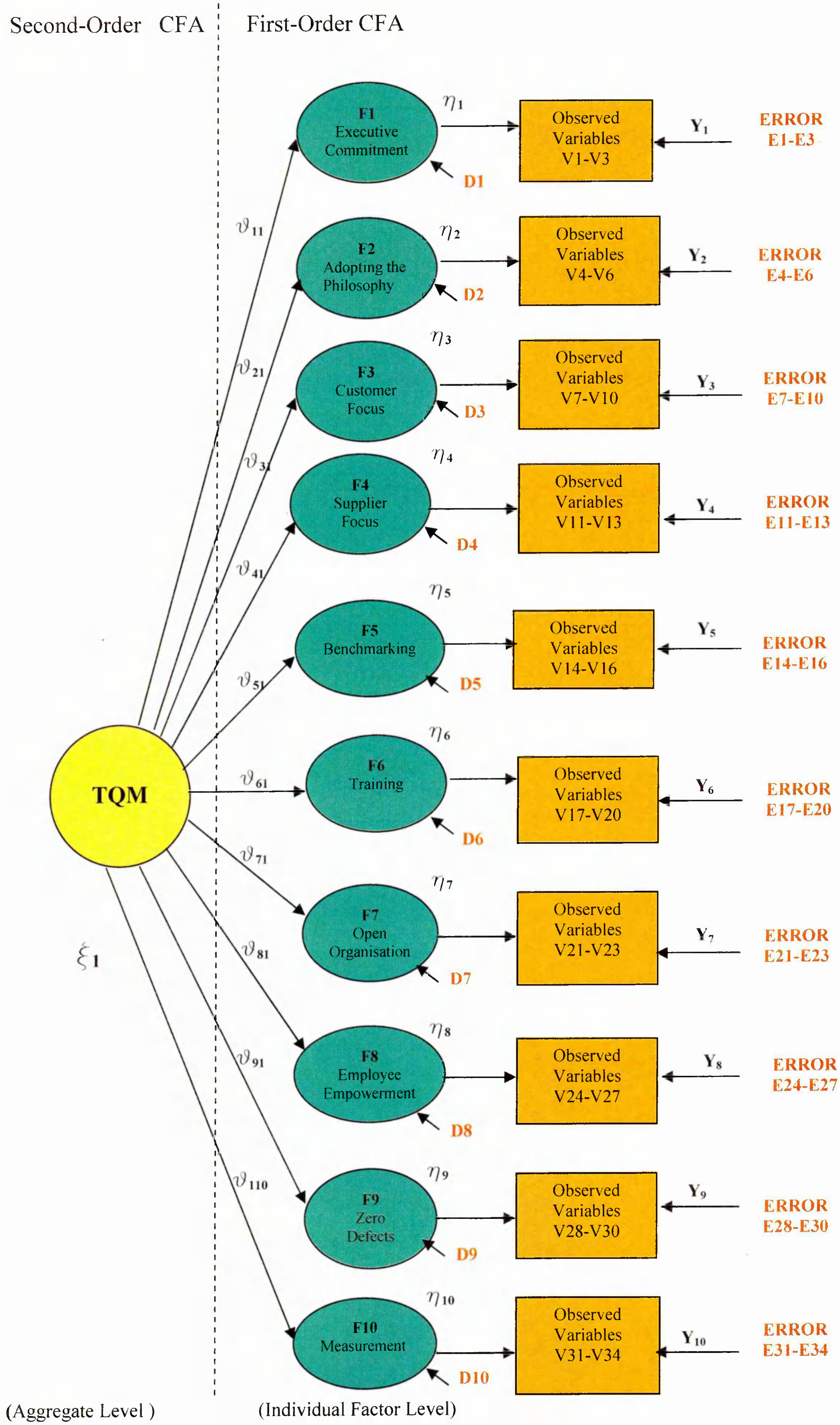


Fig 6.56 Confirmatory Factor Analysis of TQ-SMART Measurement Model

The hypothesised overall TQ-SMART model is portrayed in Figure 6.56 in Structural Equation Modelling (SEM) notation. The single headed arrows leading from the second-order of TQM (F_{11}) to each of its underlying first order factors (F_1, F_{11}; F_2, F_{11}; F_3, F_{11}; F_4, F_{11}; F_5, F_{11}; F_6, F_{11}; F_7, F_{11}; F_8, F_{11}; F_9, F_{11}; and F_{10}, F_{11}) are regression paths that indicated the prediction of the TQM Executive Commitment (F1), TQM Adopting the Quality Philosophy (F2), TQM Customer Focus (F3), TQM Supplier Focus (F4), TQM Benchmarking (F5), TQM Training (F6), TQM Open Organisation (F7), TQM Employee Empowerment (F8), TQM Zero Defects (F9) and TQM Measurement (F10) from a higher order TQM factor.

They also represent second-order factor loadings denoted as ϑ_{11} through ϑ_{101} on Figure 6.56. The results of which are presented in Table 6.24 and Table 6.25 There is also a residual disturbance term associated with each first-order factor (D_1, D_2, D_3, D_4, D_5, D_6, D_7, D_8, D_9 and D_{10}). These represent residual errors in the prediction of the first-order factors from the higher order factor of TQM. This approach draws heavily from Curkovic (2003) as used in examining a four factor of Environmental Responsible Manufacturing (ERM) F_1 through to F_{10} are constructs which are approximated units, which by their very nature, cannot be observed directly, Handfield and Melnyk (1998). In testing the theory, the researcher is testing a statement of a predicted relationship between the units observed or approximated in the real world. Thus constructs (η_1 to η_{10}) are related to each other by propositions, while variables are related by hypotheses.

F_{11}	=	Factor 11	=	TQM (2nd Order Factor)
F_1	=	Factor 1	=	TQM Executive Commitment (1st Order Factor)
F_2	=	Factor 2	=	TQM Adopting Quality Philosophy (1st Order Factor)
F_3	=	Factor 3	=	TQM Customer Focus (1st Order Factor)
F_4	=	Factor 4	=	TQM Supplier Focus (1st Order Factor)
F_5	=	Factor 5	=	TQM Benchmarking (1st Order Factor)
F_6	=	Factor 6	=	TQM Training (1st Order Factor)
F_7	=	Factor 7	=	TQM Open Organisation (1st Order Factor)
F_8	=	Factor 8	=	TQM Employee Empowerment (1st Order Factor)
F_9	=	Factor 9	=	TQM Zero Defects (1st Order Factor)
F_{10}	=	Factor 10	=	TQM Measurement (1st Order Factor)

The boxes represent the actual observed measurement obtained from the second part of the survey document which is a total of 34 variables (results) for the ten traits obtained by ten methods. Expressed more formally, the CFA model portrayed in Figure 6.56 hypothesised a priori that

- TQM can be conceptualised in terms of the ten factors
- each observed variable will have non zero loading for all other factors
- error terms (E_1 through E_{34}) associated with each observable variables will be uncorrelated
- The ten first-order factors will be correlated
- Co-variation among the first-order factors will be explained fully by their regression onto the second-order factor.

The modified TQ-SMART model is represented in Fig 6.56 according to the Linear Structural Relationships (LISREL) notation. The ellipses contain the name of the latent variables while the rectangles contain the measure used to explain each construct (Forza and Filipini, 1998). For example the 'Executive Commitment' is represented by latent variable **F1** while the measure used to explain this construct are indicated by variables V_1 to V_3 with their associated errors E_1 to E_3.

The graphical representation of the SEM shown in Figure 6.56 consists of Ten constructs (F_1 through F_{10}) that are measured by a total of 34 items (V_1 through V_{34}). The total number of parameters (i.e. variances, covariance's, regression weights and measurement error variances) that would needed to be calculated was very large and violated the recommended sample size to number of parameter ratio of greater than 10 to 1. (Barclay et al, 1995; Hair et al , 1998). The results of the SEM are summarised in Appendix G. For the measurement model as shown in Figure 6.56, some of the goodness-of-fit indices (χ^2, GFI, TLI, NC and NFI) are as follows:

Stage 1: Initial Measurement Model

The results of the SEM for the Second Order Factor (SOF) Model are summarised in Table G1, Column 5 (Appendix G). Below are some of the key fit measures.

$\chi^2 = 1091.0$, df = 517, p = 0.000	(Unacceptable fit)
χ^2/df = 2.112	(Acceptable fit)
GFI = 0.543	(Unacceptable fit)
TLI = 0.700	(Unacceptable fit)
RMSEA = 0.237	(Unacceptable fit)

As expected the sample size of 63 was insufficient for the full model as it violated the recommended sample size to number of parameters ratio. In this case it would have required a sample size of 680 to achieve the 10 to 1 ratio as there are 68 distinct parameters to be estimated. A data reduction technique was employed in order to cope with the small sample size. This technique involved a three stage process (Gribbons and Hocevar, 1998; Singh and Smith, 2004) and is illustrated in the form of a flow chart shown in Figure 6.57.

Escrig-Tena (2004) used a similar approach in reducing the numbers of parameters to be estimated and to lower the complexity of the model. Therefore to measure each of the individual dimensions of the construct, a single indicator was considered that was a result of adding all the items initially used to measure each dimension (Figure 6.56).

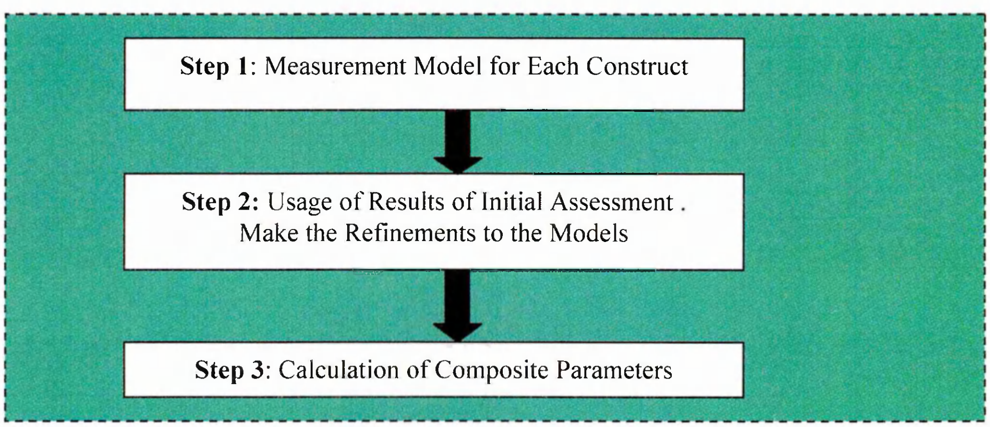
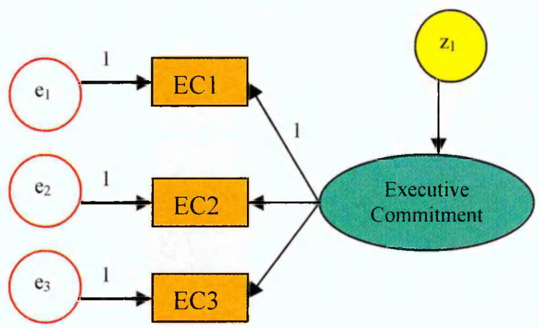
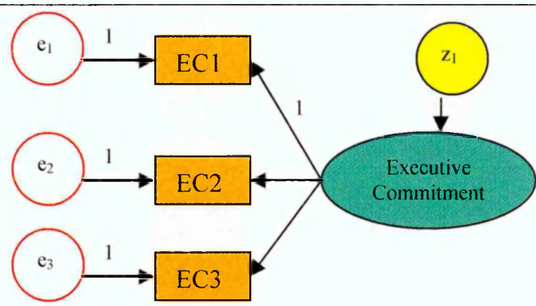


Figure 6.57: Data Reduction Techniques

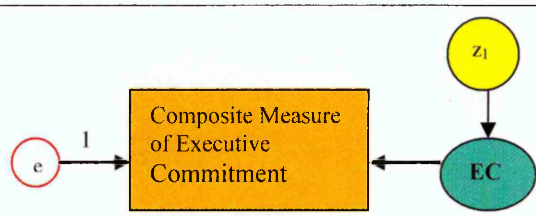
An illustration is provided for the Executive Commitment Construct and Customer Focus in the application of the data reduction technique.



Stage 1: Initial Measurement Model	
χ^2= 15.831, df = 8 p = (0.045)	Unacceptable
χ^2/df = 1.979	Acceptable
GFI = 0.925	Acceptable
TLI = 0.953	Acceptable
RMSEA = 0.126	Unacceptable
Data does adequately fit the initial model	



Stage 2: Improved Measurement Model
Data does not adequately fit the initial model
As stage 1 is adequate, the values are the same for the second stage



Step 3: Composite Measurement Model
Composite Reliability = 0.9339
Mean for Composite Measure = 4.10
Variance = 0.4220
Std deviation = 0.940

Figure 6.58 : Three Stage Reduction Process
Adapted from Singh and Smith (2004)

Figure 6.58 illustrates the one-factor congeneric model and outcome of using data reduction techniques for the "Executive Commitment" construct of TQM. The three stage process was used to produce composite measures for the nine other constructs in the model. The parameters for the composite measures are shown in Table 6.29

6.10.5 RESULTS OF THE CONFIRMATORY FACTOR ANALYSIS (SOF Approach)

A Structural Equation Modelling was applied to the hypothesised model as shown in Figure 6.56. The results from applying this model are shown in Tables 6.25, 6.26 and 6.27; first unstandardised path coefficients, secondly standardised path coefficients for the measurement model and the standardised regression weights and squared multiple correlations for the second order model. The unstandardised coefficients and associated test statistics are the estimate; its standard error (abbreviated S.E.) and the estimate divide by the standard error (abbreviated C.R. for critical ratio). Each unstandardised regression coefficient represents the amount of change in the dependent or mediating variable for each unit change in the variable predicting it. Table 6.25, showing the unstandardised path coefficients identify a number of interesting results.

The first step of the analysis (Step 6.2) as illustrated in Figure 6.56 is to examine the dimensionality of the TQ-SMART by means of CFA. The standardised loadings, reliabilities and proportions of variance extracted for the constructs and indicator coefficients are show in Tables 6.24, 6.25, 6.26 and 6.28. The indicator coefficients (ϑ_{00}) of the constructs.

Table 6.24 The final first-order TQ-SMART CFA Model (Unstandardised Solution)

TQM Factors	Measurement Equation	Standard Error (S.E)	C.R
TQM Executive Commitment (F1)			
Cronbach's α = 0.9339	V1 = F1 + 1.00E1	.109	-
	V2 = F1 + 1.00E2	.069	12.299
	V3 = F1 + 1.00E3	.080	9.835
TQM Adopting the Quality Philosophy (F2)			
Cronbach's α = 0.5700	V4 = F2 + 1.00E4	.287	-
	V5 = F2 + 1.00E5	.272	4.643
	V6 = F2 + 1.00E6	.250	0.646
TQM Customer Focus (F3)			
Cronbach's α = 0.8946	V7 = F3 + 1.00E7	.071	-
	V8 = F3 + 1.00E8	.060	11.533
	V9 = F3 + 1.00E9	.104	8.733
	V10 = F3 + 1.00E10	.174	6.314
TQM Supplier Focus (F4)			
Cronbach's α = 0.7828	V11 = F4 + 1.00E11	.166	-
	V12 = F4 + 1.00E12	.121	4.864
	V13 = F4 + 1.00E13	.139	4.543
TQM Benchmarking (F5)			
Cronbach's α = 0.8883	V14 = F5 + 1.00E14	.141	-
	V15 = F5 + 1.00E15	.095	7.721
	V16 = F5 + 1.00E16	.114	7.221
TQM Training (F6)			
Cronbach's α = 0.8779	V17 = F6 + 1.00E17	.084	-
	V18 = F6 + 1.00E18	.091	10.088
	V19 = F6 + 1.00E19	.125	6.901
	V20 = F6 + 1.00E20	.172	5.606
TQM Open Organisation (F7)			
Cronbach's α = 0.9295	V21 = F7 + 1.00E21	.062	-
	V22 = F7 + 1.00E22	.069	11.222
	V23 = F7 + 1.00E23	.091	10.896
TQM Employee Empowerment (F8)			
Cronbach's α = 0.9187	V24 = F8 + 1.00E24	.114	-
	V25 = F8 + 1.00E25	.104	7.618
	V26 = F8 + 1.00E26	.069	8.464
	V27 = F8 + 1.00E27	.069	8.421
TQM Zero Defects (F9)			
Cronbach's α = 0.8434	V28 = F9 + 1.00E28	.215	-
	V29 = F9 + 1.00E29	.104	5.878
	V30 = F9 + 1.00E30	.119	5.396
TQM Measurement (F10)			
Cronbach's α = 0.8986	V31 = F10 + 1.00E31	.127	-
	V32 = F10 + 1.00E32	.090	8.059
	V33 = F10 + 1.00E33	.101	6.005
	V34 = F10 + 1.00E34	.168	8.429

Table 6.25: The final first-order TQ-SMART CFA Model (Standardised Solution)

TQM Factors	Measurement Equation	Standard Error	Test Statistic (t)
TQM Executive Commitment (F1)			
Cronbach's α = 0.9339	V1 = 0.867F1 + 0.521E1	0.109	4.763
	V2 = 1.002F1 - 0.008E2	0.069	-0.122
	V3 = 0.873F1 + 0.372E3	0.080	4.681
TQM AQP (F2)			
Cronbach's α = 0.5700	V4 = 0.845F2 + 0.558E4	0.287	1.944
	V5 = 0.876F2 + 0.413E5	0.272	1.516
	V6 = 0.088F2 + 1.391E6	0.250	5.561
TQM Customer Focus (F3)			
Cronbach's α = 0.8946	V7 = 0.904F3 + 0.266E7	0.071	3.723
	V8 = 0.931F3 + 0.180E8	0.060	2.984
	V9 = 0.814F3 + 0.502E9	0.104	4.814
	V10 = 0.673F3 + 0.912E10	0.174	5.259
TQM Supplier Focus (F4)			
Cronbach's α = 0.7828	V11 = 0.602F4 + 0.847E11	0.166	5.102
	V12 = 0.920F4 + 0.193E12	0.121	1.601
	V13 = 0.736F4 + 0.616E1	0.139	4.426
TQM Benchmarking (F5)			
Cronbach's α = 0.8883	V14 = 0.766F5 + 0.681E14	0.141	4.842
	V15 = 0.951F5 + 0.146E15	0.095	1.534
	V16 = 0.853F5 + 0.446E16	0.114	3.917
TQM Training (F6)			
Cronbach's α = 0.8779	V17 = 0.900F6 + 0.275E17	0.084	3.281
	V18 = 0.908F6 + 0.281E18	0.091	3.076
	V19 =0.724 F6 + 0.631E19	0.125	5.029
	V20 = 0.629F6 + 0.906E20	0.172	5.252
TQM Open Organisation (F7)			
Cronbach's α = 0.9295	V21 = 0.915F7 + 0.220E21	0.062	3.545
	V22 = 0.904F7 + 0.262E22	0.069	3.802
	V23 = 0.893F7 + 0.367E23	0.091	4.033
TQM Employee Empowerment (F8)			
Cronbach's α = 0.9187	V24 = 0.805F8 + 0.548E24	0.114	4.810
	V25 = 0.838F8 + 0.476E25	0.104	4.587
	V26 = 0.903F8 + 0.254E26	0.069	3.688
	V27 = 0.900F8 + 0.261E27	0.069	3.760
TQM Zero Defects (F9)			
Cronbach's α = 0.8434	V28 = 0.628F9 + 1.611E28	0.215	5.406
	V29 = 0.994F9 + 0.019E29	0.104	0.186
	V30 = 0.798F9 + 0.562E30	0.119	4.727
TQM Measurement (F10)			
Cronbach's α = 0.8986	V31 = 0.790F10 + 0.614E31	0.127	4.856
	V32 = 0.933F10 + 0.234E32	0.090	2.602
	V33 = 0.894F10 + 0.370E33	0.101	3.664
	V34 = 0.711F10 + 0.862E34	0.168	5.140

The standardised estimates indicated in Table 6.25 enable the evaluation of the relative contribution made by each predictor to each outcome variable to be determined. Table 6.26 contains the standardised coefficients for the structural relationships. All but one of the parameters shown in Figure 6.57 are found to be both of the hypothesised sign and statistically significant. Open Organisation (**F7**) appears to be strongly linked to TQM ($\vartheta_{11} = 0.834$)

Table 6.26: Second-Order Factor Loadings of TQ-SMART Constructs

Path	Factor Loading	Standardised Regression Weights	Squared Multiple Correlations
TQM - F1	ϑ_{11}	0.542	0.294
TQM - F2	ϑ_{21}	0.515	0.265
TQM - F3	ϑ_{31}	0.806	0.650
TQM - F4	ϑ_{41}	0.720	0.518
TQM - F5	ϑ_{51}	0.602	0.363
TQM - F6	ϑ_{61}	0.751	0.564
TQM - F7	ϑ_{71}	0.834	0.695
TQM - F8	ϑ_{81}	0.746	0.557
TQM - F9	ϑ_{91}	0.797	0.635
TQM - F10	ϑ_{101}	0.569	0.324

The above results can be represented in a graphical format as shown in Figure 6.58. The results are slightly different as the values used in the second order analysis took the average scores of the variables assigned to each factor. The factor loadings are also used to generate the inter-factor correlations which are presented in Table 6.27. For example, from the factor loadings shown in Table 6.27, the path from TQM to Factor 1 (Executive Commitment) and 2 (Adopting the Quality Philosophy) illustrated as ϑ_{11} and ϑ_{12} are 0.542 and 0.515 respectively. This can further be shown as follows;

$$TQM \rightarrow F1 = 0.542$$

$$TQM \rightarrow F2 = 0.515$$

Thus the path between F1 and F2 can be computed as follows;

0.542*0.515 = 0.279, and that between F2 and F3 can be calculated as 0.415 (ϑ_{21} * ϑ_{31} = 0.515 *0.806).

This shows that the relationship between the TQM and its associated constructs at each level is stronger than within the constructs themselves. The AMOS software provides all these values and the results are summarised in the Table G9, (Appendix G). For each variable, the table presents the standardised regression weights, squared multiple correlation, sample covariance matrix and sample correlation matrix. The final TQ-SMART model is tenable from a content and theoretical standpoint. Furthermore, the final first-order TQ-SMART CFA model satisfies all of the measurement criteria. Cronbach's coefficient is widely used to measure scale reliability. These coefficients should be 0.70 or higher for narrow constructs, and 0.55 or higher for moderately broad coefficients. Table 6.27 indicates that all the values were higher than minimum requirements. Convergent validity was supported as all the factor loading (ϑ_{11} through ϑ_{101}) for each individual indicator (Table 6.30) to its respective construct was positive (greater than 0.50) indicating that all the 10 constructs were significant determinants of the TQM

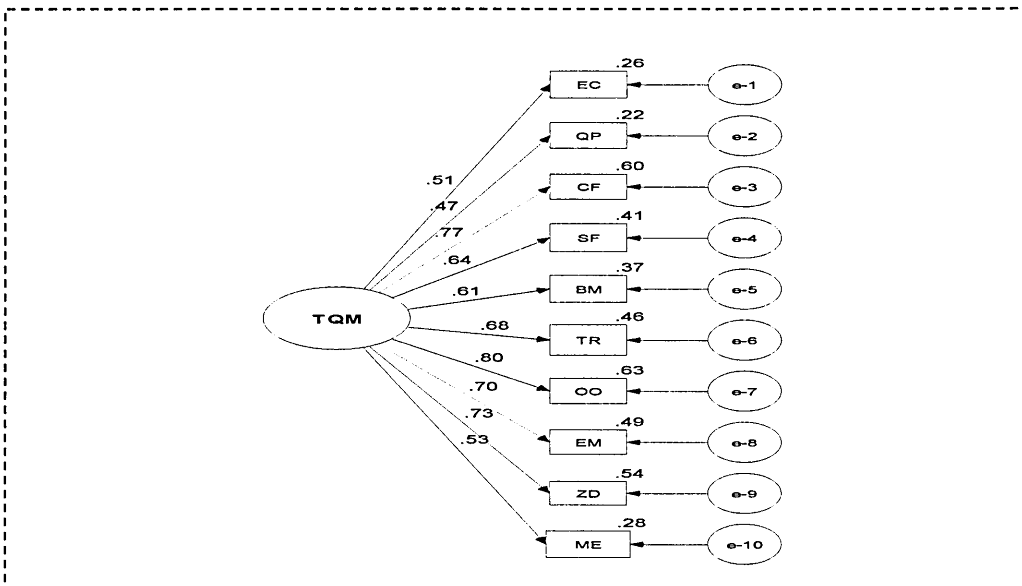


Figure 6.58-1: Results of the Second-Order Confirmatory Factor Analysis Model (Full Sample)

The strength of the relationships among the first order TQM variables in Figure 6.56 constructs are represented by the standardised path coefficients. These are summarised in Table G9 (Appendix G). The results of the structural model before specification are depicted in Figure 6.59

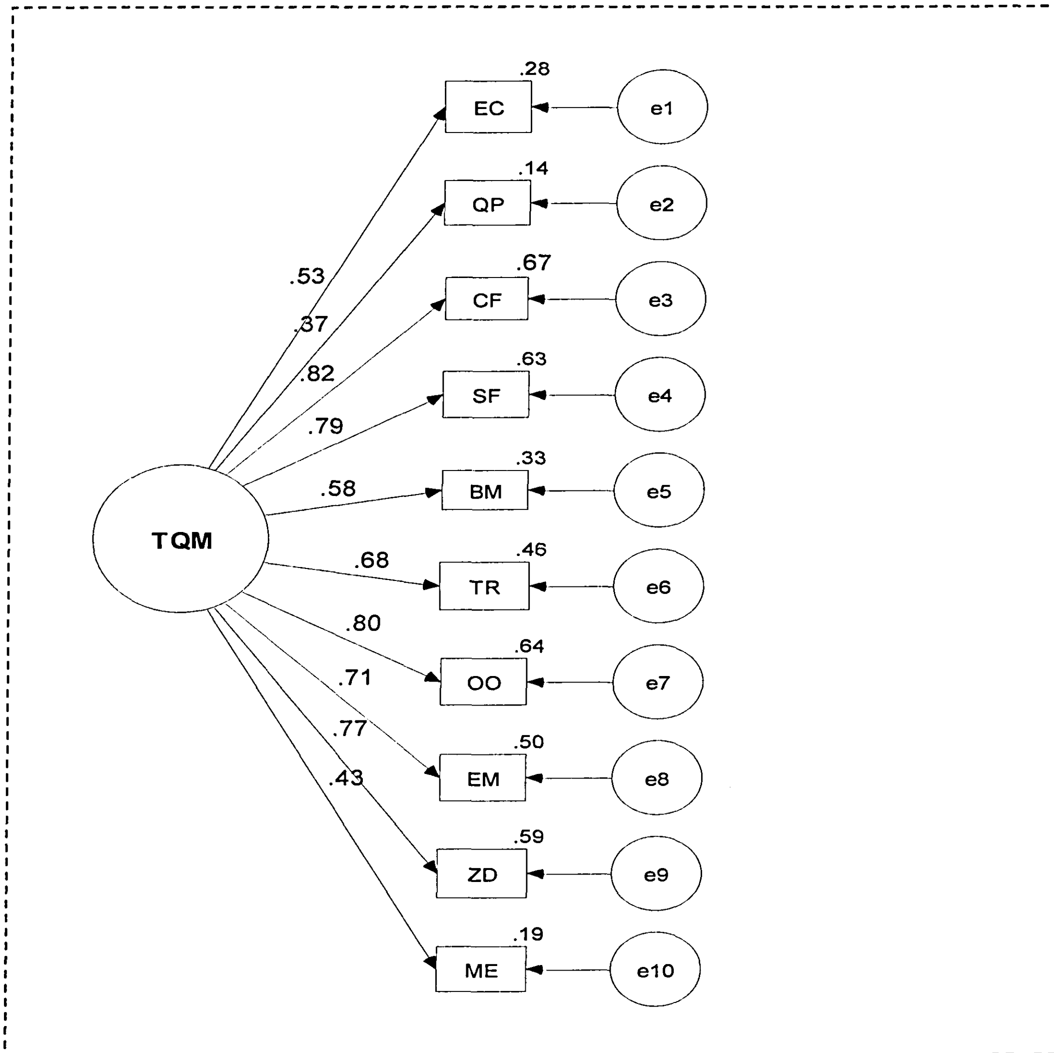


Figure 6.59: - One Factor TQM Model (Before Respecification) for non-TQM Deploying Organisations

The above model generated the following fit measures which are summarised in Table G2, Column 2 (Appendix G). The table indicates that the χ^2/df ratio was 3.981 (139.350/35), which is much higher than the threshold value of 3.00, as suggested by Curkovic et al (2000). Other indices did not support a good fit of data (AGFI = 0.342; RMR = 0.216; NFI = 0.549; CFI = 0.581) as compared to the recommended value suggested by Chau (1997). Therefore some improvement had to be achieved before testing of the structural model. The independence model had the following results taken from column 4, Table G2 (Appendix G): (χ^2 = 308.12; df = 45; p = 0.000; χ^2/df = 6.865; GFI = 0.58; TLI = 0.492, CFI = 0.605) All the indices were unacceptable with the χ^2/df been over fit. The poor fit as indicated by the non-significant chi-square statistic is because it accounts for all possible relationships between construct and construct, between construct and indicators and between indicators and indicators (Cheng, 2001: 653). Joreskog and Sorbom (1989) suggest usage of incremental modification in order to achieve the "best fitting" of the measurement model. Some of the modification indices are summarised in Table G15 (Appendix G). The results of the re specified model are illustrated in Chapter Seven (Figure 7.28) and summarised in Table G2, Column 5 (Appendix G)

H_{14}: The TQ-SMART Model depicted in Figure 6.56 as composed of a measurement and a structural equation model fits the sample data.

6.10.5.1 Convergent validity

Convergent validity refers to the degree to which the different approaches to construct measurement are similar to (converges on) other approaches that it theoretically should be similar to. Convergent validity is demonstrated by the statistical significance of the loadings at a given alpha (i.e. p = 0.05)

Three techniques are utilised for assessing Convergent Validity:
1. Statistical significance of the loadings at a given alpha (i.e. p = 0.05)
2. Average Variance Extracted (AVE) or Percent Variance Explained (PVE) = total effect / correlation
3. Reliability (standardised loadings) ($\vartheta_{11}$to ϑ_{101})

1. Statistical Significance

The convergent validity analysis was performed in ten stages using the step wise regression method. In the first model only variables belonging to the

Executive Commitment constructs were included. This was termed as Model 1. Test statistics showed that this model was inconsistent with sample data. The root mean square-residual (RMSR) was very high (RSMR = 0.190).

The residual sum of squares represents the total difference between the model and the observed data. (Field, 2000). All the models apart from No. 6 are insignificant ($p > 0.001$) and the F-ratio are not high values. The interpretation of this data was that it was difficult to predict whether an organisation was implementing TQM or not. Furthermore from Table 6.31, it was evident that when only Executive Commitment was used as a predictor, this became a simple correlation between executive commitment and implementing TQM ($r = 0.422$)

2. Average Variance Extracted

Discriminant validity is demonstrated if the average variance for each construct (within-construct variance) is greater than the squared correlations between constructs (between-construct variance). Fornell and Larcker (1981) suggest the use of the average variance shared between a construct and its measures (AVE). Discriminant validity among the ten elements of TQM was examined using Fornell and Larcker's (1981) techniques. In this test, a construct is empirically distinct if the average variance explained by that construct's items is greater than the construct's shared variance with every other construct (i.e. the square of the inter factor correlations between any two constructs (Φ^2)). For example, executive commitment (F1) demonstrates discriminant validity because the average variance extracted (AVE) are greater than the squares of its parameter estimates with each other construct with adopting the quality philosophy, F2 (AVE=0.60, Φ^2=0.078); customer focus, F3 (AVE=0.72, Φ^2=0.191); supplier focus (AVE=0.62, Φ^2=0.152); benchmarking (AVE=0.70, Φ^2=0.106); open organisation (AVE=0.77,

Φ^2=0.166); training (VE=0.77, Φ^2=204); employee empowerment (AVE=0.74, Φ^2=0.163); zero defects (AVE=,0.68 Φ^2=0.187); and measurement (AVE=0.74, Φ^2=0.095). Analysis of this data provides strong evidence of discriminant validity with the average variance of all constructs being greater than the construct's shared variance with every other construct. It is therefore reasonable to assume that all ten of the first order dimensions of the TQ-SMART scale to be undimensional. The inter factor correlation are reported in Table 6.27 below and the squares of the inter-factor correlations and average variances extracted are reported in Table 6.28 below. A ten factor correlated model representing each of the ten elements was used to examine discriminant validity, and is schematically shown in Figure 6.56

6.10.5.2 Relationship among the first-order factors

According to Cheng (2001), the structural model stage of analysis involves the evaluation of the relationship between the latent constructs. Table 6.27 presents the relationship among the first-order factors which can be used to infer the relative strength of relationship among the factors (variables) by their path loadings.

Table 6.27: Inter-Factor Correlations (Φ)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1	1.00									
F2	.279	1.00								
F3	.437	.415	1.00							
F4	.390	.371	.580	1.00						
F5	.326	.310	.486	.434	1.00					
F6	.407	.387	.605	.541	.452	1.00				
F7	.452	.429	.672	.600	.502	.626	1.00			
F8	.404	.384	.601	.537	.449	.560	.622	1.00		
F9	.432	.410	.642	.574	.480	.599	.665	.595	1.00	
F10	.308	.293	.458	.409	.343	.427	.474	.424	.453	1.00

Drawing heavily on Curkovic (2003), nomological validity was assessed from the final measurement model using the inter-factor correlation. An examination of Table 6.27 reveals that all correlations were statistically significant and very positive. Table 6.27 also indicates that there are moderately large correlations among the five core dimensions of benchmarking, zero defects, measurement, customer focus and supplier focus. Table 6.27 provides a direct picture of the relationship between the various TQM practices. This helps give a better understanding about the positive fit among the practices. As supported by Woon (2000), where the correlation among the TQM constructs provides an indication of the extent to which they reinforce one another in the TQM effort.

The highest correlation between Customer Focus and Open Organisation (Φ = 0.672) and each of the other constructs suggests that when employees have an open culture, more empowered, they'll interact more with meeting the customer's requirements. According to Cortina (2002), these structural coefficients in SEM are meant to represent the relationship among constructs. Bagozzi et al (1991) recommend the calculation of the partitioning of variance between the constructs as a stricter criterion of convergent validity. The results are shown in Table 6.28

Table 6.28: Squares of the parameter estimate between factors (Φ^2) and average variance extracted for pair of factors

	Average Variance Extracted (AVE)									
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1		0.5923	0.7222	0.6195	0.6988	0.7708	0.7681	0.7373	0.6837	0.7362
F2	0.0778		0.5167	0.4140	0.4933	0.5653	0.5626	0.5318	0.4782	0.5307
F3	0.1910	0.1722		0.5438	0.6232	0.6951	0.6924	0.6617	0.6080	0.6605
F4	0.1521	0.1376	.0.3364		0.5205	0.5924	0.5897	0.5590	0.5053	0.5578
F5	0.1063	0.0961	.0.2361	.0.1883		0.6718	0.6691	0.6383	0.5847	0.6372
F6	0.1656	0.1498	.0.3660	0.2927	0.2040		0.7410	0.7103	0.6566	0.7091
F7	0.2043	0.1840	.0.4516	0.3600	0.2520	.0.3919		0.7076	0.6539	0.7064
F8	0.1632	0.1475	0.3612	0.2884	0.2016	0.3136	0.3869		0.6232	0.6757
F9	0.1866	0.1681	.0.4122	0.3295	0.2304	0.3588	0.4422	0.3549		0.6220
F10	0.0949	0.0858	0.2098	0.1673	0.1176	0.1823	0.2247	0.1798	0.2052	
Square of inter factor correlations										

The significant managerial implication from Table 6.28 is that all the significant correlation coefficients among the constructs are positively related.

This suggests that implementing one construct does not negatively impact another construct (Tan and Wisner, 2004)

6.10.5.3 Reliability

Having established that each of the ten sub scales measuring various dimensions of total quality management do indeed discriminate between the ten identified total quality management factors, the next step in the confirmatory factor analysis as indicated in Figure 6.55 of Step 6.3 was to assess the reliability of each of the ten sub-scales. The internal consistency analysis was performed using the SPSS (Version 11.0) reliability program for the items of each of the ten critical success factors of TQM as part of step 6.3 in the development and validation of the measurement scale in Figure 6.55.

In order to assess internal consistency, there are two compulsory correlations that need to be determined. The first is the inter-item correlation, and the second is the item to total statistics. As shown in Figure 6.55, step 6.3, two measures are used to determine the internal consistency, namely Cronbach's α coefficient and the composite reliability coefficient. Although Cronbach's a coefficient has traditionally been used to evaluate reliability, it has received criticism as it makes some very restrictive assumptions as regards the equal importance of all the indicators and therefore, the valuation of reliability it makes can be biased. (Escrig-Tena, 2004:624) The following sub sections present the two measures. The composite reliability coefficient has been calculated from this expression

$$\text{Composite Reliability} = \frac{(\text{ Standardised Loadings})^2}{(\sum \text{Standardardized Loadings})^2 + (\text{Measurement Errors})}$$

Detailed Item Analysis

An internal consistency analysis was carried out to each of the ten constructs and the results of the alpha computed for each scale and respective items are presented in are summarised in Tables 6.29 and 6.30. Apart from the "adopting the quality philosophy" construct, the remaining constructs ranged from 0.5700 to 0.9339 thus indicating a high reliability of scales as values are > 0.7. (Nunnaly, 1988). The total scale alpha was 0.9334 suggesting that the scale had a very good reliability. Fagarasanu and Kumar (2002) define internal consistency as a measure of the homogeneity of compound parts of an instrument. The results of the internal consistency analysis are presented in Table 6.29.

Table 6:29: Internal Consistency analysis for the 10 scales

Scales		Number of Items	Deleted Number	Cronbach's alpha (α)	Composite Reliability Coefficient
1		**2**	**3**	**4**	**5**
1.	Executive Commitment	3	No	0.9339	0.8941
2.	Adopting Quality Philosophy	3	No	0.5700	0.5810
3.	Customer Focus	4	No	0.8946	0.8553
4.	Supplier Focus	3	No	0.7828	0.7547
5.	Benchmarking	3	No	0.8883	0.8384
6.	Training	4	No	0.8779	0.8268
7.	Open Organisation	3	No	0.9295	0.8965
8.	Employee Empowerment	4	No	0.9187	0.8852
9.	Zero Defects	3	No	0.8434	0.7276
10.	Measurement	4	No	0.8986	0.8418

Because of the small sample, a measure of the sampling adequacy using the Kaiser-Meyer-Olkin (KMO) was carried out and the results are indicated in Table 6.8 (Column 8) for the constructs, Table D7 (Appendix D) for the individual variables and for the Item-measure correlations in Table 6.30

Item Measure Correlations

Saraph et al (1989) showed how the assignment of items to scales should be evaluated. Using the method developed by Nunnally (1988), the correlation of each item with each scale was conducted. The item-score to scale-score correlations are used to determine if an item belongs to the scale as originally assigned by Powell (1995). Table 6.30 lists the correlation matrix for the 10 scales and their measurement items.

Table 6.30: Item to scale correlation matrix (Pearson correlation)

Scale	Item Number			
	1	2	3	4
1	0.8351	0.9330	0.8355	-
2	0.5199	0.6478	**0.0637**	-
3	0.7869	0.8720	0.7826	0.6413
4	0.5104	0.7248	0.6392	-
5	0.7174	0.8490	0.7831	-
6	0.7438	0.7487	0.7902	0.6692
7	0.8500	0.8603	0.8669	-
8	0.7607	0.8085	0.8528	0.8352
9	0.6090	0.8056	0.7263	-
10	0.7008	0.8467	0.8738	0.6825

All values in this Table 6.30 apart from item 3 of scale 2 were greater than 0.5. As suggested, all items with the value lower than 0.5 indicate the lack of sharing enough variance with the rest of the items in that particular scale and therefore would be deleted. In this particular case, the item was not deleted in order to have a homogenous scale. As the detailed item analysis results were satisfactory, the items reported in Table 6.30 were considered as the final items used in the survey. Prior to testing the results of the hypotheses, the statistical assumptions were diagnosed in order to satisfy the criteria set out in the flow chart in Figure 6.12.

The second assumption of the absence of multicollinearity among the 34 variables was diagnosed through observing the factor correlation matrix in SEM (Peng et al, 2004). An examination of Table 6.27:Inter-factor correlations show that none of the coefficients is greater than 0.8, indicating that there is no significant violation to the non-multicollinearity assumption. According to Peng et al (2004), this provides a robust basis for the interpretations of the results in path analysis. The third assumption regarding the number of parameters estimated in SEM, according to Peng et al (2004), there is no absolute mechanism to diagnose this assumption; however based on the working log reported by the AMOS software, all the parameter estimations and test converged were solved in eleven iterations. Therefore this frees the concerns of the parameter number problem. Having satisfied all the assumptions through the diagnosis, the results of the hypothesis testing reported in the thesis can be checked. Table 6.31 shows the standardised regression coefficients, R^2 and adjusted R^2 for the seven regression equations of the non-mechanistic model.

Table 6.31: Non-Mechanistic 7 Construct Model Summary of Regression Analysis

Model	Multiple R	R^2	Adjusted R^2	St Error of the Estimate
1-EC	.422[a]	.178	.137	.43598
2-QP	.510[b]	.260	.181	.42462
3-CF	.521[c]	.271	.131	.43732
4-SF	.622[d]	.387	.225	.41314
5-TR	.757[e]	.573	.411	.36006
6-OO	.762[f]	.581	.382	.36889
7-EE	.800[g]	.640	.413	.35950

The interpretation of the Model 7 in Table 6.31 is that if the sample was drawn from the population, then the expected variance would be R^2 less the adjusted R^2 value, which would be 0.640-0.413=0.227. This means that the variance from the sample would be 22.7 per cent.

6.10.6 Usefulness Analysis

The usefulness analysis determines which part of the variance is explained by the constructs, the measurement models, the correlations between the methods, and the correlations between the constructs. (Llusar and Zornoza, 2000)

Table 6.32: Summary of bi-variate regression of convergence of TQM against the summation of the variable

Model	Change Statistics				
	R^2 Change	F Change	df1	df2	Sig. F Change
1	.178	4.272	3	59	.009
2	.082	2.066	3	56	.115
3	.011	.199	4	52	.938
4	.116	3.088	3	49	.036
5	.185	4.878	3	45	.002
6	.009	.290	4	42	.832
7	.059	1.556	4	38	.206

The change statistics provided for in Table 6.32 indicates how much the change is in the F-ratio resulting from each block of hierarchy. For example, in this case of the non-mechanistic 7 factor model, model 1 which has the executive commitment as the only construct cause R^2 to change from zero to 0.1778, and this change in the amount of variance explained gives rise to an F-ratio of 4.272 , which is significant with a lower value ($p=0.009 < 0.05$)

Table 6.33: Model Summary of Regression Analysis (Integrated Model)

Model (Construct)	Multiple R Correlation Coefficient	R^2	Adjusted R^2	St Error of the Estimate
1	.422[a]	.178	.137	.43598
2	.510[b]	.260	.181	.42462
3	.521[c]	.271	.131	.43732
4	.622[d]	.387	.225	.41314
5	.694[e]	.481	.301	.39234
6	.801[f]	.641	.470	.34152
7	.812[g]	.660	.459	.34505
8	.838[h]	.703	.474	.34032
9	.853[i]	.727	.471	.34123
10	.872[j]	.760	.468	.34229

R Square is the coefficient of determination, and is the squared value of the multiple correlation coefficients. It shows that about half the variation in time is shared (determined) by the model.

From Table 6.33, R^2 values range from 0.76 for a ten-construct model to 0.178 for a one construct model. As the R^2 states how much of the variance in Y is accounted for by the regression model from the sample, it can be concluded that the ten construct model as hypothesised is the better option, as it can explain above the recommended variance (> .70). The second model indicated in Table 6.33 includes the three variables each for the executive commitment and adopting the quality philosophy constructs. The value of the squared multiple correlation is ($R^2 = .260$) which means that executive commitment and adopting the quality philosophy constructs accounts for 26.0 per cent of the variation in implementing TQM. As the two (six) predictors are included in this model, the value increases from 0.178 or 17.8 per cent to 0.26 or 26.0

per cent, thus the inclusion of more predictors explains quite a large amount of variation. Furthermore the data collected found a strong association between the implementation of TQM and the independent variables. Table 6.33 shows that the explained variation (R^2) improves from 17.8 percent for the executive commitment construct as the only one in the model to 76.0 per cent for a 10 construct model incorporating all the factors. The above results confirms that there is a positive relation between the implementation of TQM and adoption of the ten deployment constructs as suggested by the R square value of 0.760 and adjusted value of 0.468. Table 6.33 reports the strength of the relationship between the model and the dependent variables. The multiple (R) correlation coefficients, is the linear correlation between the observed and Model-predicted values of the dependent model. Its large value indicates a strong relationship. The conclusion drawn from the regression analysis is that TQM is best implemented on a holistic approach rather than a piece meal approach.

Table 6.34: Summary of bi-variate regression of convergence of TQM against the summation of the variable

Model	Change Statistics					Durbin-Watson
	R^2 Change	F Change	df1	df2	Sig. F Change	
1	.178	4.272	3	59	.009	1.464
2	.082	2.066	3	56	.115	
3	.011	.199	4	52	.938	
4	.116	3.088	3	49	.036	
5	.094	2.778	3	46	.052	
6	.160	4.677	4	42	.003	
7	.019	.715	3	39	.549	
8	.043	1.273	4	35	.299	
9	.024	.938	3	32	.434	
10	.033	2.603	4	28	.006	

The Durbin-Watson statistic tests for correlations between errors. According to Field (2000) any values less than 1 or greater than 3 should be cause for concern. The recommended value should be closer to 2 and for the data in this sample the value is 1.464 which indicates that the assumption of independent errors is tenable. Table 6.34 shows the results of the usefulness analysis. Executive commitment explained the highest variance ($\Delta R^2 = 0.178$, $p < 0.05$). However the inclusion of adopting the quality philosophy in the second model made no significant contribution to the explained variance in the implementation of TQM ($\Delta R^2 = 0.082$, $p > 0.05$) and the three hard or mechanistic factors namely Benchmarking ($\Delta R^2 = 0.094$, $p < 0.05$). Zero Defects ($\Delta R^2 = 0.024$, $p < 0.05$) and Measurement ($\Delta R^2 = 0.033$, $p < 0.05$).

6.10.7 Discriminant validity

In order to demonstrate discriminant validity, it is necessary to show that the measures that should not be related are in reality not related. The necessary steps in illustrating discriminant analysis are shown in form of a flow chart in Figure 6.60

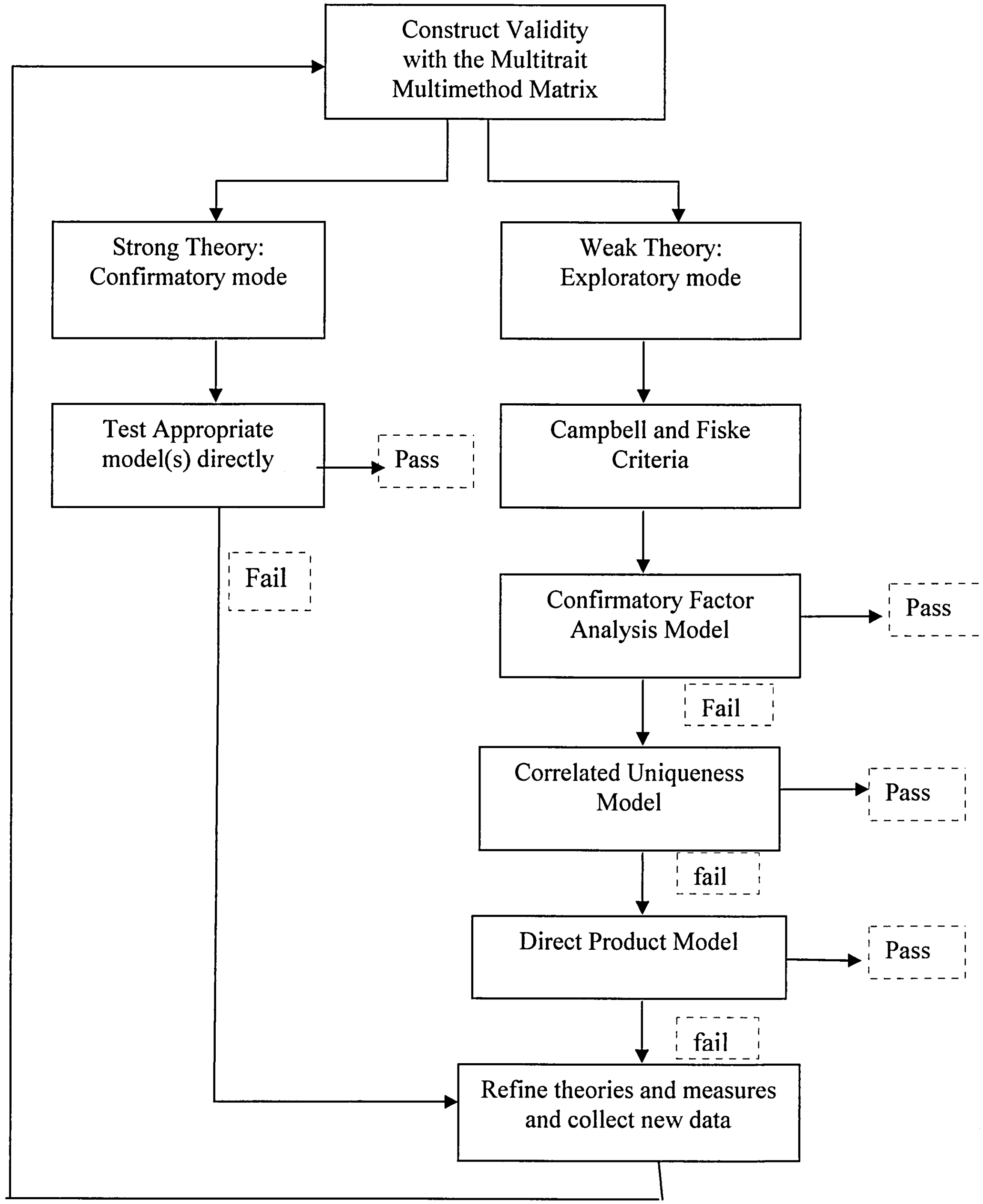


Figure 6.60: Guidelines for the Analysis of MTMM Matrix Data
Source (Bagozzi, 1998

Discriminant validity is demonstrated if the average variance extracted for each construct (within-construct variance) is greater than the squared correlations between constructs (between-construct variance). Discriminant validity among the ten elements of TQM was examined using Fornell and Larcker's (1981) technique. A ten factor correlated model representing each of the ten elements was used to examine discriminant validity and is schematically shown in Fig 6.61. For this model, the squared correlation among the constructs is shown in Table 6.28. In all cases, the variance shared by constructs was much less than the average variance extracted for any one of the constructs measurement items.

6.10.8 Construct Validity

In order to satisfy the construct validity, the following hypotheses was generated.

H_{13}: The ten constructs of TQM as measured by their respective items (V_1 through V_{34}) are significantly different from each other.

A structural equation approach in AMOS (with FILM estimation) is used to test the theoretical model. This reduced forms the first-order constructs aggregated to form indicator variables for the second-order constructs of Total Quality Management.

The confirmatory factor model used to achieve the construct validity is shown in Figure 6.61. This is equated to the second order factors and derived from Figure 6.56.

Before the relationship between TQM and Business and Organisation Performance Indicators (BOPI) could be investigated, it was necessary to confirm that the TQM constructs were related to TQM. This was tested with a second order confirmatory analysis model as shown in Figure 6.62, where it was assumed that if the constructs were related to each other, they would all load on a higher order factor nominally called TQM. This is shown in the form of the circle in Figure 6.61. The model was set up as shown in Figure 6.61 for the full sample and Figure 6.62 for the TQM deploying sample.

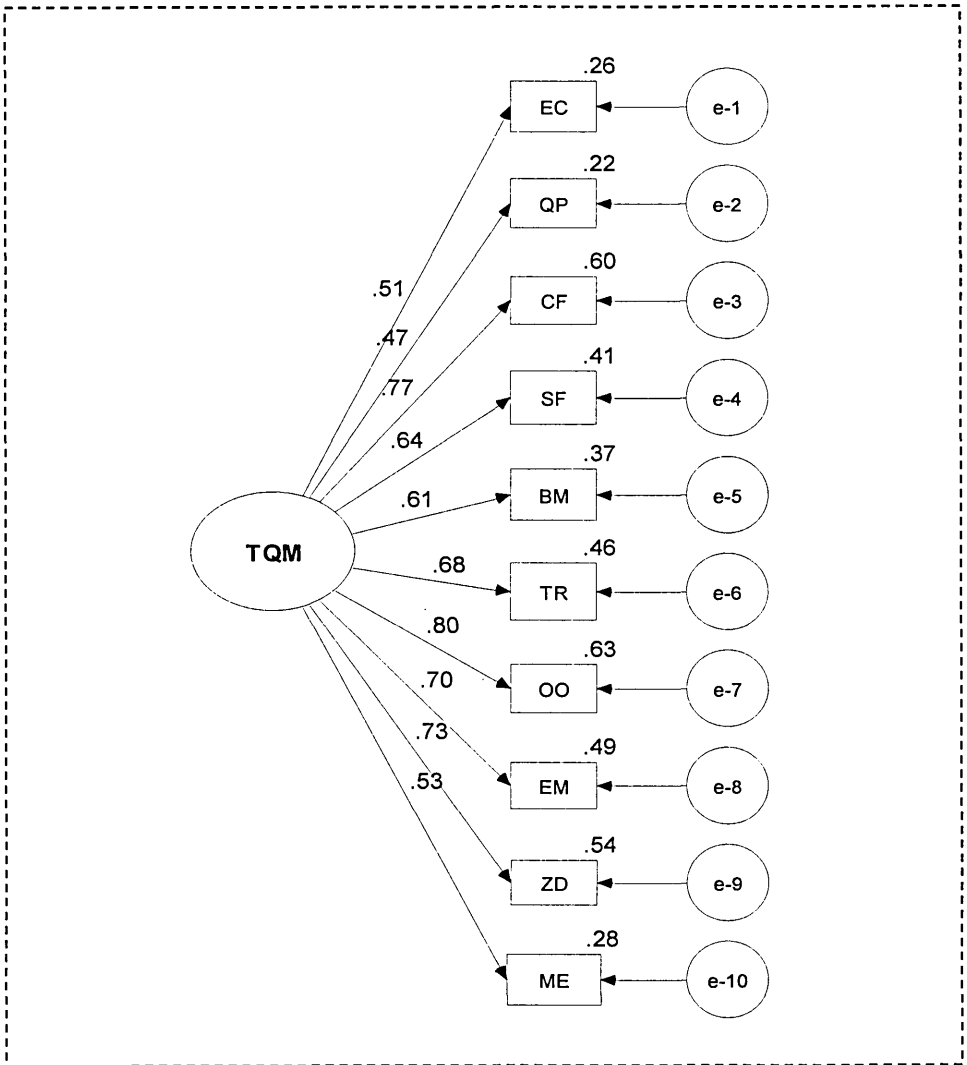


Figure 6.61: Results of the Second-Order Confirmatory Factor Analysis Model (Full Sample, n = 63)

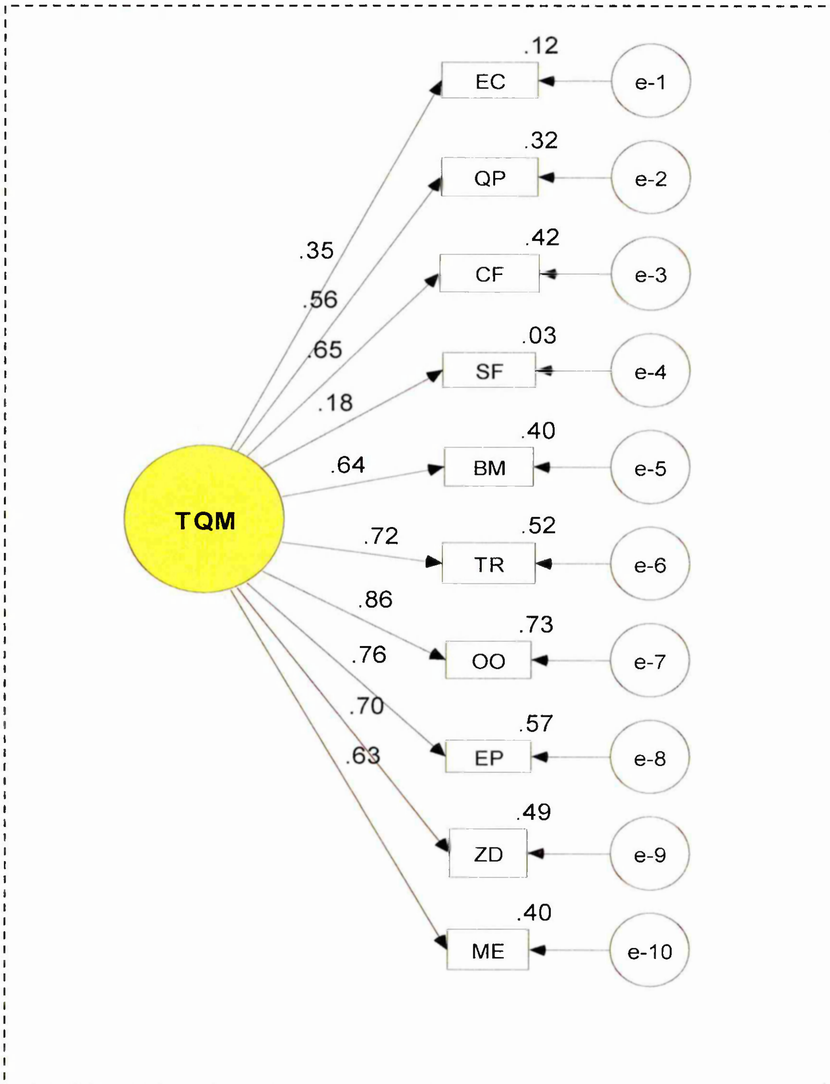


Figure 6.62 Results of the Second-Order Confirmatory Factor Analysis Model (TQM Deploying Sample)

For the one factor model, the chi-square statistic produced by AMOS in the confirmatory factor analysis is not significant (χ^2_{20} = 52.859, p = 0.027), Goodness-of-fit index is low (GFI = 0.691), root-mean-square is slightly high (RMSR = 0.164). All these indicate that the one factor model is consistent with the sample. (CFI = 0.755, TLI = 0.685)

The five popular measures of fit (Hair et al 1998) are shown. Chi-square ($\chi 2$ - unacceptable fit; $p < 0.05$); Normed chi-square (χ^2/df - acceptable fit; 2 < χ^2/df < 3; overfit; χ^2/df < 1) goodness-of-fit index (GFI - unacceptable fit; 0.95 < GFI <1; reasonable fit; 0.9 < GFI < 0.95), Tucker-Lewis Index (TLI- acceptable fit; TLI > 0.95; reasonable fit; 0.9 < TLI < 0.95; lack of parsimony; TLI > 1.0); root mean-square error of approximation (RMSEA - acceptable fit; RMSEA < 0.05; reasonable fit; 0.05 < RMSEA< 0.08). For the measurement model in Figure 6.62, two of the five measures are reasonable or outside the acceptable fit range. This suggests that the data did not adequately fit the model. The results show that the empirical data did not adequately fit this second order TQM Model. An examination of the modification indices suggested that co varying errors e_1 and e_2 would improve the model.

6.10.9 Criterion-related validity

Correlation analysis was used to test for criterion validity. Criterion related validity has been defined in chapter three as pertaining to a relationship between a measure and another independent measure. For the purpose of this study the ten TQM implementation constructs taken as the predictor set and the criterion set was that of the two measures of *business performance* and the two measures of *organisation performance.* Only the TQM deploying organisations were considered in this analysis as the objective was to determine whether the implementation of TQM was correlated to organisation performance. The bivariate correlation (Pearson's coefficient) was employed to study the interrelationships between the independent and dependent variables.

The TQM Impact on Organisation Performance has 30 variables, with 16 unobserved variables (i.e. 10 measurements errors e_1 through e_{10}, 4 measurement errors for organisation performance ($a\text{-}_1$ through $a\text{-}_4$) and the two factors, organisation performance and TQM. Figure 6.63 shows the confirmatory factor analysis for the impact of TQM on Organisation Performance.

The criterion-related validity of the combined set of ten dimensions of quality management was estimated by finding the multiple correlation coefficients computed for the ten dimensions and measures of the unit's quality performance similar to the approach by Powell (1995)

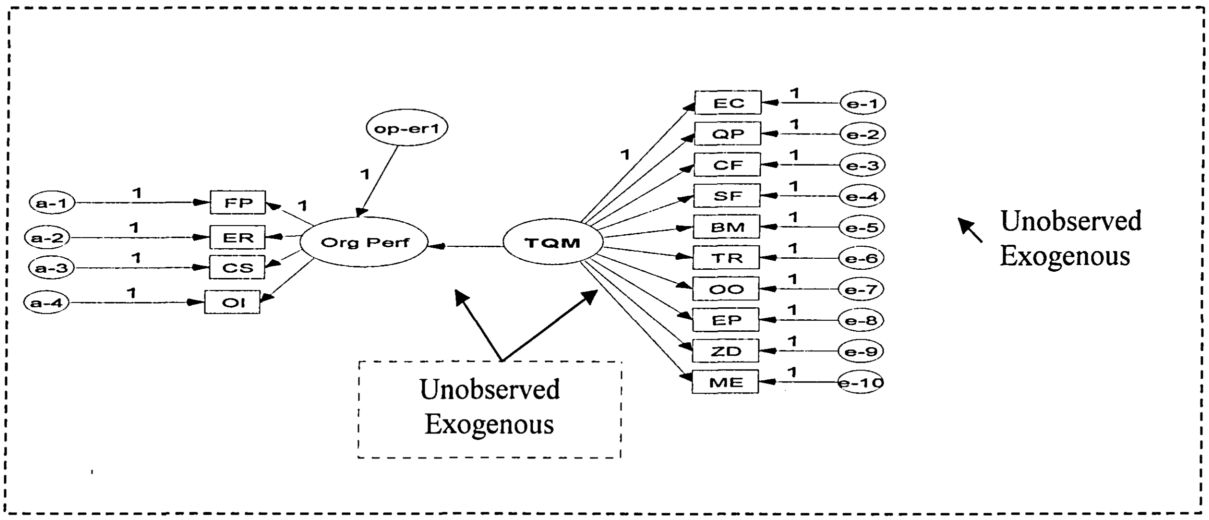


Figure 6.63: Confirmatory Factor Analysis for the Impact of TQM on Organisation Performance

The results for chi-square statistic was significant ($\chi^2{}_{20}$ = 237.907, p = 0.000), indicating that the model sample was not consistent with the data collected. Supporting evidence about the inadequacy of the model was provided by the following statistics (TLI = 0.112, CF1 = 0.249, RMSEA=0.332 and the parsimony ratio = 0.846) indicating the sample was significant and the model sample was not consistent with the data collected. The option for determining criterion-related validity is established by correlating the scale scores with the four constructs considered to be outcomes of the TQM programme that is the financial performance, employee relations, customer satisfaction and operating indicators.

One of the objectives of the study was to investigate the relationship among the ten TQM practices and to identify the direct and indirect effects of TQM practices on the various dimensions of business and organisational performance. In order to verify the hypothesis (H_{12}) that soft factors or infrastructure factors depicted as TQM1 in Figure 6.64 and characterised by the constructs of

- Executive Commitment (EC)
- Adopting the Quality philosophy (AQP)
- Employee Empowerment (EE)
- Open Organisation (OO)
- Training (TR)

predict SMEs business performance better than the hard factors namely,

- Benchmarking (BM)
- Zero Defects (ZD)
- Measurement (ME)
- Supplier Focus (SF)
- Customer Focus (CF)

a correlation analysis was performed between the TQM deployment factors and TQM outcomes or the Business and Organisation Performance Indicators (BOPI) shown as Org-Per (ellipse) in Figure 6.59 which is represented by the four indicators namely Financial Performance (FP), Employee Relations (ER), Customer Satisfaction (CS) and Operating Indicators (OI).

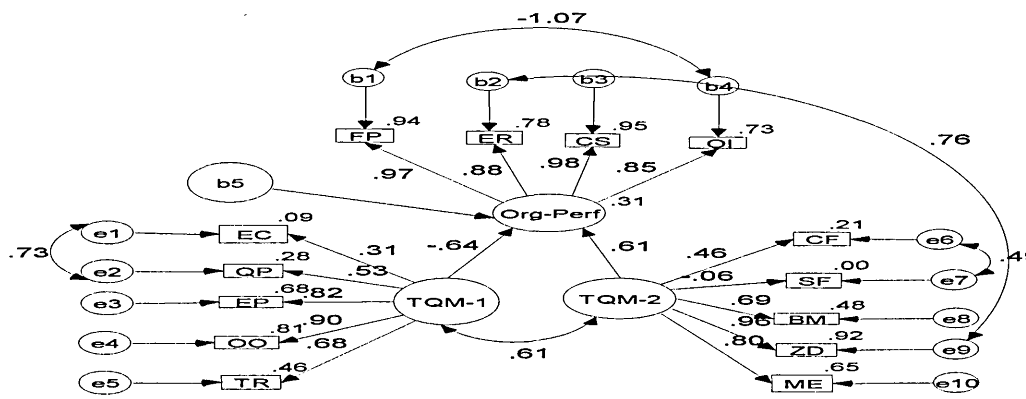


Figure 6.64 Hard and Soft Factors Impact on Organisation Performance for TQM Deploying Organisations

For this purpose, a variable equivalent to the average of the ten deployment constructs, which was used as the TQM level for any given organisational TQMI as shown in Table 6.35 (mean = 2.8014), and a variable was created for the Business and Performance Indicators as the average of the four TQM outcomes (mean = 2.9302). The ten TQM factors correlated positively (r^2 = 0.76). Powell (1995) used a similar procedure

6.10.10 Investigating the Inter-play between TQM and BOPI

However in order to investigate the interplay among the variables of the TQM practices (constructs and BOPI) Structural Equation Modelling was used and is depicted in Figure 6.64. The Business and Organisational Performance Indicator was portrayed as a construct which could be measured through its four variables. The two step procedure as recommended in the estimations with SEM (Anderson and Gerbing, 1998) is adopted. This involved the adjustment of the TQM measurement models on each of the 15 business and organisation variables, the structural models that include the relationships derived from the hypothesis outlined in Chapter Two and stated in this

Chapter. The factor loadings (λi)were very high (0.97, 0.88, 0.98 and 0.85) for the financial performance, employee relations, customer satisfaction and operating indicators respectively. The highest being that of customer satisfaction (mean = 3.443, λi = 0.98) followed by financial performance (mean = 3.333, λi =0.97). The squared multiple correlation for the BOPI were all above the value of 0.7 indicating that the model accounted for more than 70% of the variance.

Hypothesis (**$H_{7\text{-}2}$:**) predicts that as a result of proper implementation of the quality constructs, medium-sized TQM deploying UK construction related organisations performed better in organisation performance. This hypothesis is supported by the study as shown in Table 6.36. The p-values indicate significant statistical differences in the organisation performance between small and medium organisations.

Table 6.35: Quality management differences between small and medium TQM deploying constructional related organisations

Factors	Small (n=6)		Medium (n=14)		*t*-value
	Mean	sd	Mean	sd	
Quality Constructs					
Executive Commitment	4.278	.9509	4.071	.7297	0.462
Adopting the Philosophy	3.056	.8549	3.239	.7219	-0.458
Customer Focus	3.208	1.123	4.000	.7467	-1.584
Supplier Focus	2.668	.3652	3.286	.8362	-2.301
Benchmarking	2.056	1.453	2.785	1.1811	-1.084
Training	2.458	1.345	2.693	1.0122	-0.383
Open Organisation	2.833	1.572	3.287	1.1896	-0.633
Employee Empowerment	2.333	1.506	3.304	.9103	-1.468
Zero Defects	2.666	1.521	3.643	1.0822	-1.425
Measurement	2.458	1.259	3.275	1.2069	-1.346
Average	**2.8014**		**3.358**		
Performance constructs					
Financial Performance	3.333	1.866	2.855	1.239	0.109
Operating Indicators	2.500	1.264	2.250	1.051	0.688
Customer Satisfaction	3.443	1.916	3.095	1.428	0.195
Employee Relations	2.445	1.424	2.571	1.423	0.851
BOPI	**2.9302**		**2.6927**		

6.10.11 Results of the Impact of TQM Practices on Business and Organisational Performance Indicators

One of the objectives was to observe the impact of TQM on organisation and business performance. The ten critical success factors were utilised as independent variables to determine their usefulness for predicting changes in the dependent performance related variables. For each of the ten factors, a factor variable was created by averaging the responses for items contained within the factors (n =20) for TQM deploying organisations. The hypothetical relationships are shown in Figure 6.63. Having obtained the composite measure of TQM and Business and Organisational Performance constructs based on the two-staged procedure, it was then possible to conduct the correlation between the TQM and BOPI. The composite BOPI for small-sized UK Construction-related TQM deploying is indicated in Table 6.35 (mean = 2.9302) and for Medium-sized (mean = 2.6927)

The multiple correlation coefficients (R) of the quality performance measure and the ten dimensions of quality management were found to be 0.67. This value indicates that the ten measures of quality management, considered together, have a higher degree of criterion-related validity. The theoretical model adopted in this study for the examination of relationships of a number of independent variables of the TQM constructs on the dependent variable of Financial Performance Index.

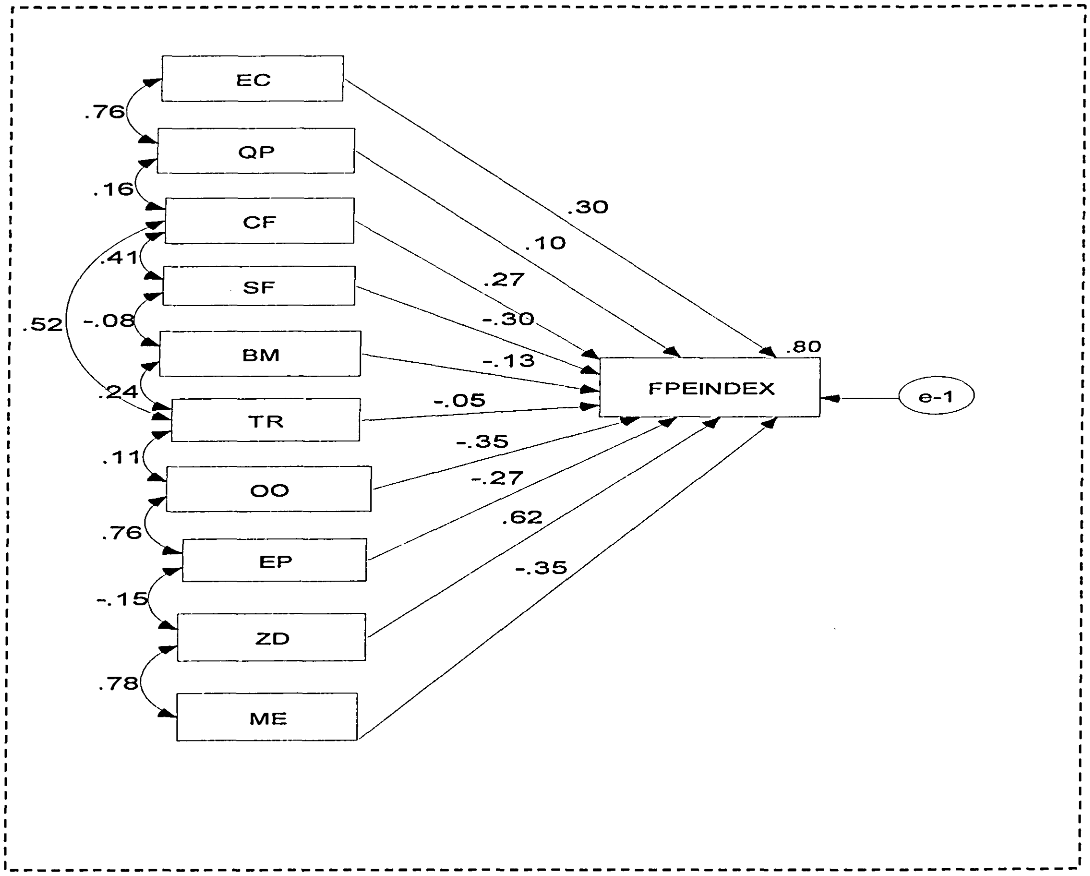


Figure 6.65: Impact of TQM on Financial Performance (Standardised Values)

The key construct of Financial Performance has been developed as a composite measure consisting of the Market share, Sales Per Employee (SPE), Return on Assets (ROA), Internal / External Efficiency and Return on Sales Profitability (ROSP).

The multiple correlation coefficient (R) of the quality performance measure and the ten dimensions of quality management were found to be 0.80. This value indicates that the ten measures of quality management, considered together, have a higher degree of criterion validity.

From Figure 6.65, the multiple correlation coefficients (R) of the quality performance measure and the ten dimensions of quality management were found to be 0.80. This value indicates that the ten measures of quality management, considered together, have a higher degree of criterion-related validity. It is evident that only EC, QP, CF and ZD positively contribute to financial performance. The above respecified model generated the following revised fit measures: χ^2= 49.170, df = 35.0, p = 0.057, χ^2/df = 1.405, RMR =0.462, GFI =0.682, AGFI =0.401 NFI = 0.640, IFL = 0.861, TLI =0.782, CFI = 0.827, RMSEA = 0.146 and parsimony ratio = 0.636

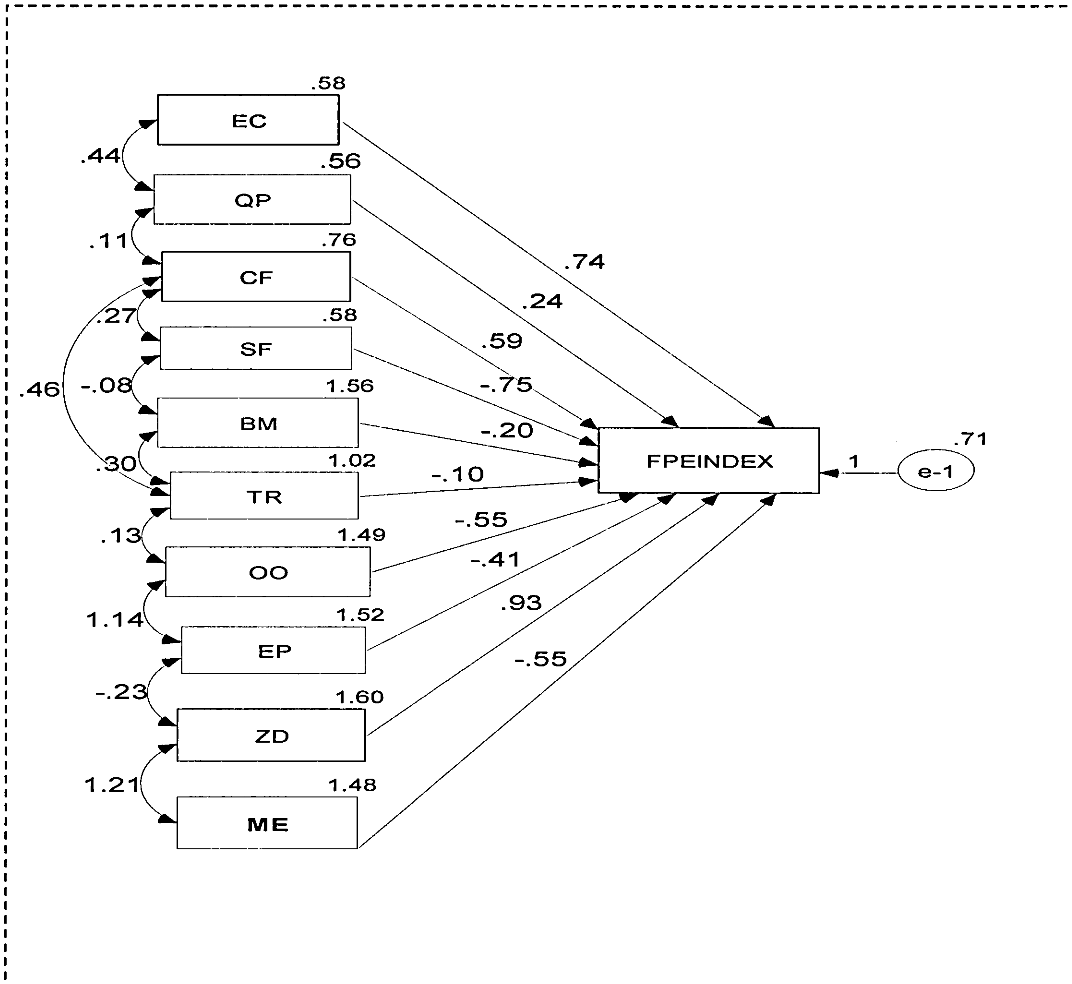


Figure 6.66: Results of Impact of Total Quality Management as a direct contributor to Financial Performance (Unstandardised Values)

This sub section examined three mechanisms by which TQM contributes to organisation performance.

6.10.12 Discussion of Results from the Regression and Confirmatory Factor Analysis

Because no prior order of inclusion existed in the model, forced-entry multiple regression was used on the independent variables using the market share, sales per employee and internal and external efficiency for the performance measures. The utility of the models was checked using the analysis of variance F-test and the multiple coefficient of determination.

Table 6.36 Impact of TQM Implementation on Market Share

Variable		Unstandardised Coefficients		Standardized Coefficients	t	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	3.502	2.164		1.618	.140
	EC	.534	.713	.253	.750	.473
	QP	.417	.814	.188	.512	.621
	CF	-1.759E-02	.538	-.010	-.033	.975
	SF	-.663	.474	-.310	-1.399	.195
	BM	-.443	.334	-.343	-1.326	.217
	TR	.213	.414	.141	.515	.619
	OO	-.706	.445	-.552	-1.587	.147
	EP	-.399	.446	-.283	-.893	.395
	ZD	1.196	.493	.922	**2.428**	.038
	ME	-.667	.421	-.505	-1.586	.147

Multiple R = 0.843 ; $R^2 = 0.710$; $F = 2.204$, Significance of $F = 0.125$

Even though the model fit looks positive ($R^2 = 0.70$), the first section of the coefficients in Table 6.36 shows that there are too many predictors in the model. There are several non-significant coefficients indicating that these variables do not contribute much to the model.

Table 6.37: Regression Summary of Organisation Performance and TQM Factors

Stepwise regression procedure	Intercept	Regression Component (parameter estimate)	R	R^2	*F* ratio
1.Market Share	3.502 5.151	EC (0.544) QP (0.417) EP (-0.747) ZD (1.196)	0.843	0.710	2.204
2. Sales per employee	1.657	EC (.569) CF (.643) SF (-.681)	0.793	0.628	1.526
3. Return on assets	-0.100	SF (-0.421) ZD (0.785)	0.801	0.642	1.613
4. Internal and External Efficiency	1.786	SF (-0.514)	0.658	0.432	0.686
5. Return on Sales and Profitability	0.936	EP (-0.661)	0.783	0.613	1.424
6. Employee Satisfaction	1.215	EC (0.494) SF (-0.703) EE (-0.765) ZD (0.711)	0.755	0.570	1.191
7. Attendance	5.137	BM (-0.665) ZD (-0.379)	0.847	0.717	2.277
8. Number of useful suggestion	0.813	QP (.613) CF (.160) (ZD (.896)	0.696	0.484	0.845
9.Employee turnover	0.824	CF (.160)	0.689	0.457	0.815
10. Overall satisfaction	2.871	EC (.881) CF (.660) EP (-.394) ZD (.800)	0.685	0.470	0.797
11. Customer Satisfaction	2.992	EC (.922) SF (-.756) OO (-.569)	0.836	0.698	2.082
12. Customer Retention	3.384	EC (.926)	0.702	0.493	0.876
13. Reliability	5.190	EC (1.027)	0.857	0.734	2.487
14. Timeliness of Delivery	4.964	EC (.936)	0.806	0.649	1.663
15. Product Lead Time	3.240	SF (-0.610) ZD (1.098)	0.780 0.173	0.608	1.396

6.10.13 The Impact of Product Lead Time (PLT) on the TQM Deployment Constructs

The Model summary information for the impact of the 15 business and organisation performance indicators on the dependent ten deployment constructs is illustrated in Table 6.37. The R^2 which is a measure of how much variability in the outcome is accounted for by the predictors. For the

PLT model, this value is 0.608 which means that all the predictors combined together account for 60.8% of the variance in the PLT. The adjusted R^2 value provides an indication of how well the model generalises. Ideally this value should be the same or very close to the value of R^2 (Field, 2000). For this model the difference between the values is 0.608-0.173 = 0.435 (43.5%). This shrinkage means that if the model were derived from a sample, it would account for approximately 43.5% less variance in the outcome.

6.10.13.1 An Example of Model 1: Impact of Market Share

Market Share = $\beta_0 + \beta_1$**EC** + β_2**QP** + β_3**CF** + β_4**SF** + β_5**BM** + β_6**TR** + β_7**OO** + β_8**EE** + β_9**ZD** + β_{10}**ME**

Where the β values shows the relationship between market share and each of the ten predictors, in this case the ten critical success factors. The values of the β_0 can be found in Table 6.36 as the constant for the dependent variable. This approach is used for the fifteen dependent variables. Based on the output of the analysis for the sales per employee, the above formula is written as follows:

Market Share = 3.502 + (0.534 **EC**) + (0.417**QP**) - (0. 00176**CF**) - (0.663**SF**) - (0.06**BM**) - (0.213**TR**) - (0.706**OO**) - (0.399**EE**)+ (1.196**ZD**) - (0.667**ME)**

For this data four predictors have positive β values indicating positive relationships and six predictors have negative β values indicating negative relationships. For example the interpretation of the above means that the executive commitment (β = 0.534), this value indicates that as the executive commitment increases by one unit, sales per employee would increase by 0.534 units. This interpretation would be true if the effects of the remaining nine predictors were to be held constant. The β values indicate the individual contribution of each predictor to the model (Field, 2000). Therefore from Table 6.36, Zero Defects has the highest contribution (β = 1.196) followed Executive Commitment (β = 0.534) and Quality Philosophy (β = 0.417)

6.10.14 Structural Equation Modelling (SEM)

The basic components of Structural Equation Modelling were illustrated in Figure 6.4 as having two components; the following sub section presents the measurement model of the SEM.

Testing the Model fit

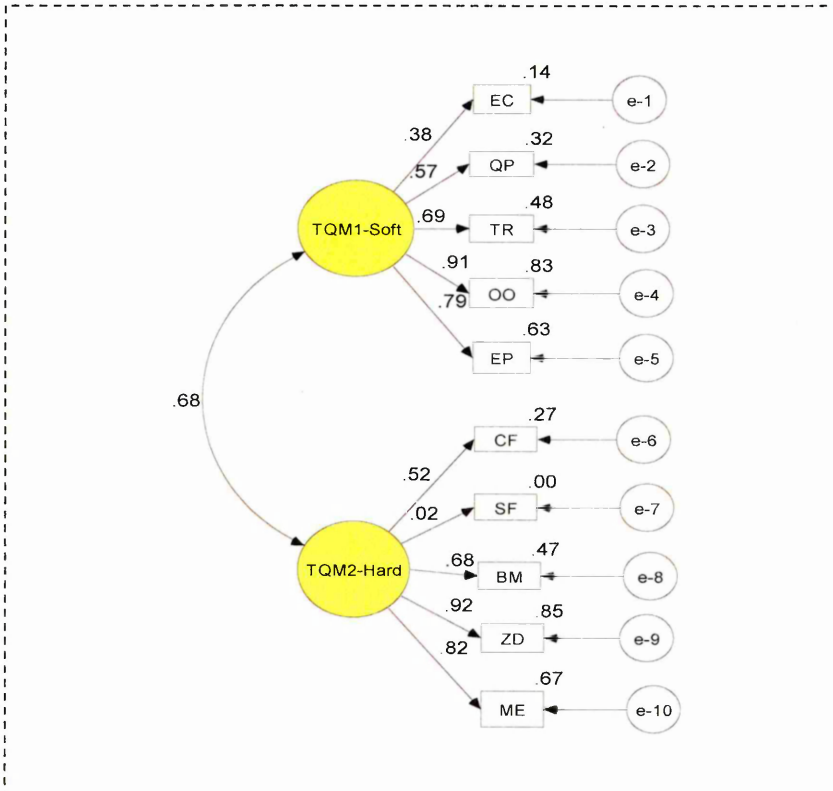


Figure 6.67: Two Factor Model (TQM Deploying Organisations)

For the two factor model, the results of the SEM are summarised in Table G1, column 2 (Appendix G). The chi-square statistic (χ^2) produced by AMOS in the confirmatory factor analysis is not significant ($\chi^2_{34} = 44.290$, $p = 0.111$), Goodness-of-fit index is low (GFI = 0.740), root-mean-square residual is slightly high (RMSR = 0.1115) . It is recommended that the RMSR should be less than 0.10 in order to have confidence in the model (Hajjat, 2002). All these indicate that the two factor model is not consistent with the sample. (CFI

= 0.859, TLI = 0.813). The largest modification index values were found in the first two pairs of residual covariances. For example, the covariance of the model was to be re-specified with the covariance added and refitted to the model. The model's chi-square test of overall fit should be approximately 4.197 units lower than the model's present value of 44.290. Furthermore, from the values of modification index shown in the Table G15 (Appendix G), the model could further be improved by adding the covariance between e-$_1$ and e-$_2$ which would be expected to be 0.315 with the models chi-square test of overall fit reducing by approximately 9.961. However caution is normally exercised as this would entail relying on empirical data rather than theory to re-specify the model. However from this, there is a strong theory to support the re-specification as the added covariance would be between executive commitments and adopting the Quality philosophy, and since the data is from the same research participants, it can be concluded that there may be shared variance between the two factors. The re-specified two-factor model for the TQM deploying organisations is shown in the above Figure **6.68.** The equation which comprise the measurement model of the LISREL notation with the coefficient mean, manifest variables and constructs corresponding to those used in the model are shown in Figure 6.68.

$$X_1 = \lambda_1\xi_1+\delta_1$$
$$X_2 = \lambda_2\xi_2+\delta_2$$
$$X_3 = \lambda_3\xi_3+\delta_3$$
$$X_4 = \lambda_4\xi_4+\delta_4$$
$$X_5 = \lambda_5\xi_5+\delta_5$$
$$X_6 = \lambda_6\xi_6+\delta_6$$
$$X_7 = \lambda_7\xi_7+\delta_7$$
$$X_8 = \lambda_8\xi_8+\delta_8$$
$$X_9 = \lambda_9\xi_9+\delta_9$$
$$X_{10} = \lambda_{10}\xi_{10}+\delta_{10}$$

Where the values of the factor loadings are obtained from Figure 6.68 and for the soft factors designated by the five constructs with their following factor loadings (λ_1 through λ_5) are as follows; λ_1= 0.38, λ_2= 0.57, λ_3= 0.69, λ_4= 0.91, λ_5= 0.79, and the hard factors are as follows; λ_6= 0.52, λ_7= 0.02, λ_8= 0.68, λ_9= 0.92, λ_{10}= 082,

6.10.14.1 Re-specifying the Model fit

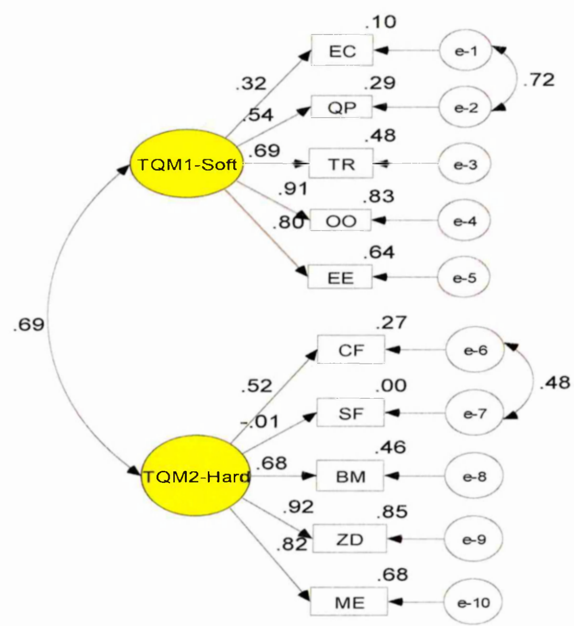


Figure 6.68: Respecified Two Factor Model (TQM Deploying Organisations)

For the re-specified two factor model. The results are summarised in Table G3, Column 8 (Appendix G). The chi-square statistic (χ^2) produced by AMOS in the confirmatory factor analysis is not significant ($\chi^2_{(32)} = 26.109$, $p = 0.759$), Goodness-of-fit index is low (GFI = 0.804), TLI = 1.114, CFI = 1.000, root-mean-square is very low (RMSR = 0.012). It is recommended that the RMSR should be less than 0.10 in order to have confidence in the model (Hajjat, 2002). All these indicate that the specified two factor model is consistent with the sample. (CFI = 1.000, TLI = 1.114). An examination of the independence model revealed the following fit values: χ^2 = 117.909, df = 45, p = 0.0000 and the discrepancy/df ratio = 2.620

Table 6.38 -Unique Variances from both analyses and improvement in the two-factor over the one factor model

Variable	One-Factor Model	Two-Factor Model	Improvement
EC	0.88	0.86	0.02
QP	0.68	0.68	0.00
TR	0.48	0.52	-0.04
OO	0.27	0.17	0.10
EP	0.43	0.37	0.06
CF	0.58	0.73	-0.15
SF	0.97	1.00	-0.03
BM	0.60	0.53	0.07
ZD	0.51	0.15	0.36
ME	0.60	0.33	0.27

Another model excluding the customer focus and supplier focus from the original Powell (1995) as illustrated in Figure 6.69 was tested. The results of the non-mechanistic structural model as depicted in Figure 6.69 are summarised in Table G3 (Column 2) in Appendix G.

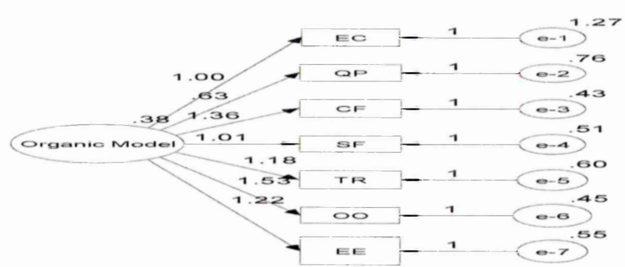


Figure 6.69 Graphic Representation of 7 Factor Organic (Soft) TQM Model - Unstandardised (Based on 1995

The table indicates that the χ^2/df ratio was 2.793 (13.966/5), which was smaller than the threshold value of 3.00, as suggested by Curkovic et al

(2000). Apart from the RMR = 0.081 which was less that the acceptable value of 0.10, other indices did not support a good fit to the data (AGFI = 0.461; NFI = 0.704; CFI = 0.820) as compared to the recommended value suggested by Chau (1997), Curkovic et al (2000)

6.10.15 Confirmatory Analysis of the Soft Model Based on Powell

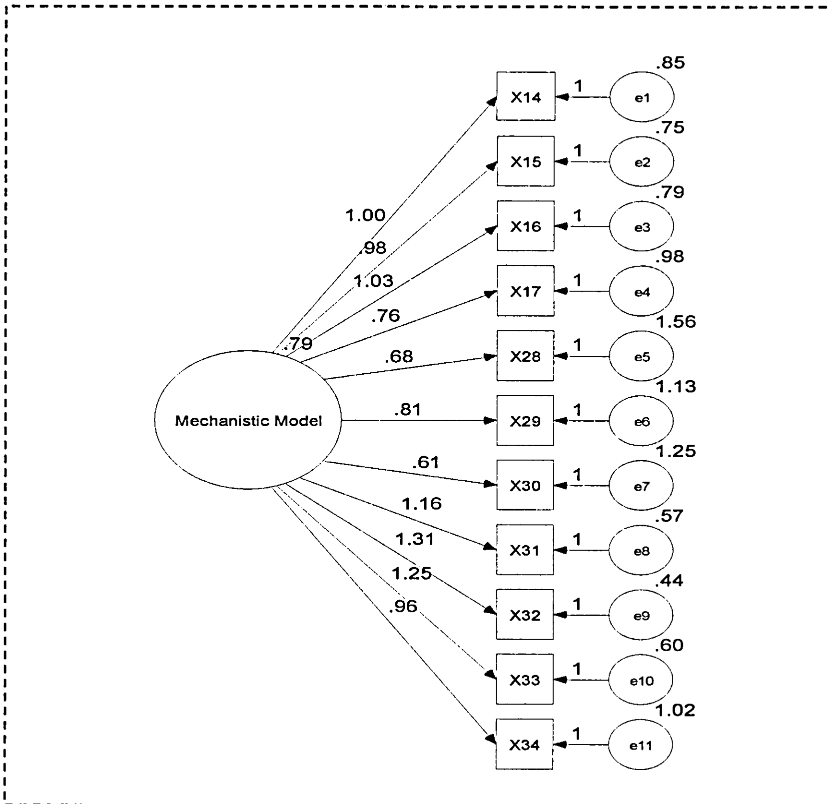


Figure 6.70: Results of the CFA for the one factor Mechanistic Model

The above model in Figure 6.70 generated the following fit measures which are summarised in Table G4, Column 8 (Appendix G). For the one factor mechanistic model for the total sample, the chi-square statistic (χ^2) produced by AMOS in the confirmatory factor analysis is significant ($\chi^2_{63} = 207.3, p = 0.000$), Goodness-of-fit index is low (GFI = 0.610), root-mean-square is slightly high (RMSR = 0.245). It is recommended that the RMSR should be less than 0.10 in order to have confidence in the model (Hajjat, 2002). All these indicate that the two factor model is not consistent with the sample. (CFI

= 0.639, Tucker Lewis Index = 0.548). In order to improve the indices, the model in Figure 6.70 is now presented as a three factor model with the same number of variables. Figure 6.71 illustrates the three factor mechanistic model.

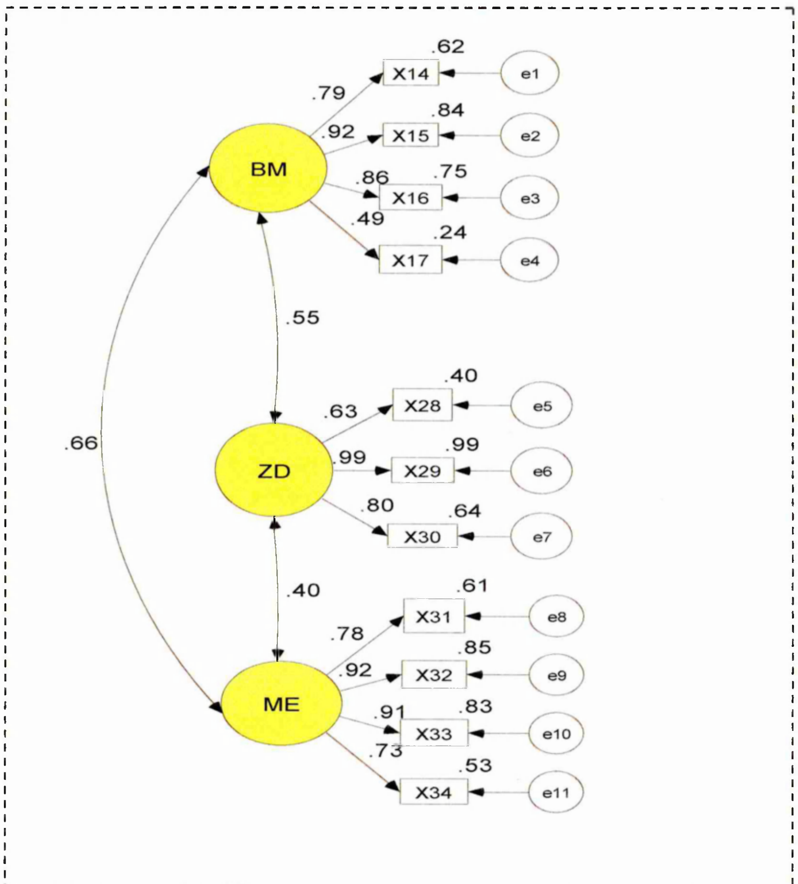


Figure 6.71: Results of the CFA for the Three Factor Mechanistic Model (All Organisations)

The above model in Figure 6.71 generated the following fit measures which are summarised in Table G6, Column 8 (Appendix G). The table indicates that for the three factor mechanistic model for the total sample, the chi-square statistic (χ^2) produced by AMOS in the confirmatory factor analysis is not significant ($\chi^2_{(63)}$ = 72.7, p = 0.002), Goodness-of-fit index is low (GFI = 0.833), root-mean-square is slightly high (RMSR = 0.136). It is recommended that the RMSR should be less than 0.10 in order to have confidence in the model (Hajjat, 2002). However, the other indices are acceptable which indicates that the three factor model is consistent with the sample. (CFI = 0.930, TLI = 0.906, NFI = 0.857). The comparative fit index (CFI) of 0.930 is slightly below the recommended cut-off of 0.95 (Hu and Bentler, 1999)

The following table 6.39 and provides a summary of the comparison between the one factor and three factor mechanistic model.

Table 6.39 - Unique Variances from both analyses and improvement in the three-factor over the one factor mechanistic model

Variable	Construct	One-Factor Model	Three-Factor Mechanistic Model	Improvement
X14	Benchmarking (BM)	0.52	0.38	0.24
X15		0.50	0.16	0.34
X16		0.48	0.25	0.23
X17		0.53	0.28	0.25
X28	Zero Defects (ZD)	0.81	0.20	0.61
X29		0.61	0.01	**-0.60**
X30		0.81	0.36	0.45
X31	Measurement (ME)	0.35	0.39	**-0.04**
X32		0.24	0.15	0.09
X33		0.33	0.17	0.16
X34		0.58	0.47	0.03

Table 6.40: Mechanistic 3 Construct Model Summary of Regression Analysis

Model	Multiple R	R^2	Adjusted R^2	St Error of the Estimate
1	2	3	4	5
1	.355[a]	.126	.082	.44970
2	.467[b]	.218	.134	.43667
3	.550[c]	.303	.168	.42789

Based upon the two models illustrated Figures 6.70 and 6.71 as shown in Table 6.39, there was a marked improved in nine of the variables apart from variable X_{29} and X_{31}.

Model 1 has the following predictors, Variables X_{14}, X_{15}, X_{16}, X_{17}, whereas Model 2 has X_{14}, X_{15}, X_{16}, X_{17}, X_{28}, X_{29}, X_{30} and Model 3 has all the variables namely X_{14}, X_{15}, X_{16}, X_{17}, X_{28}, X_{29}, X_{30}, X_{31}, X_{32}, X_{33}, and X_{34}.

Table 6.40 reports the strength of the relationship between the models and the dependent variables. The R in column 2, the multiple correlations, is the linear correlation between the observed and model predicted values of the dependent values. Its small value (r = 0.355) for the first model indicates a weak relationship. Model 1 refers to the variables of the Benchmarking Construct when entered in the regression model. The objective of Table 6.40 is to verify whether or not the inclusion of the methods and quality dimensions improves the fit of the model (Llusar and Zornoza 2000). The R square, the coefficient of determination, is the squared value of the multiple correlation coefficients and it shows that the model explains about 12.6% of the variation in the Benchmarking Construct. Clearly this is a weak model as the threshold should be approximately 50%, thus requiring the multiple R to be greater than 0.7. The first model in Table 6.40 for the mechanistic scenario only contains Benchmarking as a construct and this can only explain 12.6 per cent of the variance. The following Table 6.41 summarise the change statistics of the R2 for the mechanistic model as illustrated in Figure 6.71.

Table 6.41: Summary of bi-variate regression of convergence of TQM against the summation of the variable

Model	Change Statistics				
	R^2 Change	F Change	df1	df2	Sig. F Change
1	.126	2.834	3	59	.046
2	.092	2.190	3	56	.199
3	.081	2.028	3	53	.121

As a further measure of the strength of the model fit, comparing the standard error of the estimate in the model to the standard deviation of the Benchmarking Construct reported in the change statistics table 6.41. Though useful test of the model's test to explain any variation in the dependent variable, it does not directly address the strength of that relationship. The

ANOVA shown in Appendix F tests the acceptability of the model from a statistical perspective. The significance value of the F Statistics is less than 0.05, which means the variation explained by the model is not due to chance. From Table D25 (Appendix D), the regression row model displays information about the variance accounted for by the model. For example in the above table, Model 1 accounts for 12.59 % which is obtained by dividing the sum of squares for the regression model by the total values, in this case 1.719/13.651= 12.59. From the regression model in row 1, it is evident that the regression and residual sum of squares are not equal, which indicates that about 87.4% of the variation is explained by the residuals. The second row is for the residual which displays information about the variation not accounted for by the model. The inferences of the statistics are that ideally the regression values should be higher than the residual.

6.10.16 Comparison of Non Mechanistic (Soft) and Mechanistic (Hard) Models

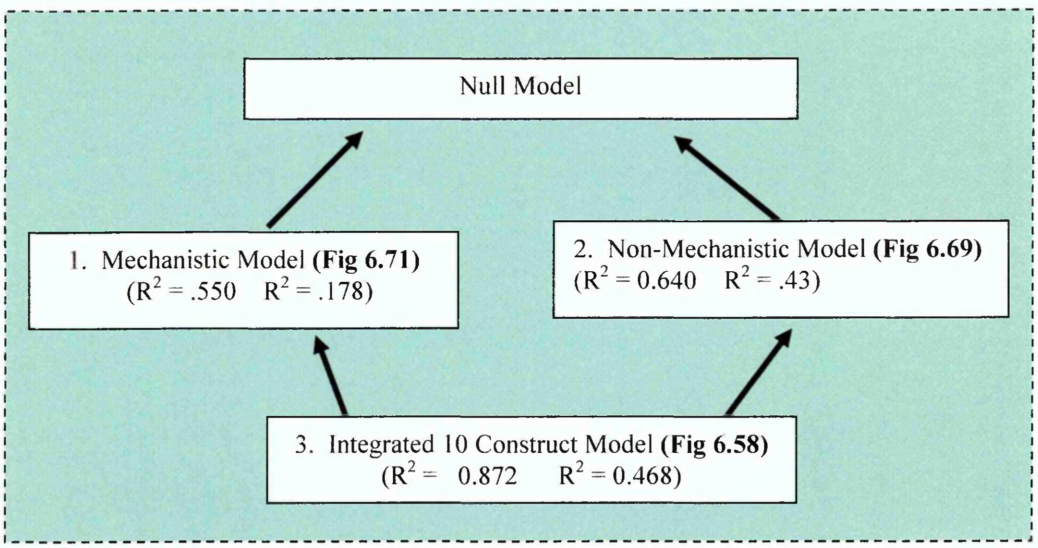


Figure: 6.72 Testing the differences of the three Models

The three models examined are summarised in Figure 6.72. Based on the values of variances explained, the integrated 10 Construct Model (R2 = 0.872) is a better representation of TQM than the separate elements of Soft, Non-Mechanistic (R2 = 0.640) and the Hard, Mechanistic (R2 = 0.550) Models.

6.10.17 Summary

This sub section presented the results from the preliminarily data analysis based on the descriptive statistics, and results from the micro-level analysis which dealt with the hypothesis testing for the TQM deployment constructs for both TQM and non-TQM UK Constructional related SMES. The findings reported are linked to the aim and objectives of the study. Objective One dealt with the identification of the major constructs of TQM and the refinement of the scales for measuring the constructs. This was addressed in Chapters One, Three and the rationale for the Powell Instrument provided for in Chapter Five. The second objective was to review and evaluate validated Instruments used to measure Quality Management within the Manufacturing and Services Industries. Chapter Five addressed this objective through a comparison of the Manufacturing and Construction Industries as well as an extensive review of the instruments. Part of the results dealing with empirically testing the instrument for validity and reliability were conducted in this Chapter.

This subsection presented the results of the confirmatory factor analysis approach; the instrument has been empirically tested for undimensionality, reliability and constructs validity illustrating the various relationships between its various dimensions. As observed by Kang et al (2002), it is especially important to show that instruments are valid and reliable when items that are used have been changed from their original wording. Chapter Six also addressed objective three which was to determine if they are any differences in quality management implementation and quality outcomes across UK Construction related SMEs and if so, how and why they differ.

This study through the third objective, attempted to determine if they are any differences in quality management implementation outcomes and also attempted to assess the levels of TQM implementation within the UK Constructional related SMES. The TQM deploying organisations were found to have a medium level of TQM implementation. The TQM constructs in these organisations were also found to be highly inter-related. The 10 TQM constructs exhibited strong undimensionality, reliability, convergent, discriminant and criterion-related validities.

In testing the differences between the Medium-sized TQM and non-TQM deployment of the ten quality practices, there were significant differences between TQM and non-TQM deploying organisations. This supports the hypothesis (H_7) that Medium TQM deploying UK construction related SMEs exhibit a high level of advancement of the ten TQM constructs than medium non-TQM deploying UK construction related SMEs. The refined instrument thus standardised can be used to measure the levels of TQM practices in UK Construction-related SMEs. The Total Quality Management Index (TQMI) with each dimension can be computed for each organisation. The results of the TQMI for all the organisations in the sample are shown in the Appendix B (Table 2B). The detailed calculation of the TQMI is presented in the next Chapter.

The results of factor analysis on the critical factors of TQM Implementation show that Executive Commitment is the first factor. This finding is consistent with the theory on TQM that Leadership support or Top Management commitment is crucial to the Implementation of TQM. (Saraph et al, 1989; Black and Porter, 1996; Powell, 1995 and among others Flynn et al (1994). The empirical study reported in this Chapter made it possible to test the hypothesis formulated to determine the influence of the degree of introduction of TQM on Business and Organisation Performance (Results), the impact of organisation size and TQM Maturity on TQM implementation and consequently results.

- Impact of TQM on BOPI

Studying the relationship between QM constructs and organisation performance would help contribute to the QM theory building efforts in construction. This would in turn facilitate the continued development of QM theory in construction. This study further contributes to the continued efforts in quality management theory building. It addresses the limited effort in the Construction industry by specifically refining the QM constructs based on construction organisations. It expands the effort of studying SMEs across the UK Construction industries.

The measurement models for the overall TQ-SMART and the outcome element of BIPO were tested at both the individual factor level and the aggregate level (Second-Order Factor). The measurement model results at the individual and aggregate levels for the TQ-SMART and are shown in Tables 6.25, 6.26 and Table 6.27. The conceptual framework developed in the second chapter established a link between TQM practices, organisational contextual factors, and organisational performance to the creation of a sustainable competitive advantage.

The contribution made in this section is through refining theory by showing which assumed predictors have substantive links to outcomes are explained in detail in Chapter Eight..

- Impact of Organisation Size on TQM
- Impact of Organisation Size on TQM and BOPI
- Impact of TQM Maturity on TQM Implementation
- Impact of TQM Maturity on TQM Implementation and BOPI

- Limitations

One limitation noted is the use of self reported data when assessing the organisation's performance; as this could lead to a gap between perceived and actual success. As reported by Nilsson et al (2001), the usage of only one informant as a source of information is not severe, particularly for small organisations. They further acknowledge though that this limitation might be possible in large organisations. Therefore as this study relates to SMEs with the majority of the respondent organisations having up to 250 employees, is thus excluded from therefore mentioned limitation. The findings suggest that Executive Commitment is necessary when the effectiveness of TQM implementation is investigated. This study extends the work of Sousa and Voss (2002).

6.11 Introduction to the Cases.

Following on from the Quantitative analysis, this section presents the findings of the Qualitative approach. As argued by Dwyer (2002), the preceding methods of quantitative approach lie within the positivist paradigm which at the end, merely confirms or refutes hypotheses. As the study is intent on making a contribution to theory development in quality management research, there is a need to employ triangulation which entails the usage of the qualitative approach. This would in turn result in the discovery of meaning and reality in specific organisational context. Drawing heavily on Woodside and Wilson's (2003) definition, the principal objective of a case study is to achieve a deep understanding of processes and other concept variables such as actors perceptions of their own thinking processes, intentions and contextual influences. The first sub section of this Chapter describes how the triangulation was achieved through the fusion of three methods namely; the findings from the quantitative approach through statistical analysis, qualitative approach through case studies and findings grounded in the literature review.

The steps in the case study methodology are shown in form of a flow chart in Figure 6.75 and are structured as follows; first the case study protocol and conceptual development are described in form of a flow chart shown in Figure 6.73, second the individual case studies are presented followed thirdly by the analysis and individual case reports. The fourth step involves the cross-case analysis based on Huq and Martin (2000) in which the descriptors /identifiers are deduced from the case write up to highlight and contrast between what researchers deduce and what is reality when the phenomena are investigated (Dwyer, 2002:4). This is summarised into one table pertaining to the following; general characteristics and features, extracting the critical success factors, obstacles and benefits derived from the quality initiatives. The fifth step involves the testing of theories and findings quantitatively and linking these to the individual cases, with the results and triangulation in the final sixth section.

6.11.1 The Study and Methodology

Three UK constructional related SMEs was studied. Two were medium-sized (more than 100 employees) non-TQM deploying organisations and one was a small-sized TQM deploying organisation. The case study questionnaire's main objective was to determine for the TQM deploying organisation the implementation process that they undertook for the TQM programme. Information pack to the questions such as documentary sources in form of policy documents, the profile documents containing the aims, overall company quality goals and objectives, mission statements, organisation's charts and any flow diagrams showing the organisation's TQM implementation approach were requested as part of the general submission.

As the concepts put forward in the survey document via the questionnaire did not lend themselves to direct examination, they were studied as part of a broad examination of various steps as shown in Figure 6.73

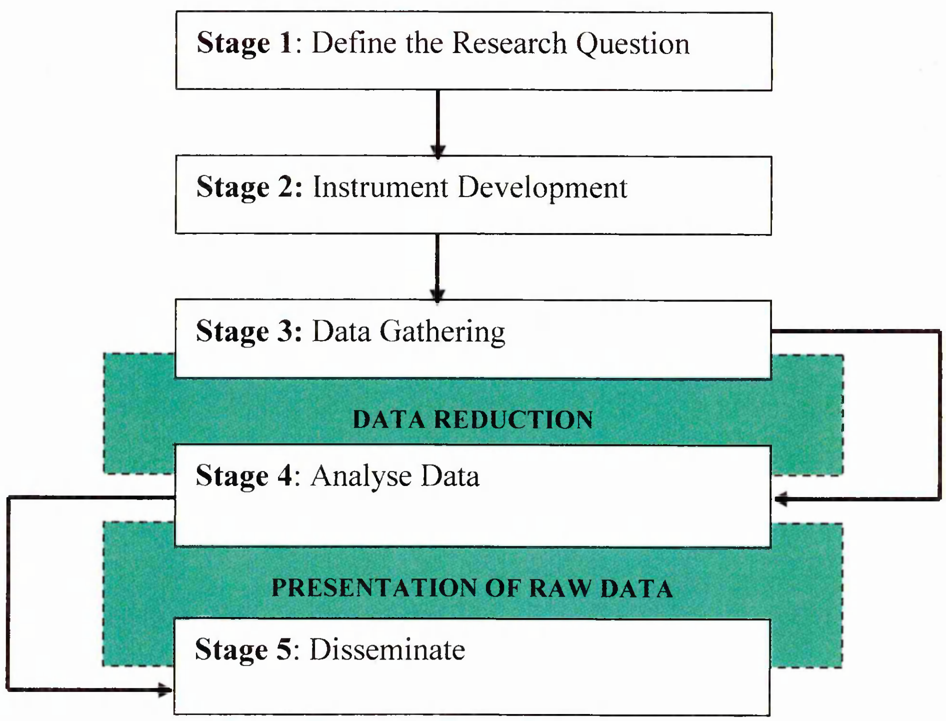


Figure 6.73: Stages in the Case Study Methodology

Issues involved in the stages of the Case study methodology as shown in Figure 6.73 are discussed as follows:

Stage 1 defined the research question followed by **Stage 2** which involved instrument development. The data gathering in **Stage 3** was conducted via semi-structured interview and an examination of historical documentation. The data gathering process adopted the triangulation approach. Multiple means of data collection such as semi-structured interviews and review of archival sources such as policy documents increase the validity of the study (Voss et al, 2002).

The type of information sought through the semi-structured interview followed the five step approach shown in Figure 6.74. According to Voss et al (2002), such frameworks explain either graphically or in a narrative form, the main things to be studied. The approach taken is a combination of the graphical and narrative nature.

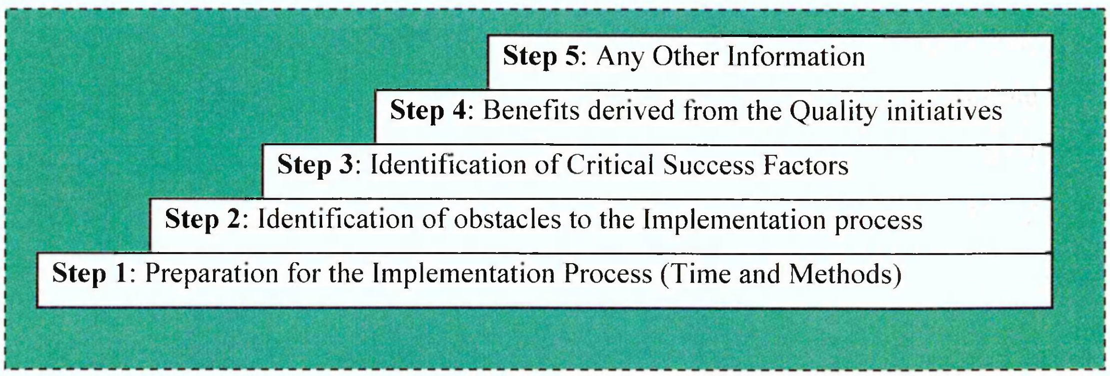


Figure 6.74: Steps in the Research Model for Case Study: Data Gathering

Issues in applying the case study protocol and conceptual development in each of the steps of Figure 6.74 are addressed below:

Step 1: Preparation

Preparation for the TQM and the quality initiative process; typical questions asked were as follows;

1) What preparations, if any, did you undertake at the initial stage of producing TQM,
2) Identify what you did exactly, and the time/personnel allocated to this initial stage?
3) Did you adopt the method of steering? i.e. Board Steering TQM, Quality Steering Team or Quality Council?

For non-TQM deploying organisations, the format to the question was similar apart from replacing the word "TQM" with "Quality Program or Initiative". It was important to include them in the study so that a comparison could be made in their quest for a different quality initiative.

Step 2: Obstacles - This was an open ended question regarding the obstacles inhibiting the effective implementation of TQM whose primary objective was to determine major barriers to successful implementation of TQM or quality related initiative.

Step 3: Critical Success Factors - This step sought the identification of critical success factors.

Step 4: Benefits - Benefits dealt with the improvement perceived by the organisation after the implementation of the quality initiatives.

Step 5: Any Other Information - Any other information relating to the assignment of roles and responsibilities, education and training.

The intermediate stage between the data gathering (**Stage 4**) and analysis of data (**Stage 5**) involved the data reduction process which could be combined with the intermediate stage between the analysis (**Stage 4**) and dissemination of data (**Stage 5**). The approach undertaken in the analysis is based on Yin (1994) where the data for each individual case is analysed and then bring the findings together in the cross case analysis in section 6.13 as illustrated in Figure 6.75. The following describes the presentation of raw data

Stage 4 - Presentation of Raw Data

One of the valid criticisms for case type methodology is the presentation of the qualitative data in a suitable format. One of the suggested ways is the taking of qualitative data and accomplishing useful data reduction and data display. The major weakness of the proposed method is that it is difficult to convince the reader that the items in the table properly present the raw data.

It is for this reason that the cases are reported as raw data and the analysis used the data reduction by presenting the findings in tabulated format in the cross case analysis. This way readers can cross reference the accuracy of data presented in the tables from the individual raw case data. Drawing heavily from Silvestro (2001), McAdam and Henderson (2004), throughout the data analysis, usage is made of verbatim quotes from the semi-structured interviews to support the arguments.

Given the study and methodology described in section 6.11.1, the following section now presents the raw data of the three cases. In the interest of anonymity the three constructional SMEs observed in the case studies are referred to as organisation A, B, and C. There was no specific reason for the number of case studies picked, however it had the added advantage of helping guard against observer bias when multiple cases was used as stated by Voss et al (2002), and the fewer the case studies, the greater the opportunity for depth of observation

The main steps in the case methodology are summarised as a flow diagram shown in Figure 6.75. The steps undertaken in the case study methodology are explained in detail under their relevant sub sections as indicated in Figure 6.75. The first step elaborated upon and further presented in sub section 6.11 is that of the case study protocol

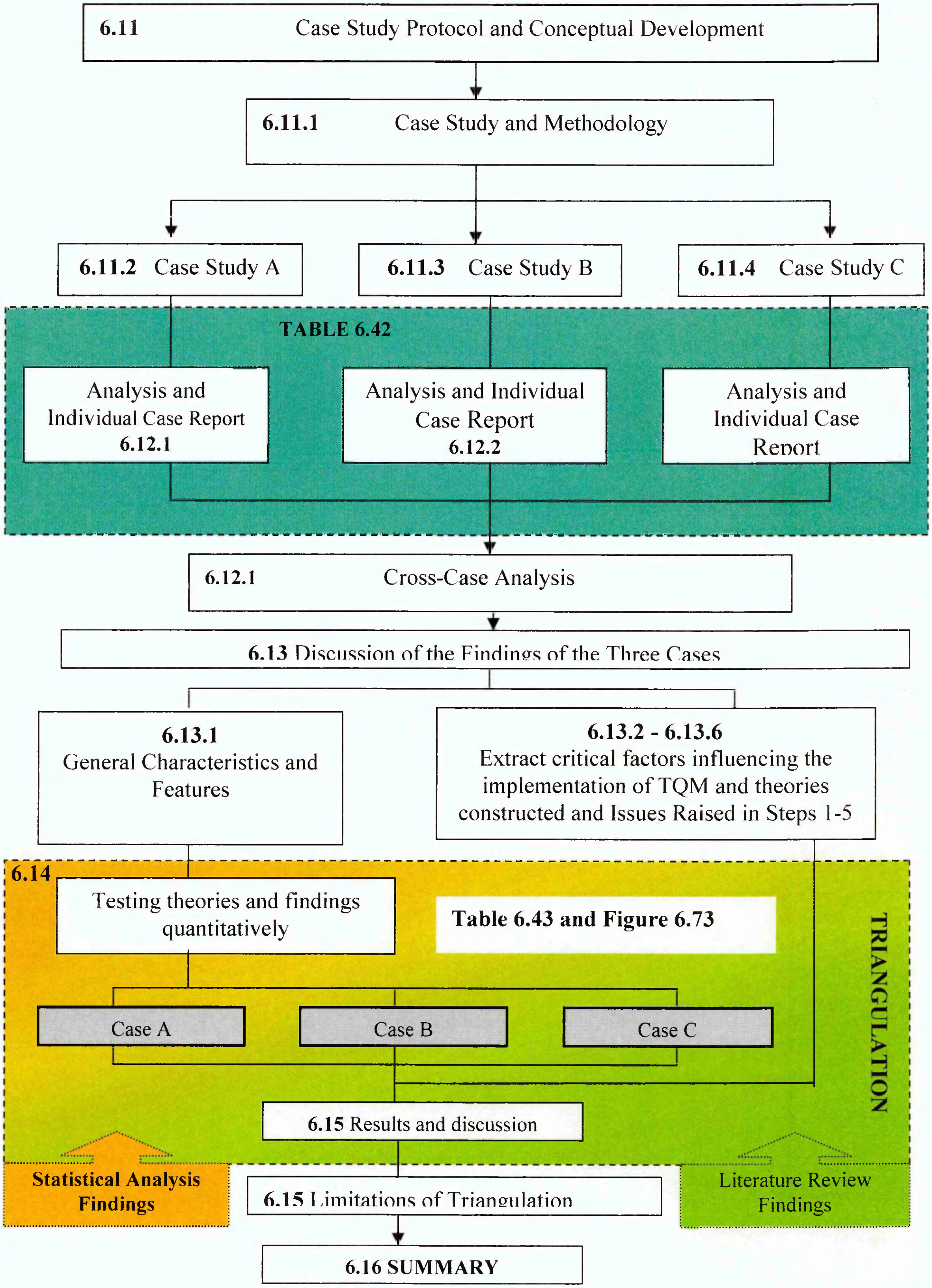


Figure 6.75: Steps in the Case Study Methodology

(Adapted from Blismas et al, 1999)

6.11.2 Case Study 1: Non-TQM Deploying Organisation A

The questions asked are outlined in the appendices, therefore the format is presented in such manner that the key areas are covered and it is reported in the respondent's own words.

Preparation for the Quality programme

We established a new department called Business Assurance with the goal of assuring the Executive Board that the company was continuously developing, improving, and implementing appropriate processes to satisfy customers, employees and shareholders. For a year this was a two-person department but then grew to six people. The Head of Department reported directly to the Board so there was no steering group. Some of the primary goals were to achieve IS0 9001: 2000 accreditation and to continuously improve by using the European Foundation for Quality Management Excellence Model (EFQM .EM) Framework. At no time have we used the terms TQM and we have dropped the use of the word "Quality". We had Project Execution Plans not Quality Plans. We have a Management System Manager not a Quality Manager.

Strengths and Weaknesses: During business/strategic planning SWOT analysis takes place and this is a continuous process. For example business plan review and adjustments were made after September 11th, 2001. There is one integrated, process based management system for the whole company. These processes are owned by the users, written by the users and co-ordinated by Business Assurance. In order to help identify the areas for improvement, the Excellence Model Full Assessment was utilised. Therefore there was no real initial stage – it was a constantly evolving project as changes in organisation structure have occurred.

Comments about the Quality Initiative: There is no "TQM" programme. There is a 5-year plan for implementation of the EFQM Excellence Model which sets annual targets for improvement. Therefore TQM is not something that you achieve; it is a continuous journey of improvement. Even companies that have won the EFQM European Award still look for improvements and attend benchmarking and improvement workshops.

Obstacles inhibiting the effective implementation of the Quality Initiative and measures undertaken to resolve them?

- Lack of commitment from the Board. Needs to be supported and driven by the Chairman.
- Changes in company structures or merges/acquisitions can delay progress.
- Resources available for training, implementation of improved systems etc.
- Lack of support from Middle Managers
- Failure to keep up the momentum of improvement.
- Inadequate communication of successes.

In our case, the first key is to recognise the barriers and have actions in place to deal with them. Board level support has never been a problem. Communication is difficult but we keep at it. Middle management support was driven by communications coming from the Board or Chairman rather than the business improvement team.

Identification of Critical Success Factors: Chairman's support, vision and drive, improvements in methods of communication to Senior Managers through conferences and bi-annually for a quality driven agenda. Commitment from other directors to achieve improvement targets (incentives through their bonus scheme). Equally, hard work and enthusiasm of the business improvement team. Consultants were brought in to guide the development programme and benchmarking the programme against competitors and other industries. The following were seen as benefits;

- Improved, consistent management approach, leading to efficiencies.
- Better communication internally.

- Better understanding of customer needs and satisfaction.
- Better understanding of employee needs and satisfaction.
- Improved leadership.
- Improved supply chain management.
- Better measurement of performance.

Did your organisation take into consideration the following crucial factors such as cost, manpower and clients when implementing TQM?

Cost was largely man-hours but also budgeted for an on-line management system. It was a learning exercise as with all IT developments. However the process was not driven by clients, but by the company's desire to improve performance. This was achieved through the Excellence Model which covered all the critical factors.

Employee Involvement: Completely. The users through voluntary improvement groups defined processes. Communication to all employees and involvement in surveys.

Application of the EFQM

- We use self-assessment on an annual basis by a team of in house assessors who work on improvements as well as undertaking their 'day job'
- We also undertake a quarterly survey using a snapshot of employees.
- Our external consultants have helped with training and consensus meetings.
- We have now started down the route of applying for an award.

However in our organisation, we do not use the word 'Quality' in the company. <u>It is much easier for us if we do</u>. The use of the word Quality is confusing and misunderstood.

6.11.3 Case Study 2 - Non-TQM Deploying Organisation B

Position of Respondent: Business Improvement Manager

Organisational Starting Position, Strengths and Weaknesses

Organisation B developed a steering committee called a Quality Executive (QE) - The purpose of the QE was to initiate change with respect to the business management system incorporating quality, safety and environmental system requirements. The QE comprises of a Chairman (Director for Quality), four representatives from Business units with quality system knowledge, one representative from safety and one from an environmental background.

The Quality Executive developed policies and recommended them to the main board via the Chairman of the Quality Executive. Once approval was obtained, the QE was responsible for the implementation programme. Having been in operation for a little over a year now, the QE has obtained a positive reputation with the Senior Management of the Company. However, as the QE promotes change there maybe a degree of suspicion from others within the organisation. Initially the organisation did not understand its strengths and weaknesses. However it would be fair to say that the improvement programme has been initiated rather quietly and not been the subject of a big communication exercise - it is a programme of stealth. The company has also appointed its best practice co-ordinators in the following areas: *Quality, Programming, Planning, Design, Operations & Maintenance, and Risk Management*

Progress was planned in the following ways:

- Annual review by UK based Managing Director with all the QE in attendance.
- First Review was December 2001 and the Second planned for December 2002.

- Best Practice area had an initial introduction to all of the business units in March 2002 and an update planned for October 16th and 17th 2002

Based on feedback received in the planned meeting in October, the initiatives were rolled out by formal communication briefing to all employees

Other comments made about the programme

We saw the QE activity and the Best Practice Initiative as TQM in that both programmes would never be concluded as they were based on continual improvement - which could be described as a never ending journey. In reality, we expected targets and objectives to be set with respect to both initiatives - annual targets and objectives being derived from the company budget process.

Obstacles inhibiting the effective implementation of TQM and measures undertaken to resolve them?

The primary objective was to determine major barriers to successful implementation of the Business Improvement Programme. These are listed as follows:-

Communication - Not only pitching the message at the right level, but also establishing feedback systems to ensure that the message given out has been received and understood.

Resources - Those involved in the Quality Executive and Best Practice groups have other jobs and responsibilities.

The following measures were undertaken to resolve them by trying to lobby the Directors to make sure they allocated funds in the budget and resources to address the issues. Whichever way we looked at it, the exercise would cost time and money for the company.

Identification of critical success factors: 'The Senior Management Team' and 'The Business Directors'. –These people were actively involved in the programme, thereby demonstrating by their leadership and commitment, that continuous improvement was fundamental to the business thriving.

Benefits to the organisation: This is a complex business which operates across six business units and one separately registered company. The major benefit to the company would be when a high degree of *competence* and *flexibility* of its workforce is achieved. This would enable clients across the business to be served efficiently and effectively and it would enable the company to maximise the use of its resources

Consideration of Clients, Manpower and Cost Prior to Implementation

Clients are our ultimate focus, without them we cannot exist. Therefore, all improvement initiatives are identified with clients in mind. Of course we recognise that there are internal clients as well as external clients. If we make processes easier and more user friendly for our internal clients, we believe the benefits will be eventually realised by our external clients.

Cost must be considered at all stages. There must always be a cost incentive to our business. The aim is to generate more business with our clients which should give us an increased turnover and improve the business performance in terms of profitability. I do not believe additional *Manpower* will be available to realise these initiatives. However, the practices identified will sign cultural changes required of everyone in the business.

Employee Involvement: Not greatly at present, but as, the programme develops we will need to get all of the business' employees involved. They are the users of the business systems and can only influence the systems if they get involved in its review and development.

Due to a small number of employees in your organisation (SME), would you retain experienced staff if they do not usually follow the procedural requirements laid down in the quality manual?

Not sure I understand this question. However, I would say that we are moving away from looking for compliance in line-by-line instruction and procedures. The company is involved in engineering consultancy and as such it employs some very competent people who do not need line-by-line instructions. We are moving to demonstrating compliance with processes rather than procedures. Currently quality training is an integral part of all job instructions and this is always carried out by quality management personnel and superiors. Equally internal project management training is carried out by different disciplines.

Other Information Requested was the Assignment of Roles and Responsibilities to which the organisation stated that they did not have job descriptions since the business manual and associated procedures indicate requirements.

Education and Management Training: Management have undertaken a variety of courses - most notably internal project management training. This covers finance, Quality, Project Management and Information Technology Training.

Determining Customer requirements: These requirements are identified in each individual contract by recognising client needs. Careful and regular monitoring makes sure that the client's needs are fully understood at all times throughout the project.

Recognition and reward schemes for employees: Recognition and reward schemes are not utilised by the company.

6.11.4 Case Study No 3: Organisation C

Director of a small organisation with 28 years experience.

Preparation for the TQM programme

We recognised that our clients were asking us at the pre-selection stage if we had a quality management system. With some clients like MOD and Metropolitan Police, it was necessary to be quality assured "QA". We therefore embarked on the National Federation of Builders Quality Assurance path and achieved our goal. However as BSI was a better standard to achieve, we wrote our procedures and with BSI help achieved accreditation. We saw this as a necessary requirement for the company's discipline and for clients to see this in the market in which we operate. A small team was responsible for writing the manual.

Organisational Starting Position, Strengths and Weaknesses

This company is long established and in my experience, large long established companies have much the same procedures to deal with the management of their businesses. We have all worked somewhere else and take the benefit to others. We also share knowledge at best practise federation meetings and by the visits available from inside UK DETR. We wrote down what we did already and only a few adjustments and additions were necessary to meet the standard.

In order to progress, the following measures were implemented:

- A quality manual for the whole company.
- The departments were all consulted on their particular procedures.
- Standard use forms were refreshed

In response to whether the organisation underwent any changes, the response was as follows:

There was no cultural change undertaken and I do not believe any reasonable contractor would find one for the reasons I have stated earlier.

In response to any other comments about the TQM programme and what was the period of time between planning of TQM and when TQM became operational, the following is the response:

'It took under a year to achieve the NFB accreditation on a fast track tutorial system organised by the NFB. We were committed so paid attention to it. Secondly, the transition to BSI ISO 9000 was also relatively straight forward. We are now in the transition to BS EN ISO 9001-2000 and meet the new standards by the end of 2003'

The obstacle(s) to the Implementation of TQM was mainly "time to devote to what may be regarded as not front line priority" and we made time. In terms of the critical success factors, commitment from the leadership was vital as well as the need and ability to show the clients that TQM was in place.

Benefits for the organisation - Hopefully more opportunities to tender for work, secondly TQM could be used as a system to measure that the business procedures were being followed by regular audits.

Consideration of Clients, Manpower and Cost Prior to Implementation - Clients and Cost was, but it was not significant prior to the implementation although manpower was never a consideration. In terms of the extent of employee involvement, only department heads were consulted. In response as to whether they had any knowledge of other Quality Models and teaching of the quality gurus such as Crosby and Deming (to mention a few), the following was the response,

" However even though we implement TQM, we are not aware of the following: EFQM Excellence Model, Deming Model, Philip Crosby 14-step programme, Juran's ten step plan, Oakland eleven step process, but we do have ISO standards".

Employee Training - Quality training is considered to be an integral part of all job instruction and this is undertaken by superiors, other operators and outsiders. About 10 % of our operators have attended special quality courses.

Other Information Requested - Assignment of roles and responsibilities defined in our manual. Education and training in terms of management courses (NFB & BSI).

Determining customer requirements - We discuss with clients Key Performance Indicators in use

Recognition and reward schemes for employees - None

6.12 Case Study Analysis

Having completed the case studies, the following sub section presents the data analysis. The approach undertaken is that of enabling data analysis in a qualitative way through the construction of Tables. This is similar to the approach undertaken by Huq and Martin (2000). The following tables are generated; Table 6.42: Results from Case Analysis and includes the following dimensions; Designation of respondents, Critical Success Factors, Obstacles to the Implementation Process and Benefits of the Quality initiatives to the organisations. Table 6.43: Cross Analysis of behavioural Process Factors. With different approaches to case data analysis, according to Voss et al (2002). Table 6.42 can be used in making predictions and then using the case data to test them. From the three cases, it is possible to pull together key issues regarding how the UK Construction-related SMEs approach quality initiatives. The following section now presents that Nwankwo (2000) called "first shots" observations due to the limited sample size.

6.12.1 Cross Case Analysis

In terms of experience, Table 6.42 indicates that respondents in the case studies had enough experience in the areas of quality management. Table 6.42 also shows that the critical success factors perceived by the respondent that are necessary for any implementation initiative as well as the obstacles that might impede the process. It is evident that all the three cases acknowledge the leadership support as being vital for any implementation initiative. The results of the individual case analysis indicate that although SMEs might be aware of the need for human resources strategies such as training and human empowerment, they are affected by lack of resources as indicated by organisations A and B (Table 6.42). This finding is consistent with those of Ahire and Golhar (1996). Evidence of emerging new concepts such as 'Best Practice Initiative' driven by the Quality Executive of Organisation B was seen as TQM. This finding supports the emerging trends such as six sigma, business process reengineering and learning organisations.

Table 6.42: Results of Cross Case Analysis

Dimension Label	Descriptors / Identifiers
1. TQM Status	**Case A:** Non TQM deploying **Case B:** Non TQM deploying **Case C:** TQM deploying
2. Position of Respondents and number of years ( ) employed.	**Case A:** Management System Manager (2) **Case B :** Business Improvement Manager (1.5) **Case C:** Director (28)
3. Preparation for the Quality Initiative Implemantation Process (Step 1 of Figure 6.74)	**Case A:** Business Assurance Department initially a two man team which grew to six people. HoD reporting to the Board. Used EFQM as vehicle to achieve ISO 9000 accreditation. • Usage of continuous improvement initiative **Case B:** Steering Committee called Quality Executive fraught with suspicion. No communication exercise undertaken quality. • Clients and costs considered prior to implementation **Case B**: Quality Assurance route through BSI. Quality manual for the organisation and consulted the departments.
4. Obstacles (Step 2 of Figure 6.74)	**Case A:** Lack of commitment from the board, changes in company structures or merges/acquisitions could delay progress, resources available for training, lack of support from middle managers, failure to keep up the momentum and inadequate communication of success **Case B:** Communication and Resources **Case C:** Time
5. Critical Success Factors (Step 3 of Figure 6.74)	**Case A:** Chairman's support, vision and drive, Improvement in methods of communication, Commitment from other drivers, hard work and enthusiasm of the business improvement team **Case B**: Commitment of Senior Management Team and Business Directors **Case C:** Commitment, ability to show clients that TQM was in place, and construction time registration was improved
6. Benefits for the Organisation (Step 4 of Figure 6.74)	**Case A**. Improved, consistent management approach, leading to efficiencies, better internal communication, better understanding of customer and employee needs and satisfaction, improved leadership **Case B:** High degree of competence, flexibility of the workforce, efficient and effective way of serving clients, and maximising usage of resources **Case C:** More opportunities for tender work and TQM could be used as a measurement indicator.

6.13 Discussions of the Findings of the Three Cases

Given the data analysis presented in Section 6.12, this section discusses the findings of the three cases. The approach and order undertaken is in the same format as Table 6.42 and the steps shown in Figure 6.74. First, the characteristics of the respondents are analysed in terms of TQM status and the number of years they have been employed. This is followed by a brief discussion of the perceived obstacles to the implementation process, critical success factors and the benefits emerging from the process.

6.13.1 Demographics of Respondents

The respondents were well versed in quality management and had considerable experience (mean = 10.5 years, std dev = 15.16) in terms of number of years in employment. The respondents were selected on a "key informant" basis and in terms of SMEs, it can be argued that the respondents were placed in terms of knowledge of quality management and related improvement initiatives as evidenced by their designations, hence no multiple respondents were sought from the organisations in the case study.

6.13.2 Preparation for the Implementation Process (Time and Methods)

The implementation methods of the quality related issues varied across the three organisations. Organisation A adopted the Business Assurance Department approach and Continuous Improvement through the application of the EFQM Excellence Model, whereas Organisation B adopted the "Steering Committee" approach. Sohal and Terziovski (2000) attributed the creation of a steering committee as one of the major factors contributing to the implementation of TQM. Organisation C also used the Quality Assurance route through the accreditation to BSI.

The commonality in the implementation process was 'Top-down implementation', as was the case with Organisation A where middle management support was driven by communication coming from the Board or Chairman despite a business improvement team being in place. According to Hackman and Wageman (1995), the third practice of TQM is 'Top-down implementation'.

The approaches undertaken by the three Organisations are consistent with literature which recommends the gradual adoption than "full-blown" implementation (Yusof and Aspinwall, 2000). Evidence can be found in the usage of Quality Assurance route through the BSI (Organisation A) or the Steering Committee as was the case with Organisation B.

6.13.3 Obstacles to the Quality Initiatives

Application of the three Organisation's TQM Principles evaluated under some of the Ten Implementation Constructs revealed some commonalties in the obstacles to the implementation process. The major issues emerging were due to cost and resources. The findings from Organisation B regarding cost is similar to Walsh et al (2002) who noted that a TQM programme may require substantial investment. Davig et al (2003) support the notion further by linking the cost to be more psychological than monetary. According to their study, the psychological element lies with the top managers not understanding the benefits of TQM. This in turn leads to the lack of communication to the employees about the benefits. It must be noted that although the study conducted was within the manufacturing environment, the cost associated with the quality programs is not unique among different industries.

Issues such as change management in the transition period involved the implementation of a TQM strategy as clearly identified by organisation B as noted in the statement by the respondent that TQM practices would sign "cultural changes". As argued by McCabe et al (1998), Total Quality requires a radically different method of implementation which calls for different skills. From this perspective, it is evident that Organisation C, though TQM deploying, didn't undergo any cultural change. They attempted to change from the original National Federation of Builders (NFB) accreditation to the more prestigious British Standards Institution (BSI). The motive for this approach was for the clients to see this in the market in which they operated. This could be driven by the client rather than the organisation . Though the study relates to the SMEs, Large Construction companies take a similar view in their Quality Assurance approach, as McCabe et al (1998) found using the BSI as a selling point to the clients. Other reasons for undergoing certification can be attributed to customer requirements and pressure, need for capturing market share. (Raynor and Porter, 1991; McCabe et al, 1997; Mo and Chan, 1997). According to McCabe and Boyd (2004), the assertion that accreditation works or any initiatives should be taken with a pinch of salt. For example, BSI have a vested interest in making the initiative work therefore would vigorously promote it. Chow-Chua et al (2003) observe that the two most common benefits of certification in the literature are the increase in productivity and access to overseas markets.

However "cultural barriers" were also found to be less easy to overcome in a study reported by Tannock et al (2002). This study supported the findings of Tannock et al (2002) who identified the four main barriers to TQM implementation in SMEs as cultural, management awareness, financial and training. The four barriers were evident in the case of Organisation A. Oakland and Waterworth (1995) provided further evidence by emphasising that implementing is more than simply installing systems and procedures, it is also about cultural change Oakland and Waterworth (1995). Maull et al (2001), in citing McNabb and Sepic (1995) observed that change issues associated with TQM were not contingent upon management techniques or skills but could be attributed to deeper, more critical sources; the fundamental, pervasive culture of the organisation and the operating culture instils in its employees. As observed by Montes et al (2003), culture is something tailored up with the contribution of every employee in the organisation. This led to their proposition that "TQM elements implementation effect on individual learning and behavioural processes will depend on the acceptance of the TQM driven cultural change". Oakland and Waterworth (1995) lend support to the argument by indicating that the real purpose of TQM is to change the attitudes and abilities of an organisation so that the culture is converted into a culture of mistakes prevention and whose norm will be "to do it well the first time round".

One of the research questions in this case study was to identify the preparations which the organisations undertook in their quest for the quality initiative. Starting up the quality initiatives varied across the three cases. Whereas the European Construction Institute, ECI (1996) recommends having the vision statement and mission statement during the launch of the Total Quality, only Organisation A at least demonstrated its goals from the onset, these being to achieve the ISO 9001:2000 accreditation and to continuously improve. This is consistent with Nwankwo (2000) who observed that implementation of quality management strategies in small businesses largely revolves around quality accreditation schemes such as the ISO 9000 type. Evidence from the case studies indicate that there is also a view that equates ISO 9000 to being a substitute for TQM. For example, the Quality Manager of a non-TQM deploying organisation who had been employed in the Construction Industry for 10 years had the following comment on what TQM was:

> "TQM often equates to an inflexible system - ordinary quality management systems (i.e. BS EN ISO 9000 Series) suits most construction companies".

This view is consistent with literature which recognises the ISO 9000 series as a minimum requirement and first step towards TQM (Dale, 1997; Dale and Lascelles, 1997; Van der Wiele et al , 1997). For example, one of the main problems in relation to TQM identified by Dale (1997) was that the previous attempts at introducing the TQM concept or one of more elements which being unsuccessful would be perceived to be an obsolete, unnecessary (inflexible) wasteful concept.

However, others hold different views as reflected by the literature. Sun et al (2004) argue that it depends on Managers understanding the limitation of ISO 9000 certification and TQM as opposed to whether ISO 9000 can be regarded as a step to TQM. A Quality and Environmental Manager of a non-TQM deploying organisation contributes to this debate. The respondent had only been in the job for one week and commented:

> "TQM has not yet been introduced to our organisation, but there is a will at executive level to implement a quality system aimed at providing the organisation with a sustainable competitive advantage and to improve the effectiveness of the organisation".

According to Yusof and Aspinwall (2000), other constraints identified in literature that stifle the progress of TQM adoption in SMEs included managerial knowledge in total quality, financial and human resources constraints as well as technical ones. McAdam et al (2000) found the adoption of a culture of continuous improvement provided a solid foundation on which to build a culture of effective business innovation. Huarng and Lin (2002) also found inadequate knowledge and understanding about TQM as one of the difficulties of implementing TQM. This was clearly the case of Organisation A's commitment to continuous improvement.

It can be concluded that the behaviour processes needed for TQM to accomplish its purposes as identified by Hackman and Wageman (1995) can be summarised under the following; motivation, learning and change. For the TQM to work, it must change (alter) how people behave at work. Therefore for the UK Constructional related SMEs to effectively implement TQM, they should take into account their behaviour factors. According to McCabe (1998), one of the features necessary for cultural change is organisational learning. This assumes that all people within the organisation are able to contribute make the organisation better to respond to changing markets (McCabe, 1998:87). These factors necessary are inter-linked and grounded in theoretical foundations and can further be illustrated in Figure 6.76;

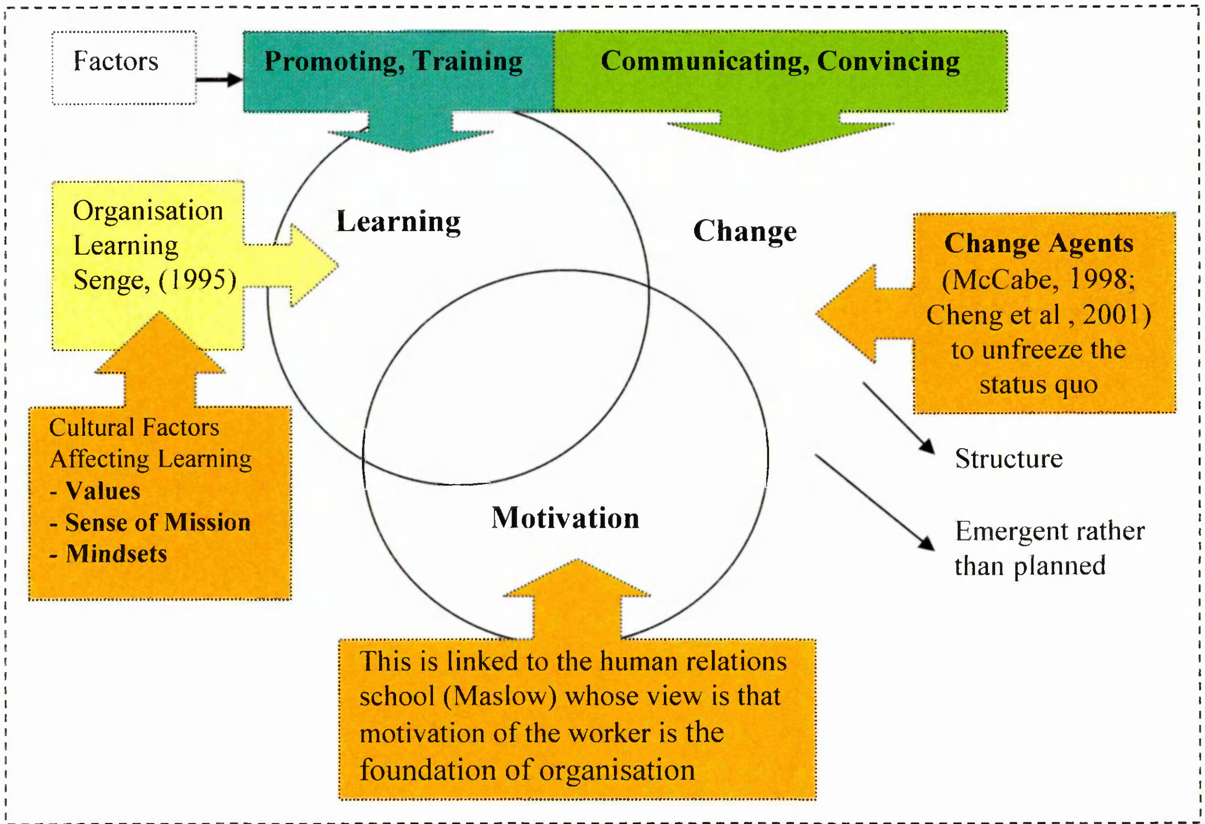


Figure 6.76: Inter-linking of Behavioural Factors Necessary for TQM

Author's interpretation of Hackman and Wageman, 1995; McCabe, 1998; Kalulanga et al, 1997; 1998; Senge, 1995 and Cheng et al, 2001.

Therefore UK Constructional related SMEs need to adopt the organisational learning approach for smooth transition from QA to TQM. Cheng et al (2001) proposed communicating and convincing as a way of handling the awareness of strengths and weaknesses of the status quo whereas learning through promotion and training would lead to attracting everyone to the bright new future.

It is evident that Organisation B was fraught with suspicions of the change process due to a lack of communication to the employees. Cheng et al (2001) provide evidence in that people are upset by an uncertain future. Furthermore Cheng et al (2001) in citing Lervitsiotis (1998) observe that communicating to all about change is vital. The issue of a learning organisation has the added benefit as it does lead to a competitive advantage. As asserted by Thiagarajan and Zairi (1997a), the best organisations recognise that communication can make a difference between success and failure. The following Table 6.43 summarises the presence illustrated by or absence of either any of the three factors.

Table 6.43: Cross Case Analysis of Behavioural Processes Factors

Behavioural Processes	Organisation (Cases)		
	A	B	C
1. Change			
1.1 Communicating	☑	☒	☒
1.2 Convincing	☑	☒	☒
2. Motivation	☑	☒	☒
3. Learning			
3.1 Promoting	☑	☑	☑
3.2 Training	☑	☑	☑
TOTAL	☑ = 5	☑ = 2	☑ = 2

Organisation A motivation was evident through the incentives and bonus scheme offered to its employees. The findings in this sub section relating to the obstacles to the implementation of TQM are consistent with literature. For example, Lee (2004) found "lack of management commitment", and " lack of knowledge about TQM" as the major impeding factors in TQM implementation by Chinese small firms. Montes et al (2003) proposed a model in which TQM affected organisation performance through the level of learning of the organisation members and the knowledge applied to their tasks and learning direction. The findings of this case study closely link and support several prominent and organisation learning theory leaders. Peter Senge (1990) in his work on strategies and tools for building a learning organisation identified five basic disciplines or 'component technologies' necessary to innovate learning organisations. These were: Systems thinking, Personal

Mastery, Mental Models, Building Shared Vision and Team Learning. Therefore UK Construction-Related SMEs need to embrace the following disciplines in order to progress as learning organisation and reap the desired benefits such as competitive advantage. Implementation of TQM is a starting point as it embraces the five basic disciplines. The systems approach to TQM was also articulated by Mohanty (1997) who conceptualised it in terms of three fundamental steps:

- A description of the present state of what it is;
- A description of the desired goal state as it ought to be or what is desired;
- A description of a structure and a process to bridge the gap between what it is and what we want

Kalulanga et al (1997) argued for a learning culture in order to achieve continues improvement in construction companies. They further observed that construction contractors would have to pay attention to the styles, processes and mechanisms of organic learning. The rationale being that it would lead to an improvement in products, processes and management. This argument is supported by Figure 6.76 in which Organisation Learning is identified as one of the factors affecting the implementation of any change initiative. A subsequent study by the same authors, Kalulanga et al (1998) identified fifty-seven learning mechanism variables from a literature review and interviews with construction executives. Their initial findings were that there was a low usage of learning mechanisms although training was found to be favoured by most of the construction executives. A recent study Farrell and Mavondo (2004) acknowledge that organisational learning is receiving increasing attention as one of the approaches that organisations can use to outperform competitors.

Accordingly, Quality Managers of UK Construction-Related SMEs can consider the above steps as an integrated whole.

Organisational learning in the form of double learning, can lead to competitive advantage (Jashapara, 2003). The behavioural factor of Change can either be regular or irregular. According to Mohanty (1997), regular changes are planned and therefore corrections are possible, whereas irregular change needs to be predicted through proactive responses.

6.13.4 Critical Success Factors

The following sub section presents the findings of the perceived critical success factors to the quality initiatives. In particular, the following are discussed;

- executive commitment
- customer focus
- employee empowerment
- training.

6.13.4.1 Executive Commitment or Leadership

It is evident that in all the three cases senior management commitment was seen to be crucial to any implementation of quality initiatives. This is consistent with the literature of the role of leadership or commitment from the top. As Reed et al (2000) argue the dimensions of leadership, education, training, teams and culture provide strong support for the notion that these activities combine in numerous ways and are difficult to separate. The importance of top management support and commitment to the success of TQM is articulated by the seminal writings of Hackman and Wageman (1995).

6.13.4.2 Customer Focus

The need for understanding customer requirements as envisaged in the Latham (1994) and Egan Reports (1998 ; 2002) was recognised throughout the three cases. Customer focus can also be used to generate a market advantage according to Lemak and Reed (2000). Furthermore, the detailed study conducted by the ECI (1996) in which they offered a practical guide for implementing TQM in the Construction Industry identified Alliancing as one the key concepts considered to be central to running a TQM project. Alliancing was defined as the business relationship between Customers, contractors and suppliers. This was evident in Organisation C in which the focus was on Clients to appreciate and note the market in which they performed through the gaining of BSI accreditation.

6.13.4.3 Employee Empowerment, Employee Involvement

Despite the arguments for the importance of employee empowerment, there was less employee involvement in the three cases. For example, Case B provides evidence on the dangers of not involving the employees in the quality initiative. This resulted in the exercise being fraught with suspicion by the employees. According to Dale (1997): Quality improvement initiatives tend to be 'bottom-up'. The results of the case analysis indicate that although SMEs might be aware of the need for human resources strategies such as training and employee empowerment, they are still affected by lack of resources. This finding is consistent with Ahire and Golhar (1996). As observed by Davig et al (2003), one of the critical success factors lies with the creation of teams that should be trained and empowered. According to Greasley et al (2003), team and individual empowerment are some of the performance improvement strategies that can be adopted for construction. Lee (2004) identified employee participation and involvement as one of the most important pre requisites to successful implementation of TQM programs. Walsh et al (2002) recommended the fusion of learning and practice as TQM cannot be taught by practice alone, but through continuous practice and observation.

6.13.4.4 Training

This varied across the three cases. As opposed to the generally accepted principle of training both management and employees in various quality and problem solving techniques, Organisation B focussed on training management in project management which in turn included aspects of quality. Organisation C at least recognised the need for employee training as it was considered as an integral part of all job instructions whereas Organisation A through its adoption of EFQM Excellence Model had external consultants helping out with training and consensus meetings. Usage of external consultants was identified as one of the success factors in a study by ECI (1996). McCabe (2004) in citing Salder (1995) observed that the learning organisation as illustrated in Figure 6.76 can adapt several processes and influences that create a learning organisation. One of the processes was 'learning from the outside' through consultants as was the case with Organisation A. The experiences cited in the study were from America, thus it can be stated that these critical factors such as training are not only limited to the UK organisations, but also can be viewed as generic.

Isolated cases in the case study showed that for TQM deploying organisations, quality training was considered to be an integral part of all job instructions as evidenced by the percentage of operators who have attended special quality courses for the organisation that was studied. Some of the organisations studied by McCabe et al (1998), found the quality manual to have a role in training. On the basis of this, Organisation C used this approach of progressing from the Quality Assurance to TQM through the production of the quality manual for the whole company as well as consulting all departments on their particular procedures. As observed by Baxendale and Burrel (1997), training for TQM requires that both technical and humanistic aspects must be addressed, therefore the UK construction related organisations must take notice of it. Furthermore, apart from improving the performance of employees, its is suggested that training would instil a sense of importance and self worth (Davig et al, 2003:75).

Tannock et al (2002) observe that Managers in SMEs receive less training and consequently are generally at a lower standard of awareness and expertise than those in large organisations. This is supported by an earlier study (Johnson and Gubbins, 1992) as observed by Smith and Whittaker (1998) which found 30% of employees received training in smaller businesses compared to 50% in larger firms. Drawing heavily on the discipline of Organisational behaviour, the UK constructional related SMEs when viewed as existing in an open system are subjected to constraints such as resource limitations. i.e. a skills shortage as identified in the training crisis. However, Barlow and Jashapara (1998) observe that for UK Construction organisations to maintain a competitive edge, they must endeavour to become "learning organisations" through the promotion of double-loop learning. This in turn leads to the creation of a culture change in construction as was the case of large construction firms (McCabe, 2004). Sureshchandar et al (2001) emphasises the importance of training and education in that employees will understand the theory of quality only when they are properly trained in the quality concepts and tools.

Smith and Whittaker (1998) in citing the Handy and McConstable reports (1987) observed that UK Managers, across the company size, lagged a considerable way behind the international competition in terms of relevant qualification. However earlier studies such as Smith and Whittaker (1998) dispelled the notion of the major barriers associated with training as not being the cost nor the possibility of well trained staff leaving the organisation, but rather as follows:

- Lack of time
- Management knowledge about training
- Employee attitudes

- Poor opinion

The about barriers cited were SME specific and Egan (1998) similarly echoed the same sentiments. The major finding of the study by Smith and Whittaker (1998) was that though training is generally perceived as beneficial, the link between training and success is difficult to prove.

6.13.5 Benefits of the Initiatives

Organisation A reported immediate benefits due to their quality initiatives such as better communication and measurement of performance. This finding is consistent with Fisher (1993) cited in Taylor and Wright (2003) who reported that smaller companies had more immediate expectations of TQM benefits, exacerbated by adopting standard TQM approaches offered by consultants. Organisation A brought in consultants to guide the development programme. As noted by Ugboro and Obeng (2000) some organisations have not realised the benefits of TQM, not because of the failure of TQM as a management philosophy but due to its half-hearted implementation. One obvious omission was the lack of understanding between certification and standards. As the case of Organisation C indicates, they mention having ISO standards without stating whether they are actually certified or use them as standards. This is an important area for SMEs. The benefits of the quality initiatives as illustrated in the three cases are consistent with existing literature. For example Nwankwo (2000) found the benefits of undertaking the ISO 9000 to be of three types, firstly ISO 9000 registration communicates to existing and potential customers that the company meets the quality assurance criteria laid down in British Standards. Secondly the process involves the undertaking of a " health check" of the company and this should lead to the uncovering of wasteful, duplicate or otherwise inefficient practices. Thirdly, helping personnel in the production and maintenance of the quality system to gain a better understanding of how the company, through its inter-related parts works and how they might improve the system Nwankwo, (2000:86-87). Among the benefits of obtaining ISO 9000 certification according to Motwani (1996) was the use of the certification label in marketing. Other studies such as Martinez-Lorente and Martinez-Costa (2004) observed that obtaining ISO 9000 certification was more related with an increase in cost rather than benefit. They concluded that ISO 9000 does not generally contribute to improving results if a company is applying a TQM policy.

6.13.5.1 Supporting the Time Lag Analysis

What case methodology brings to the task is depth of understanding to better formulate relationships. Furthermore, Stuart et al (2002) note that case methodology is both appropriate and essential where cause and effect are in doubt or involve time lags as the case in this study. Time lags are described as the time dependent relationship between TQM implementation and improvement or benefits.

6.13.6 Emergence of New Quality Initiatives

The findings of this study are consistent with the above. In particular where the respondents were asked to provide their definition of TQM, some TQM deploying organisations were consistent with the customer focus as the basis of the definition. This is hardly surprising as the key tenet of TQM is customer satisfaction. The full definitions of the respondents are in Appendix F. However its interesting to note that as shown by Leonard and McAdam (2002) the terminology of business excellence was less used by constructional related organisations.

It is not surprising that the numbers using the terminology of Business Excellence were low as evidence shows that the EFQM Excellence Model has mostly been used by large organisations. This is backed by the response from a Quality manager with 7 years of experience of a TQM deploying organisation comments:

> "We use the EFQM Excellence Model. Refer to the efqm.org for definitions"

Another Quality Director with 15 years of employment notes:

> "TQM was dropped 3-5 years ago. We currently use the EFQM to measure ourselves internally"

This is a classic example of "rise and also disappear" initiative as observed by McCabe and Boyd (2004). They posit that these initiatives are on a continua between promotion and implementation, where promotion is paper based and implementation is lacking in practice. The missing level identified here is that of development.

This is supported by another Quality Manager of a non-TQM deploying organisation who stated that the definition of TQM was not applicable to their organisation as they were implementing the EFQM Excellence Model. All this points to the fact that TQM might be giving way to other improvement initiatives. This is contrary to Taylor and Wright (2003) who in their longitudinal study found the majority of firms who continued with the TQM programme were small in size, and the majority claimed TQM was quite or very successful. Contrary to the findings from the survey about a lack of interest in the EFQM EM Award, the findings from Organisation A indicate the application of the EFQM Excellence Model was seen as being adequate, hence no need for TQM.

According to Leonard and McAdam (2002) their studies indicated that the terminology used by quality managers in referring to TQM varied. Among the results were; Continuous Improvement, Quality, Business Excellence, Total Quality and TQM. The findings indicate that whereas Organisation A was "Company Driven rather than Client", Organisation C used the "Quality

Assurance approach". Organisation B provides evidence of new concepts such as 'Best Practice Initiative' which was driven by the Quality Executive.

The findings of these case studies, in particular Organisation A are consistent with the study conducted by the European Construction Industry (ECI) in 1996. In their study, they recommended the omission of the word "Quality" from organisations starting on a Total Quality program, particularly during the launch phase of starting up TQ. Instead words such as "improvement", "enterprise", “development", "directive", "initiative", "programme", "future", "change" or "transformation" should be used. (ECI, 1996). Evidence of Organisation A avoiding the usage of the word quality can be found in the following comment; "There is no TQM program". This is also reflected in the title of the person responsible for the programme who was called the "Management System Manager". Similarly the non-TQM deploying Organisation B had adopted the title of "Business Improvement Manager" for the person responsible for the programme. In this study for example, the Director of Case Study C did not show any knowledge of the EFQM Excellence Model despite calling themselves as a TQM organisation, they had never heard of the Crosby 14 steps and Juran's model. This finding is consistent with Wilkes and Dale (1998) who observed that TQM and the Managers in many SMEs have not taken up continuous improvement initiatives as they have never been introduced to the concepts. The emergence of new initiatives as observed in non-TQM deploying organisations can be attributed to current organisational changes (McAdam and Henderson, 2004)

6. 14 Application of the Triangulation Approach

Despite the view that academic arguments can be strengthened through the utilisation of triangulation, this premise received less attention within Construction Management research. The main aim of this sub section is to present the application of triangulation within this study using methodological triangulation, to show how valid linkages between statistical analysis, case studies and literature review can be achieved.

Data Triangulation: Various data sources were used: within the quantitative study, data triangulation with regard to the identification of the critical success factors

Method Triangulation: This was achieved by the between method triangulation by applying both quantitative and qualitative semi-structured interview to investigate the implementation issues associated with TQM.

6. 14.1 Completeness of Results (Complementary)

Ammenwerth et al (2003) posits that triangulation can increase completeness when one part of the study presents results which have not been found in other parts of the study. Drawing heavily on their approach, this study achieves and demonstrates the completeness of results by highlighting the new information. Sechrest and Sidani (1995) observe that two or more measures are complementary if, assuming they do measure the same construct to the extent that they do not share the same sources of error variance.

This study in its usage of questionnaire and semi-structured interviews presented partly complementary results which led to new insights. For example the impact of cost, time and manpower on the implementation of any Quality related initiative, be it TQM or EFQM Excellence Model within the UK Constructional related SMEs had not been detected by the questionnaire. Equally the specific barriers to the implementation process had not being detected, as these aspects had not being included in the questionnaire. Another example was the complementarily results in the statistical analysis of the questionnaire and the qualitative analysis of the semi-structured interviews. In terms of the benefits of TQM to the UK Constructional related SMEs, the employees and clients revealed that the benefits to the organisation were better internal communication. This is complemented by the results from the survey which showed that 80% of the respondents felt that TQM led to improved internal communication. Table 6.51 illustrates the two methods of inquiry used in collecting data pertaining to the application of TQM within UK Constructional related SMEs.

The second and third completeness of results relates to the relationship between TQM and ISO 9000, and the impact of the behavioural factors on TQM.

The rationale for triangulation is that either method, whether through the questionnaire administration or the semi-structured interviews are guaranteed to be associated with some error.

Table 6.44: Comparison of Quantitative and Qualitative Methods of Inquiry

A: QUANTITATIVE METHOD: Questionnaire	**B: QUALITATIVE Semi-structured Interviews & Case Studies**
1a. Organisational Characteristics	1b. Preparation for the TQM Programme
2a. Factors for the Implementation of TQM based on the Likert Scale ☐ ☐ ☐ ☐☑ 1 2 3 4 5	2b. Obstacles inhibiting the effective Implementation of TQM and other Quality initiatives
3a. Identification of Advocated Advantages Associated with the Implementation	3b. Identification of Critical Success Factors
4a. Measuring the Success of TQM and Assessment of Organisation Performance	4b. Other Issues 4.1 Benefits 4.2 Impact of Cost, Manpower and Clients 4.3 Employee Involvement 4.4 Application of EFQM 4.5 Quality Training 4.6 Recognition and Reward Schemes
5a. Assessment of Competitive Environment	

For example, it is possible that the results of the questionnaire on the identification of critical success factors (Part 2) are in error to some extent.

This could be due to the administration of the questionnaire that it may over estimate the critical success factors. As noted by Sechrest and Sidani (1995), it would be difficult to estimate the amount by which the critical success factors could have been overestimated, however using the multiple methods; in this case the semi-structured interviews would be useful for confirming the direction of bias and providing complementary information.

For example “executive commitment” received the highest score among the critical success factors from the questionnaire survey. This is complemented by the semi-structured interviews where the chairman and top management support were deemed to be vital among the three cases for the success of the implementation process. This area addresses one of the problems facing Operations Management researchers in that Quality Managers wish to be seen in the best possible light. Furthermore, in order to present the ideas of the Quality Managers, the questionnaire (survey) methodology does not fully capture that, as the results contained in the questionnaire are those of the researcher (McCabe et al, 1998)

By employing triangulation, this problem is overcome. For example in this study, the second part (Table 6.44, Part 2a) of the questionnaire dealt with factors affecting the implementation of TQM. Respondents were asked to indicate their implementation of the Quality features given for the ten deployment constructs based on five-point Likert Scale (5= highly advanced in implementation, 1= have not begun implementation but intend to). A Quality Manager could thus tick the box designated 5 for example for one of the variables of the 'Executive Commitment' construct which states that "Executives actively communicate a Quality commitment to employees". This would indicate that the organisation was highly advanced in the implementation of that variable. However by using case studies or interviews, which instead of giving the respondents choices from which to pick, they were asked questions relating to what factors contributed to the successful implementation process and in all the three cases studies were in agreement that the Chair's support or Leadership commitment as being necessary, thus lending credibility and validity to the findings of the questionnaire. Although the Leadership commitment has been acknowledged as necessary for any of quality initiative, the underlying behavioural factors such as change, motivation and learning which were not fully addressed in the survey (quantitative) part of the study emerged in the case study (qualitative). Table 6.44 presented the analysis of the presence or absence of such factors necessary for implementing the cultural shift. The findings indicates that only Organisation A fully addressed the three factors and their associated five elements, whereas Organisation B & C did not address the "change" and "motivation" factors. This is one demonstration of the completeness of results. The questionnaire and semi-structured interview are complementary because they do not share all the same sources of error or bias. Furthermore two or more measures are complementary if, assuming that they do not measure the same construct, to the extent that they do not share the same sources of error variance (Sechrest and Sidani, 1995).

6. 14.2 Validation of Results (Convergence)

This is achieved when results from one part of the study are confirmed by congruent (not necessarily equal) results from other parts of the study

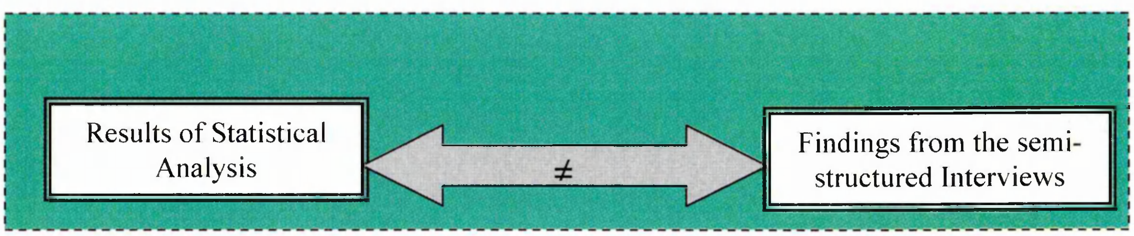


Figure 6.77: Validation of Results

Handfield and Melnyk (1998) observe that through data 'triangulation', academic arguments can be strengthened. One example provided for achieving this is by supplementing the statistical results with case studies, quotes, or even personal insights. This may help to portray the results in a vivid way and provide additional insights.

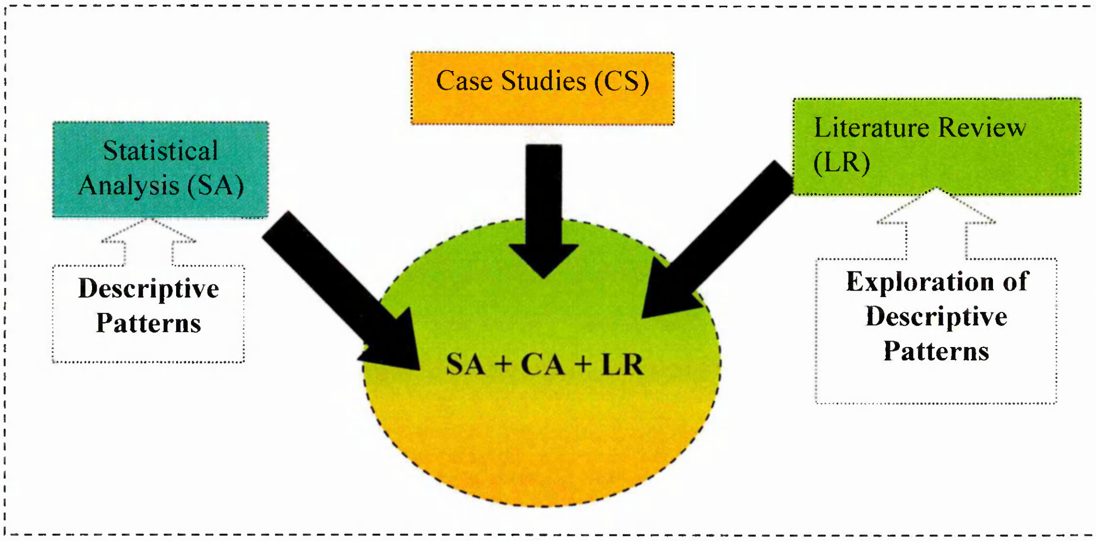


Figure 6.78: Crystallisation of the Quantitative and Qualitative Approaches

The above Figure 6.78 shows the application of a Crystallisation approach involving the findings from the quantitative method of Statistical Analysis (SA) and the qualitative method of Literature Review (LR). This process involves the support from the literature review to the major findings from the quantitative study. The findings are discussed as follows;

- TQM deploying organisations had a medium level of TQM Implementation. This is supported by Woon (2000) who in a study of Singapore productive leaders found similar medium levels of TQM implementation. The findings are also consistent with other studies conducted in different industries and countries such as Quazi et al, (1998); Bradi et al, (1995); Flynn et al, (1995). They found medium levels of TQM in the organisations studied.

- Executive Commitment was found to be the most important critical success factor for both TQM (mean = 4.27) and non-TQM (mean = 3.07) deploying organisations. Management writing on executive commitment or leadership is clear on the importance of this construct to any implementation process. (Juran, 1988; Crosby, 1979; Dale, 1994; Walsh et al, 2002; Lee, 2004)

- Benchmarking and Training were found to be the least two factors implemented by TQM deploying organisations as supported by various authorities in the literature review (ECI, 1996; Dale, 1997; Storey and Westhead, 1997; Smith and Whittaker, 1998; McCabe, 2001; Dattakumar and Jagadeesh, 2003; Davig et al, 2003). This in turn has contributed to a crisis in the Construction Industry where the proportion of trainees in the workforce appears to have declined by half since 1970s (Egan, 1998). Tannock et al (2000) in their study of Thais manufacturing SMEs found training problems in the four organisations studied. Mccabe (2004) acknowledges that construction industry views on training and education is more of simply imparting 'standard' or 'established' knowledge. However more education is required in order to achieve a sustainable competitive advantage. Issues related to benchmarking in SMEs are not only confined to Construction or a specific country. For example, Spencer and Loomba (2001) encourages benchmarking to be an appropriate TQM practice for SMEs within the USA manufacturing sector. Escriga-Tena (2004) in citing Rose and Ito (1996) observe that the knowledge created through the learning process such a s self-assessment does not depreciate with time, as long as it is used and shared. Therefore it has the characteristics of durability. Both the questionnaire survey and case studies showed that training of management and employees in quality principles is not highly adhered to within Construction-related SMEs.

- non-TQM deploying organisations consider the EFQM Excellence Model as being adequate for their quality initiatives. Talyor and Wright (2003) found other initiatives may have replaced TQM. The case study supported the literature review findings. For example McAdam and Henderson (2004) observed that TQM could help with the development of education, management training and development in developing cultural change. Training is also regarded as one of the core practices of TQM (Hackman and Wageman, 1995).Earlier studies by Mann and Kehoe (1995) found that an employee with a high level of education was likely to accept TQM more quickly and recent studies such as Lee (2004) acknowledge employee education and training as one of the most important requirements, yet it is still a significant challenge.

- Van Hoek (2001) argues that one of the benefits of triangulation is its capacity to bring research to a more advanced methodological level. Furthermore it has potential to enhance the richness of the findings by filling in gaps in available knowledge.

- Both the literature review (Burnes, 2004) and case studies showed that changes such as quality initiatives create friction and resistance. Huarng and Lin (2002) in their empirical investigation of total quality management in Taiwan also found 'fear and resistance to change' as one of the difficulties in implementing TQM. Other difficulties cited were lack of consistent management support; inadequate knowledge and understanding about TQM, and employee apathy.

6.14.3 Application of Theory Triangulation

One of the criteria for judgement of a PhD thesis is the existence of a clear relationship with existing research. It is argued that an interdisciplinary perspective would shed more extra light on a phenomenon which is only partially understood and viewed from a single standpoint. It is for this reason that the linkages to other disciplines are explored in the following sub-section.

Linkages to Other Disciplines

The conceptual framework developed in Chapter Two (Figure 2.2) refers to the second middle block as the Internal Environment of the UK Construction related SMEs. The ten TQM practices identified have links with the discipline of **Organisational Behaviour** through the application of variables and practices such as organisation Size, Employment Empowerment, Open Organisation, Employee Relations, Employee Involvement and Team Building (Teamwork). The discipline of **Human Resources Management (HRM)** is represented by Training, whereas **Service Marketing and Management** are represented by Customer Satisfaction, Supplier Focus, Customer Focus and Employee Satisfaction which are covered in the TQM and Organisation Performance part of the Measurement Instrument. Other disciplines are **Business Policy and Strategy** that deal with Benchmarking and **Mathematics / Statistics** with the Practice of Measurement whose principle is covered through the usage of Statistical Process Control (SPC). The subject of Economics is covered through the usage of the "five forces model" by Porter (1980) which is one of the tools and techniques from the subject area. Literature on Organisation theory highlights how an organisation interacts with their environment and is important for performance. Bennett (1997) defines the subject of organisation behaviour as concerning the study of how organisations function and how people relate to them through their conduct, perceptions and intentions-individually or in groups. Organisational behaviour draws heavily on the social and behavioural sciences (especially sociology and industrial psychology). Though the main schools of organisation behaviour are normally defined as the classical and human relations and systems school which includes contingency theory. Drawing heavily on the systems theory, the study can be constructed as bringing together the elements of TQM as illustrated in Chapter Two's conceptual framework. The UK Constructional related SMEs can be regarded as belonging to an open system in which they are in continuos contact with their environment. The constraints considered in this study are organisation size, the actual or potential behaviour of competitors which was explored in Chapter Five (and illustrated in the Conceptual framework as the environmental factors) and resource limitations (skills shortage). By investigating the impact of organisational size on the implementation of

TQM, literature from two different fields or areas, namely organisation behaviour and service marketing and management have not been examined in the same study (Goldschmidt and Chung; 2004). Drawing heavily on Vignali and Zundel (2003), the relationship between theory and practice as highlighted through the different academic disciplines helps narrow the actual barriers in practice. For example the case findings revealed barriers related to cognitive (organisational behaviour), recourse behaviour (human resources management) and cultural biases.

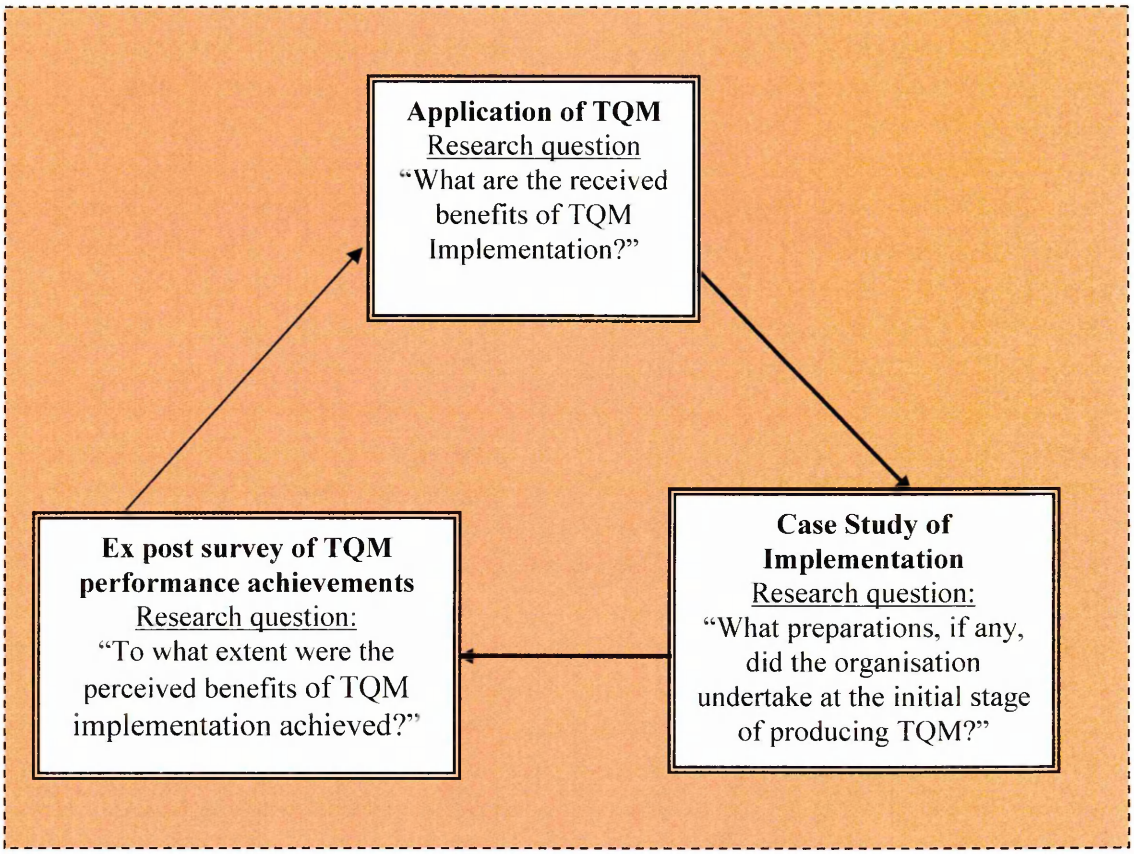


Figure 6.79: Example of triangulation in TQM Implementation

6.15 Limitations of Triangulation

Belgey (1996) cited in Ammenwerth et al (2003) observes that some researchers seem to expect that the "mere fact they are utilising triangulation will magically solve all problems of bias, error and invalidity" in their research. According to Marshall and Rossman, (1994) cited in Green et al (2002), the usage of multi-method must satisfy the following criteria of soundness;

- Credibility / internal validity
- Transferability / external validity
- Dependability / reliability
- Conformability / objectivity

Voss et al (2002) identifies how each of the above points can be satisfied. The case of internal validity which Yin (1994) defines as the extent to which we can establish a casual relationship, whereby certain conditions are shown to lead to better conditions, as distinguished from spurious relationships, was achieved during the Data Analysis Phase. This was possible through pattern matching or explanation building as highlighted in Table 6.42. The next criteria of external validity whose definition was provided for in Chapter Two was achieved through the Case Study tactic of using replication logic in multiple case studies during the Research Design Phase as indicated in Step 1 of Figure 6.73. Reliability was explained in the subsection 6.2.15 as being achieved during the data collection phase through the usage of case study protocol and development of case study data base.

6.15.1 Discussion of the Findings from the Triangulation Approach

Using the literature review, questionnaire and semi-structured interviews as a mode of data collection in a study designed to investigate the application of TQM within the UK Construction related SMEs, the analysis of the quantitative and qualitative study were combined in order to ascertain how the different results could be represented. According to Cassell et al (2002) a clearer rationale for the usage of combining the qualitative and quantitative techniques is that the SME population is continuously shifting at the periphery based on the number of SMEs that register and de-register for VAT during a similar period, and given that diverse nature of SME organisations, usage of quantitative data would be of relatively little value unless supplemented by qualitative data. This study has achieved that by the usage of triangulation. The sub section reported on the achievement of the objectives of triangulation, namely validation and completeness of results. New insights gained through the complementarily of results were presented. Evidence of validation of results (convergence) was shown through the supplementing of statistical results with case studies and quotes from Quality Managers. The application concluded by presenting the different types of triangulation, in particular methodological triangulation and illustrating its application via this study. The benefits and the capacity of triangulation in enhancing the richness of the research findings were clearly explored. Furthermore, through the usage of cross-case analysis increases the internal validity of the findings (Voss et al, 2002). Triangulation with different sources increased the explanatory power of this study.

6. 16 Summary

This sub section reported on the exploration of the implementation of quality initiatives undertaken by three UK constructional related SMEs. As stated by Dwyer (2002) the purpose of this approach was to build theory about quality, which is faithful to the evidence found in the real world. From the results of the triangulated research study (methodology) i.e. survey, semi-structured interview and literature review, a number of conclusions can be drawn in regards to the aims and objectives posed in this thesis. In particular the third objective of this study was to determine if they are any differences in quality management implementation and quality outcomes across UK Construction related SMEs and if so, how and why they differ. Using case studies has helped to achieve the objective.

The results of the survey and case studies provide a good insight into the current status or snapshot of TQM practices within the UK constructional related SMEs. It is hoped that this study will bring out some important lessons for the UK Construction Industry in improving their quality management practices. The anecdotal reports of TQM definitions provided by Quality Managers was useful in a complimentary way to the questionnaire data in that it represents a monitoring probe (Sechrest and Sidani, 1995) that tells us that the quantitative data may not be fully trustworthy. Complementarily was proved as the questionnaire and case study evidence did not share all the same sources of error or bias.

The purpose of the case studies was to highlight the methods taken in quality initiatives, in particular by the non-deploying organisations who exhibited some fundamental quality principles. As identified by Ghobadian and Gallear (1996) no specified training budget, local incidence of unionisation and the operations and behaviour of employees were influenced by owners' / managers' ethos and outlook. Some of the characteristics of the SMEs are tabulated in Chapter three and the findings from this case study verify the status of the SMEs.

In particular, Organisation A provides evidence that TQM may have given way to other improvement initiatives.

This study extends the work of Taylor and Wright (2003) about the growing importance of EFQM Excellence Model as de facto "TQM" program. The fact that Organisation A was firm in avoiding the usage of the word "TQM" or "Quality" indicates that TQM might be giving way to other improvement initiatives such as 'Six-Sigma' and 'Business Process Reengineering'. However the goal of these initiatives have some similarities with the aspirations of TQM, namely that of satisfying the customer, employee and shareholders. However the proliferation of initiatives within the industry should be treated with caution. McCabe and Boyd (2004) offer insights as to why there is a plethora of initiatives in the Construction Industry. They observe that initiatives "rise and also disappear", that there is little historical reflection and mostly there are two phases of promotion and implementation in the quest for quality initiatives. The findings of this study through the case studies lends supports to McCabe and Boyd assertions. Furthermore, as observed by Kruger (2001) cited in McAdam and Henderson (2004), the current six-sigma developments within TQM operations, when critically evaluated, is found to be based on the statistical and incrementalism side of TQM. The findings from the quantitative analysis reveal that the extent of TQM initiatives in non-TQM organisations are no different from those in TQM deploying.

This Chapter has presented some basis of triangulation and illustrated them in the three case studies. The findings further extends the work of Terziovski and Samson (2000) who advocated for the usage of in-depth case studies in order to provide detail on the impact of TQM categories and the improvement initiatives on the performance measures. Borrowing the phrase from Boyer and Pagell (2000), usage of the case studies in this thesis was designed to uncover more complex insights, more like the rifle as opposed to the survey methodology which they equated to the shotgun, guaranteed to hit something. In a special issue of Operations Management Replication Research, Frolich and Dixon (2003) provide the basis for the usage of methodological triangulation on an existing OM theory, model or framework as a possible option for testing existing theory. Furthermore, according to Johnston et al (2004) usage of case studies permits the access to the rich interaction of factors and events that produce the perceptions summarised in the measured scores from the quantitative study. Further support is provided by Stuart et al (2002) who note that case methodology is both appropriate and essential where cause and effect are in doubt or involve time-lags (e.g. the time dependent relationship between TQM implementation and implementation or benefits) as is the case with this study. It also brings to task depth of understanding to better formulate relationships. In summary, the two main barriers to the implementation of TQM within SMEs can be taken firstly as "cultural and political", that is lack of belief in TQM and / or the need to change. Secondly, "cognitive", lack of knowledge or skills. The findings from the case studies also supports and extends the work of Taylor and Wright (2003) by providing evidence of little usage of TQM in preference to the EFQM Excellence Model among the non-TQM deploying organisations. The findings reported in the case methodology forms part of the descriptive study. The key findings from the case studies are what this research sought to identify:

- the obstacles to the implementation process,
- identify the critical success factors and benefits to be derived from the quality initiatives.
- Understanding of the TQM/ISO 9000 Relationship

This study contributes to the debate as articulated by Sun et al (2004) as to whether ISO 9000 is the stepping-stone to TQM (Quazi and Padibjo, 1997, 1998; Parr, 1999) or whether ISO 9000 standard and certification is the foundation on which TQM is to be built (Stephen, 1994). The findings are mixed as revealed by the case studies. Those organisations implementing TQM progressed from ISO 9000 whereas non-TQM deploying organisations viewed the standards as the de-facto TQM. As stated by Martinez-Lorente and Martinez-Costa (2004), ISO 9000 does not satisfy a large number of TQM requirements. The study also extends the work of Sila and Ebrahimpour (2002) who suggested that further research examines a comparison of companies implementation approaches to ISO 9000 and TQM (TQM only, ISO 9000 only, TQM first and ISO 9000 second, ISO 9000 first and TQM second, and both ISO 9000 and TQM at the same time). Through the case studies and Quality Managers definitions of TQM, insight has been gained in understanding the differences. The usage of ISO 9000 can contribute as "systems and procedures" as vehicles for learning (McCabe, 2004). It also confirms the findings of Taylor and Wright (2003) who highlighted the understanding of TQM and its relationship to ISO 9000 as an antecedent.

6.17 References

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Chapter Seven

Model Development & Validation

CHAPTER SEVEN: MODEL RE-DEVELOPMENT AND VALIDATION

7.1 Introduction

The final objective of this study was the development and validation of a model focused on the provision of assessing and monitoring the levels of TQM implementation within small and medium sized UK constructional related organisations. This therefore has in turn enabled the organisations to attain a sustainable competitive advantage. Based on first principles would result in the development of TQ-SMART model which is based on the data from the 63 respondents. A further 8 respondents are used as part of the validation process using various techniques. This chapter will attempt to validate the TQ-SMART model with the data of the quality initiatives of the 63 organisations in the UK SME's Constructional related organisations. It also presents the Assessment Type 3, as outlined in the conceptual framework for the survey part of the study. This deals with the assessment of outcome criteria.

7.2 Modelling Aim

The data gathered in the survey was the basis for building or redefining the model that could present an average pattern of links between the variables concerned (Ameenwerth et al 2003). Based on research by Flynn and Saladin (2001), it was established that radical changes to the weighting schemes are necessary in order to establish the relative importance of the constructs. For example, the ten implementation constructs deemed necessary for the implementation of TQM. Only the Executive Commitment construct scored highly indicating that Senior Management Commitment is always necessary for the implementation process, however, there is no research to date which explores the right mix or "structural mix" of the implementation constructs. This study poses the following research question. Should the ten TQM deployment constructs carry equal weights?

Confirmatory factor analysis was employed to examine the underlying relationships as theorised among the different constructs in the TQ-SMART model, i.e. executive commitment, quality philosophy, customer focus, supplier focus, training, open organisation, employee empowerment, zero defects and measurement.

As stated by Curkovic (2003), structural equation modelling attractiveness is twofold

1) It provided a straight forward method with multiple relationships simultaneously while providing statistical efficiency

2)Its ability to assess the relationship comprehensively provided a transition from exploratory to confirmatory analysis.

The results support that the theorised structure provides to a certain degree a good fit and represents the data collected. According to Field (2002) this is the degree to which a statistical model represents the data collected.

7.3 Previous Research Findings and Limitations

Limitations in previous research have been the lack of assessing the dimensionality of the measuring instruments. Furthermore, most of the validated instrument designed for the manufacturing and service sectors rarely included construction industry in its sample of respondents. Further, the models need to be tested for the fit of assessment which could for example fall into three categories namely: Good fit, moderate and poor fit. Therefore, the primary task in this model testing and revalidating procedure was to determine the goodness of fit. In order to assess their undimensionality and internal consistency, the ten scales were subjected to ten limited information factor analyses (Anderson and Gerbing, 1998).

7.4 Model Construction

The modelling is initiated using the first principles. The methodology used in the modelling process is shown in Chapter Six, Figure 6.3: The Confirmatory Factor Analysis Using Structural Equation Modelling (SEM) and comprises the following four steps: namely;

1.Model Specification,

2.Model Data Fit

3. Model Comparison

4. Model Respecification.

Using the mean values obtained from the 63 respondents on the deployment of the ten constructs ascertained to contribute to TQM, the overall score for items used to assess the levels of TQM were calculated. The total scores are shown in Table E1, Column 6 (Appendix E). As a comparison, the data was split into those claiming to implement TQM (Table E2) and those who didn't (Table E3). The means for the performance indicators were also generated resulting in a matrix to measure the overall impact of TQM on Organisation performance. The detailed calculations with the respective formulas were established in Chapter Six and re-stated within this Chapter.

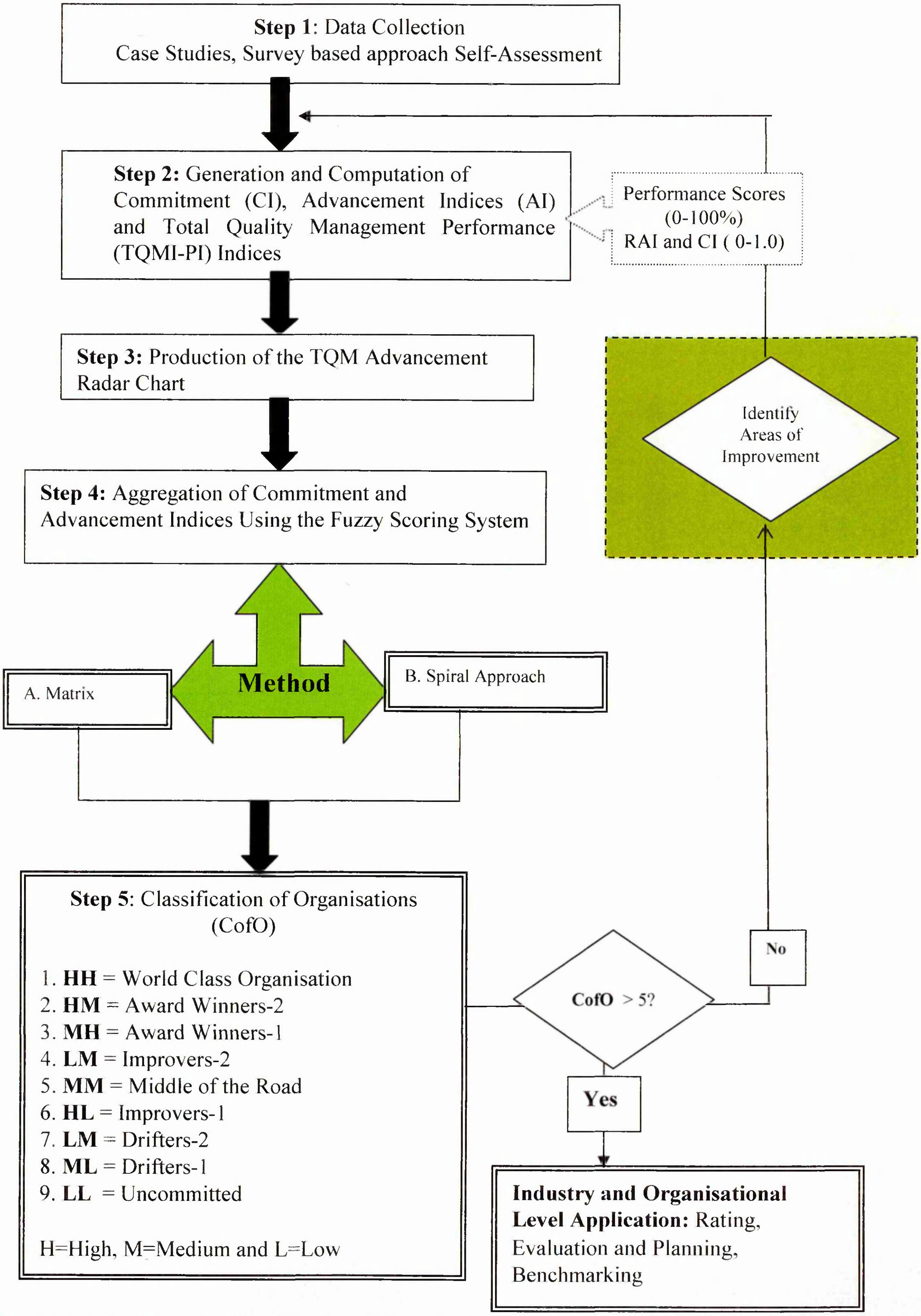

Fig 7.1: Methodology for Classification of Organisations

From Figure 7.1, it is evident that three basic measures are used to assess the performance and levels of TQM of the UK Construction-related SMEs. These measures are

1. Performance Scores
2. Importance Weights - TQM
3. Importance Weights - BOPI
4. Percentage of Variance Explained (PVE).

The following flowchart summarises the assessment criteria used and sources of information in terms of Table Numbers as indicated in the Appendices.

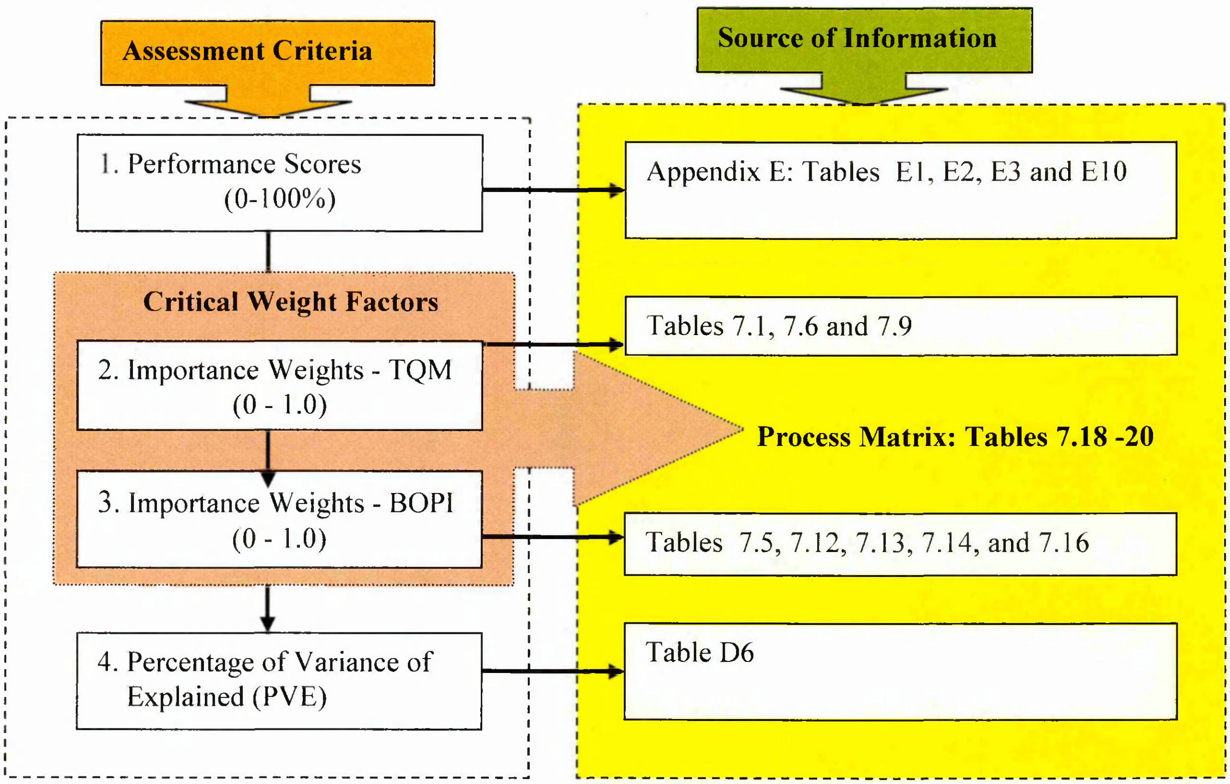

Figure 7.2: Linking the Assessment Criteria to Source of Information

7.4.1 Measuring the Levels of TQM Deployment

The main steps in applying the TQ-SMART in the measurement of TQM levels are summarised as a flow diagram shown in Figure 7.1. Issues in applying the methodology in each of the steps of Figure 7.1 are addressed in the following:

Step 1.0: Data Collection using Survey Based Self Assessment Approach

SPSS package was used for the analysis of the item and total scores for the whole sample (n = 63) and based on the respondents, the sample is split into TQM and non-TQM. The results of the items and total scores for the total sample, TQM deploying and non-TQM are shown in Tables E1 to E3 respectively as shown in Appendix E.

Step 2.1-2.3: Generation and Computation of Commitment (CI), Advancement Indices (RAI) and TQMI-P

The next sub sections present the results of exploring the data for the descriptive statistics of the ten TQM deployment factors for the TQM and non-TQM deploying organisations.

7.4.2 Computation of Relative Advancement Indices

The *relative advancement index* (RAI) derived to summarise the contribution to the advancement of each implementation construct was established in Chapter Six and can also be computed as:

$$\mathbf{RAI} = \frac{\sum \Phi i}{WxN} \quad \textbf{.. (Equation 7.1)}$$

Where: $\sum \Phi$ = the total score obtained from Table 7.16, Column 2.

W = Maximum possible weight for the item (5);
N = number of respondent in the sample

The following Tables E4 through to E6 (Column 7) in Appendix E presents the relative advancement indices for the three groupings as earlier shown in Tables E1 through E3.

Stage 1: Initial Measurement Model

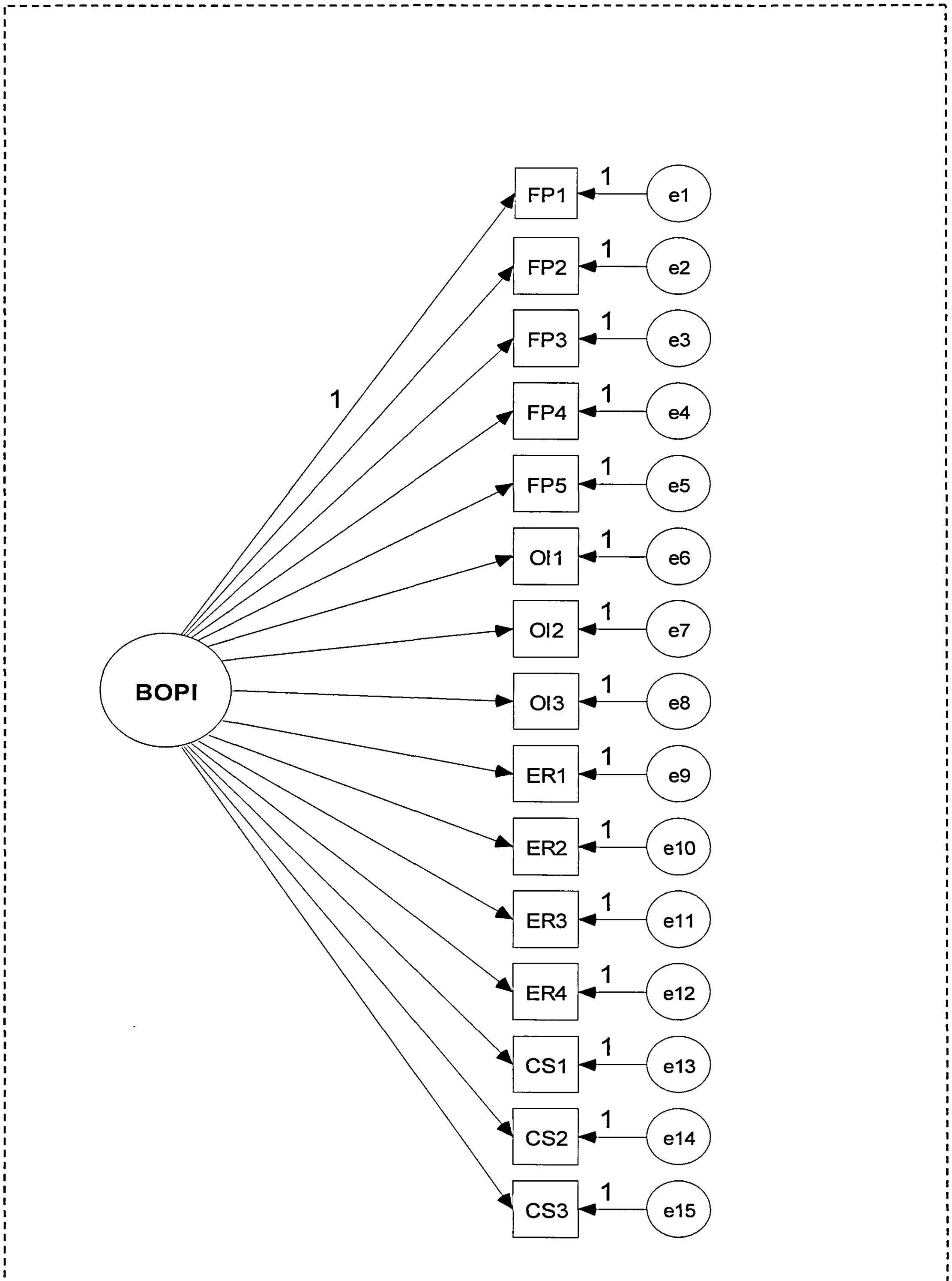

Figure 7.3: First-Order Confirmatory Factor Analysis Model for Business and Organisation Performance Indicators (BOPI)

$\chi^2 = 1091.0$, df = 517, p = 0.000	(Unacceptable fit)
χ^2/df = 2.112	(Acceptable fit)
GFI = 0.543	(Unacceptable fit)
TLI = 0.700	(Unacceptable fit)
RMSEA = 0.134	(Unacceptable fit)

As expected the sample size of 20 is insufficient for the full model as it violates the recommended sample size to number of parameters ratio, which in this case would require 300 sample size to achieve the 10 to 1 ratio, as there are 30 distinct parameters to be estimated. A data reduction technique is employed in order to cope with a small sample size. This technique involves a three stage process (Gribbons and Hocevar, 1998; Singh and Smith, 2004) and is illustrated in the form of a flow chart in Figure 6.57.

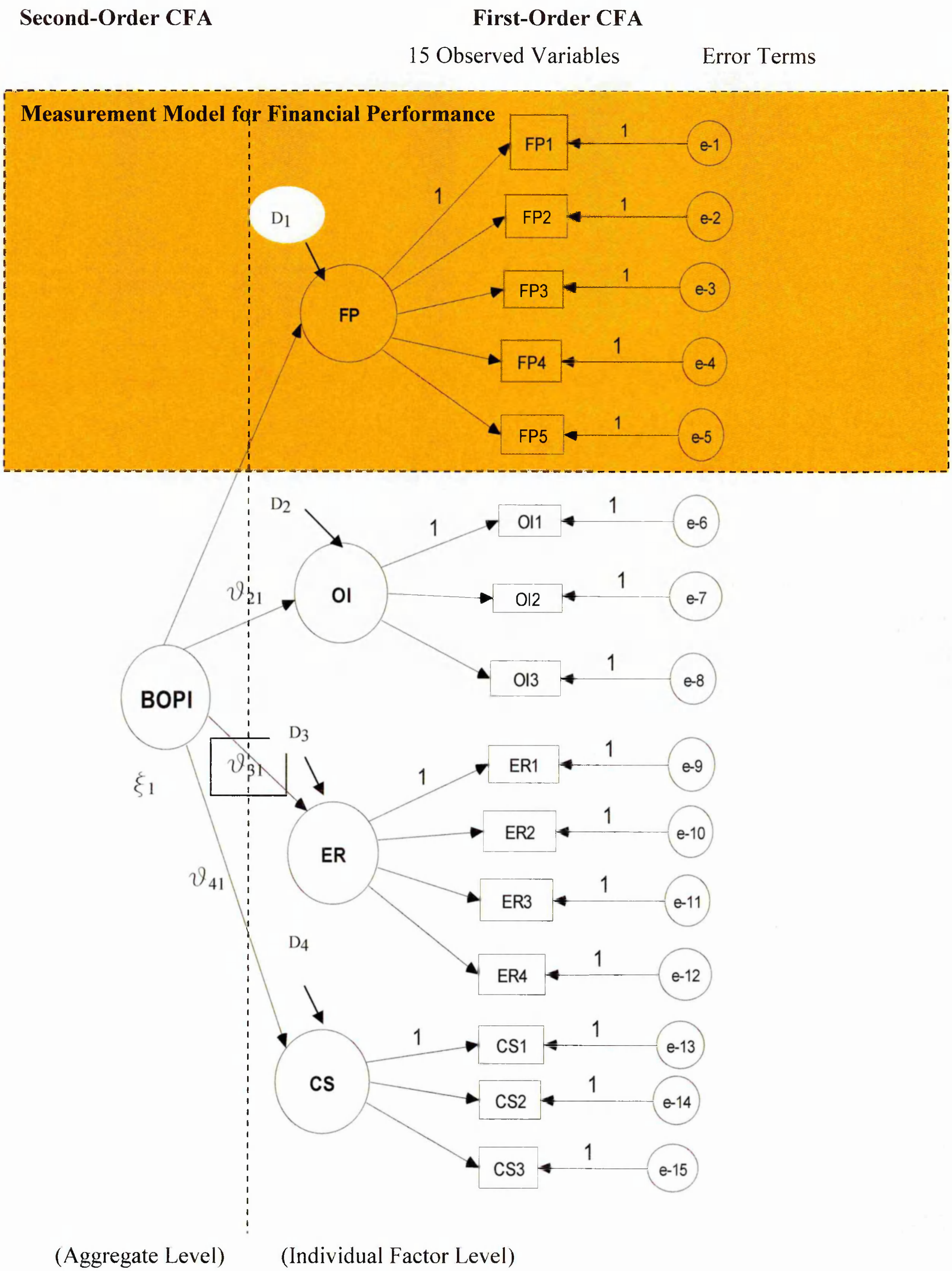

Figure 7.4: Second-Order Confirmatory Factor Analysis Model for Business and Organisation Performance Indicators (BOPI)

Before the relationship between TQM and BOPI could be investigated, it was first necessary to confirm that the BOPI constructs were related to BOPI. The hypothesised overall BOPI model is portrayed in Figure 7.4 in Structural Equation Modelling (SEM) notation. As in the case of TQ-SMART, the single headed arrows leading from the second-order of BOPI (F_5) to each of its underlying first order factors (F_1, F_5; F2, F_5; F_3, F_5; and F_4, F_5) are regression paths that indicate the prediction of the BOPI Financial Performance (F1), BOPI Operating Indicators (F2), BOPI Employee Relations (F3), and BOPI Customer Satisfaction (F4) from a higher order BOPI factor. They also represent second-order factor loadings denoted as ϑ_{11} through to ϑ_{41} on Figure 7.4. The results of which are presented in Table 7.2 and Table 7.4 There is also a residual disturbance term associated with each first-order factor (D_1, D_2, D_3, and D_4). These represent residual errors in the prediction of the first-order factors from the higher order factor of BOPI. In testing the theory, the researcher is testing a statement of a predicted relationship between the units observed or approximated in the real world. Thus constructs (η_1 to η_4) are related to each other by propositions, while variables are related by hypotheses.

F_5	=	Factor 5	=	BOPI (2nd Order Factor)
F_1	=	Factor 1	=	BOPI Financial Performance (1st Order Factor)
F_2	=	Factor 2	=	BOPI Operating Indicators (1st Order Factor)
F_3	=	Factor 3	=	BOPI Employee Relations (1st Order Factor)
F_4	=	Factor 4	=	BOPI Customer Satisfaction (1st Order Factor)

The boxes represent the actual observed measurement obtained from the second part of the survey document, which is a total of 15 variables (results) for the four traits obtained by four methods. Expressed more formally, the CFA model portrayed in Figure 7.4 hypothesised a priori that:

- BOPI can be conceptualised in terms of the four factors
- each observed variable will have non zero loading for all other factors
- error terms (E_1 through E_{15}) associated with each observable variables will be uncorrelated
- The four first-order factors will be correlated
- Co-variation among the first-order factors will be explained fully by their regression onto the second-order factor.

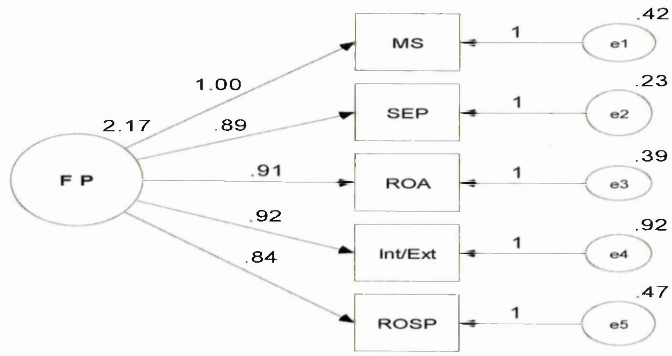

Figure 7.5 First-Order Confirmatory Factor Analysis Model for Financial Performance Measurement Model

A summary of the selected indices for the AMOS analysis is provided in Table 7.1. Presented with the findings of χ^2 (20) = 8.228 and CFI = 0.866 for the first-order BOPI-Financial Performance CFA model, no further modifications were required to improve the model fit to acceptable levels.

Table 7.1: Goodness-of-fit indices for the initially hypothesised first-order BOPI - Financial Performance Indicators CFA Model

n	**20 (TQM deploying)**	
Number of latent variables	5	
Total number of observed variables	11	
Degree of freedom (df)	5	
χ^2 statistic	8.228	Acceptable fit
p-value	0.144	Acceptable fit
χ^2/df	1.646	Acceptable fit
Bentler-Bonett normed fit index (NFI)	0.922	Acceptable fit
Bentler-Bonett non-normed fit index (TLI)	0.932	Acceptable fit
Comparative fit index	0.966	Acceptable fit

The relationship among the first order factors are indicated in the following table

Table 7.2: First-Order Factor Loadings of the Financial Performance Indicators

Path	Factor Loading	Standardised Regression Weights	Squared Multiple Correlations
FP - FP1	ϑ_{11}	1.000	1.000
FP - FP2	ϑ_{21}	0.893	0.797
FP - FP3	ϑ_{31}	0.911	0.829
FP - FP4	ϑ_{41}	0.919	0.844
FP - FP5	ϑ_{51}	0.841	0.707

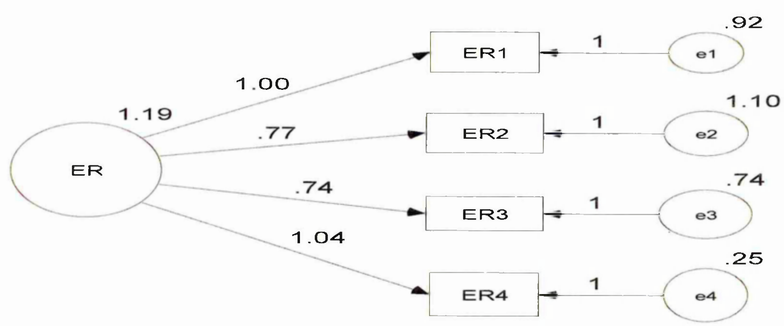

Figure 7.6: First-Order Confirmatory Factor Analysis Model for the Employee Relations Measurement Model

A summary of the selected indices for the AMOS analysis is provided in Table 7.3. Presented with the findings of χ^2 (20) = 8.228 and CFI = 0.866 for the first-order BOPI-

Financial Performance CFA model, no further modifications were required to improve the model fit to acceptable levels.

Table 7.3: Goodness-of-fit indices for the initially hypothesised first-order BOPI - Employee Relations CFA Model

n	**20 (TQM deploying)**	
Number of latent variables	5	
Total number of observed variables	11	
Degree of freedom (df)	5	
χ^2 statistic	8.228	Acceptable fit
p-value	0.144	Acceptable fit
χ^2/df	1.646	Acceptable fit
Bentler-Bonett normed fit index (NFI)	0.922	Acceptable fit
Bentler-Bonett non-normed fit index (TLI)	0.932	Acceptable fit
Comparative fit index	0.966	Acceptable fit

Relationship Among the First-Order Factors

Nomological validity was assessed from the final instrument shown in Figure 7.4 using the inter-factor correlations. From Table 7.5, it is evident that all correlations were statistically significant and positive, also some of the correlations were very large. As asserted by Curkovic et al (2000), the large correlations are hardly surprising as it was hypothesised a prior that these four business and organisational performance factors are associated with a higher-order factor called Business and Organisational Performance Indicator (BOPI) as illustrated in Figure 7.4. The inferences to be drawn are that the absence of negative correlations among the BOPI factors indicates a high value on one factor and that the factors complement one another (Curkovic et al, 2000:779)

Table 7.5: Relationship Among the First-Order Factors Table: Inter Factor Correlations

Factors	Performance Indicators	Correlation
Factor 1: Factor 2:	BOPI Financial Performance BOPI Operating Indicators	**0.466**
Factor 1: Factor 4:	BOPI Financial Performance BOPI Customer Satisfaction	**0.893**
Factor 2: Factor 4:	BOPI Operating Indicators BOPI Customer Satisfaction	**0.692**
Factor 1: Factor 3:	BOPI Financial Performance BOPI Employee Relations	**0.737**
Factor 2: Factor 3:	BOPI Operating Indicators BOPI Employee Relations	**0.605**
Factor 3: Factor 4:	BOPI Employee Relations BOPI Customer Satisfaction	**0.745**

An examination of Table 7.5 reveals that all correlations were statistically significant and very positive Table 7.5 provides a direct picture of the relationship between the various Business and Organisation indicators. This helps give a better understanding about the positive fit among the practices. As supported by Woon (2000), where the correlation among the TQM constructs provides an indication of the extent to which they reinforce one another in the TQM effort.

The highest correlation between Financial Performance and Customer Satisfaction indicators ($\Phi = 0.893$) and each of the other constructs suggests that when customers have less complaints, more overall satisfaction, the market share of an organisation is bound to improve. On the contrary, the weakest correlation between Financial Performance and Operating Indicators ($F = 0.466$) suggest that poor timeliness of delivery of the project, customer retention and reliability have a negative impact on the financial performance.

Figure 7.7: Second-Order Factor Loadings of the Business and Organisation Performance Indicators

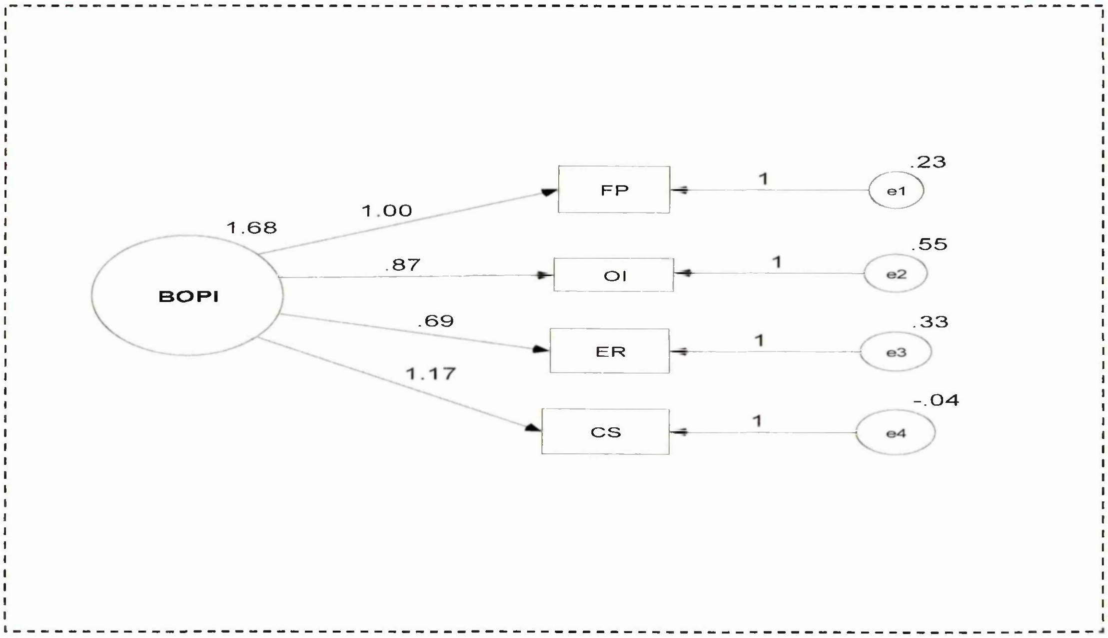

Table 7.4: First-Order Factor Loadings of the Business and Organisation Performance Indicators

Path	Factor Loading	Standardised Regression Weights	Squared Multiple Correlations
BOPI → FP	ϑ_{11}	1.000	1.000
BOPI →OI	ϑ_{21}	0.870	0.756
BOPI → ER	ϑ_{31}	0.692	0.478
BOPI → CS	ϑ_{41}	1.172	1.373

According to Cheng (2001), the structural model stage of analysis involves the evaluation of the relationship between the latent constructs. Table 7.5 presents the relationship among the first-order factors which can be used to infer the relative strength of relationship among the factors (variables) by their path loadings.

7.4.3 Construct Centre of Gravity

The centre of gravity gives an indication of the overall weight within the TQ-SMART that can be apportioned by the construct. It can be defined as the ratio of the construct to the overall construct relative advancement indices. The Construct centre of gravity can be computed as follows:

$$\acute{\O}_{RAI} = ((\sum (Wi_{RAI} / NA)/n) \text{ ....} \textbf{Equation 7.2)}$$

Where

$\acute{\O}_{RAI}$ = Centre of Gravity of the Construct

$\sum Wi_{RAI}$ = the sum of the relative advancement indices of all constructs i.e. for all the organisation = 5.976, similarly when considering the TQM and Non-TQM deploying organisations in isolation, $\sum Wi_{RAI}$ = 6.41 and 5.18 respectively. These values are shown in column 6 of Tables E7, E8 and E6 (Appendix E) respectively

$$\sum Wi_{RAI} = RAI\,1 + RAI\,2 + RAI\,3 + \ldots\ldots RAI\,n.. + RAI\,10 \text{ ....} \textbf{ Equation 7.3}$$

Where n is the number of the nth construct. Weighting assigned to the commitment construct with the maximum being 1.0.

The summary for the centre of gravity are indicated in Tables 7.6 and the calculation is illustrated in Tables E7 through E9, Column 7 (Appendix E).

A similar approach was used by Arditi and Lee (2003), in their study though the construct of gravity was referred to as the importance weights. Based on the rule of thumb, their importance weights added up to 1.0

Table 7.6: Summary of Scale Centroid Constructs:

Implementation Construct	Category	Scale Centroid Constructs (Critical Weights)		
		TQM (n = 20)	non-TQM (n = 43)	All Organisations (n = 63)
1	**2**	**3**	**4**	**5**
1. Executive Commitment	Soft	0.1279	0.1127	0.1128
2. Adopting the Philosophy	Soft	0.1014	0.0965	0.0957
3. Customer Focus	Hard	0.1186	0.1181	0.1148
4. Supplier Focus	Hard	0.0952	0.0965	0.0991
5. Benchmarking	Hard	0.0811	00818	0.0833
6. Training	Soft	0.0780	0.0984	0.0927
7. Open Organisation	Soft	0.0983	0.1138	0.1051
8. Employee Empowerment	Soft	0.0952	0.0824	0.1004
9. Zero Defects	Hard	0.1045	0.1069	0.1074
10. Measurement	Hard	0.0952	0.0868	0.0886
$\sum$ (C.W.F)		1.000	1.000	1.000

7.4.4 Discussion of the Scale Centroids Constructs (Critical Weight Factors)

It was found that only the TQM deploying organisations stressed the importance of soft aspects of TQM implementation.

7.5 EXAMPLE OF SCORING THE RAI FOR INDIVIDUAL ORGANISATIONS

The individual scores for the variable are presented in Table D17 (Appendix D). Based on the summary sheet in the appendix, the score of 87 compared against column 9 falls into the low level of TQM implementation and this organisation can be classified as belonging to the Adopters group (EFQM), or Improvers based on the Dale and Lacessell (1997) classification.

Table 7.7 Scale Item, Component and Average Scores of Organisation A (Respondent No 8)

Implementation Construct	**Item Scores**				**Component Score $\sum$ Wi**	**Average Score**
	1	**2**	**3**	**4**		
1	2	3	4	5	6	7
1. Executive Commitment	5	5	3		13	4.33
2. Adopting the Philosophy	5	5	1		11	3.67
3. Customer Focus	5	4	1	4	14	3.50
4. Supplier Focus	4	4	4		12	4.00
5. Benchmarking	1	1	1		3	1.00
6. Training	1	1	3	1	6	1.50
7. Open Organisation	3	4	1		8	2.67
8. Employee Empowerment	4	4	2	3	13	3.25
9. Zero Defects	1	1	1		3	1.00
10. Measurement	1	1	1	1	4	1.00
Total Score					25.59	
Overall TQM Indicator (Low Level of Implementation)						2.559

Based on the classification of TQM implementation levels, Organisation A can be classified as having a low level of TQM implementation with the TQMI =2.559. Based on this method, the Quality Managers or the person(s) responsible for the management of quality can clearly identify which areas have low scores. For example, an examination of Table 7.7 indicates that Organisation A has a low level in three areas of the 'hard' aspects of TQM implementation, namely 'Benchmarking', 'Zero Defects', and 'Measurement' all with a TQMI = 1.00 followed by 'Training' with a TQMI of 1.50. The model can then be used as a down-up communication to the strategic or corporate level about the need for improvement in the identified four areas. In this manner, the areas requiring immediate attention are clearly identified. It is notable from the results that, the level of 'Executive Commitment' has the highest TQMI of 4.33, followed by 'Supplier Focus' and 'Adopting the Quality Philosophy'.

Table 7.8 Gravity of Constructs of Organisation A (Respondent No 8)

Implementation Construct	**Item Scores**				**Average Score**	**Centroid Construct Ǿ**
	1	**2**	**3**	**4**		
1	2	3	4	5	6	7
1. Executive Commitment	5	5	3		4.33	0.1671
2. Adopting the philosophy	5	5	1		3.67	0.1412
3. Customer Focus	5	4	1	4	3.50	0.1350
4. Supplier Focus	4	4	4		4.00	0.1540
5. Benchmarking	1	1	1		1.00	0.0390
6. Training	1	1	3	1	1.50	0.0578
7. Open Organisation	3	4	1		2.67	0.1030
8. Employee Empowerment	4	4	2	3	3.25	0.1254
9. Zero Defects	1	1	1		1.00	0.0380
10. Measurement	1	1	1	1	1.00	0.0380
Total Score					25.59	0.0380
Overall Indicator (Low Level of Implementation)						**1.000**

7.5.1 Step 2.3: Computation of the Total Quality Management Index (TQMI)

Method 1

$$TQI = \sum_{i=1}^{10} Fi\,(\sum_{j=1}^{Ki} fijRtij\ ) \text{ ....}\textbf{Equation 7.4}$$

where $\sum_{i=1}^{10} Fi = 1$, $1 \leq R_{ij} \leq 5$

Fi = The importance weight of a Quality Management critical factor (for i = 1,...., 10)

$f_{ij......}$ = The importance weight of an item associated with a Quality Management critical factor (for i = 1, ..., 10; and j = 1, ..., k_i)

Ki = The number of items within each Total Quality Management construct

Method 2

$$\textbf{TQMI} = 100 \text{ x } \frac{[E\{n\} - Min\ \{n\}]}{[Max\ \{n\} - Min\ \{n\}]} \text{ ....}\textbf{Equation 7.5}$$

Where E{}, Min { } and Max { } denotes the expected, the minimum and maximum range value of the variable. For example, the Executive Commitment Construct has the E value of 4.10 which is the mean aggregated value of its three variables, the Min and Max Values are 1.0 and 5.0 respectively, therefore the TQMI for the Executive Commitment Construct can be computed as follows:

100 x [4.10 - 1.00] / [5.0-1.0] = 77.5%

The significance of the TQMI is that when applied to measure the percentage of TQM advancement, there is a reduction in the value of the RAI obtained using equation 6.1. A similar approach of using the TQMI was used by Joseph (1999) in his study of the Indian Manufacturing industries. It is also similar to the Customer Satisfaction Index (CSI) obtained by Chan et al (2003). The TQMI of 5.00 and the TQMI of 3.058 in Table 7.9, are the summary figures for all the critical factors.

Table 7.9 Summary for Total Quality Management Index

Critical Factor Weights (F*i*)	Item weights f_{ij}		Max Possible Score (R^*ij)	Item Score R^1_{ij} (Mean)	($F_i . f_{ij} . \mathbf{R}^*_{ij}$)	($F_i . f_{ij} . \mathbf{R}^1_{ij}$)
1	2		3	4	5	6
F_1 = 0.1274	f_{11} =	0.3450	5	3.49	0.2197	0.1533
	f_{12} =	0.3219	5	3.25	0.2051	0.1333
	f_{13} =	0.3331	5	3.65	0.2122	0.1549
					$TQMI^*_1$= 0.6369	**$TQMI^1_1$= 0.4415**
F_2 = 0.1016	f_{21} =	0.4178	5	3.580	0.2122	0.1519
	f_{22} =	0.3717	5	3.190	0.1888	0.1205
	f_{23} =	0.2105	5	1.790	0.1069	0.0382
					$TQMI^*_2$= 0.5079	**$TQMI^1_2$ = 0.3106**
F_3 = 0.1181	f_{31} =	0.2590	5	3.555	0.1528	0.1086
	f_{32} =	0.2520	5	3.460	0.1487	0.1029
	f_{33} =	0.2578	5	3.539	0.1521	0.1077
	f_{34} =	0.2312	5	3.147	0.1364	0.0858
					$TQMI^*_3$= 0.5900	**$TQMI^1_3$ = 0.4051**
F_4 = 0.0954	f_{41} =	0.3594	5	3.191	0.1713	0.1093
	f_{42} =	0.3436	5	3.048	0.1637	0.0998
	f_{43} =	0.2969	5	2.635	0.1415	0.0746
					$TQMI^*_4$= 0.4765	**$TQMI^1_4$= 0.2837**
F_5 = 0.0807	f_{51} =	0.3410	5	2.539	0.1378	0.0699
	f_{52} =	0.3380	5	2.524	0.1364	0.0688
	f_{53} =	0.3210	5	2.397	0.1295	0.0621
					$TQMI^*_5$= 0.4035	**$TQMI^1_5$ = 0.2007**
F_6 = 0.0823	f_{61} =	0.2591	5	2.873	0.1066	0.0612
	f_{62} =	0.2546	5	2.825	0.1048	0.0592
	f_{63} =	0.2302	5	2.556	0.0947	0.0484
	f_{64} =	0.2561	5	2.841	0.1054	0.0598
					$TQMI^*_6$= 0.4115	**$TQMI^1_6$ = 0.2295**
F_7 = 0.0985	f_{71} =	0.3423	5	3.302	0.1684	0.1112
	f_{72} =	0.3391	5	3.159	0.1668	0.1054
	f_{73} =	0.3186	5	2.968	0.1568	0.0930
					$TQMI^*_7$= 0.4920	**$TQMI^1_7$ = 0.3096**
F_8 = 0.0947	f_{81} =	0.2410	5	2.968	0.1141	0.0677
	f_{82} =	0.2464	5	2.921	0.1167	0.0681
	f_{83} =	0.2608	5	2.984	0.1235	0.0737
	f_{84} =	0.2518	5	3.159	0.1192	0.0753
					$TQMI^*_8$= 0.4735	**$TQMI^1_8$= 0.2848**
F_9 = 0.1066	f_{91} =	0.3412	5	3.047	0.1818	0.1107
	f_{92} =	0.3328	5	3.269	0.1774	0.1159
	f_{93} =	0.3260	5	3.301	0.1738	0.1146
					$TQMI^*_9$= 0.5330	**$TQMI^1_9$ = 0.3412**
F_{10} = 0.0947	f_{101} =	0.2471	5	3.127	0.1170	0.0732
	f_{102} =	0.2772	5	2.667	0.1313	0.0700
	f_{103} =	0.2091	5	2.539	0.0990	0.0503
	f_{104} =	0.2666	5	2.254	0.1262	0.0569
					$TQMI^*_{10}$= 0.4735	**$TQMI^1_{10}$ = 0.2504**
TOTAL	**Actual versus Maximum**				**$TQMI^*_{10}$= 5.000**	**$TQMI^1_{10}$ = 3.0581**

7.5.2 Demonstration of Total Quality Management Index (TQMI)

Table 7.9: Summary of Total Quality Management Index provides a numerical example illustrating the calculation of the components of measures used in this study. The illustration assumes that there are ten critical Quality Management factors (F1, F_2, F_3, F_4, F_5, F_6, F_7, F_8, F_9, and F_{10}), the factors are shown in the Confirmatory Factor Analysis model (Fig 6.52) and they correspond to the Constructs in the ellipse. For example F_1 relates to 'Executive Commitment', F_2 to 'Adopting the Quality Philosophy' and so on. Each factor is shown with its assignment items. For example the executive commitment factor has three items or variables assigned to it. These are denoted as (f_{11}, f_{12}, and f_{13}). Similarly the second factor, 'Adopting the Quality Philosophy' is assigned to three items or variables as f_{21}, f_{22} and f_{23}. The remainder of the factors and their corresponding items can be found in Table 7.9 (column 2). Furthermore, each item is assigned the importance weights. These are equivalent to the standardised weights generated by the SEM or linear regression. In theory they state how much the item contributes to its respective factor. For example the importance weights for the items in the executive commitment factor are 0.3450, 0.3219 and 0.3331 corresponding to f_{11}, f_{12} and f_{13} respectively. As a rule of thumb, these weights should add up to one.

The items weights are computed as follows:

$$f^{ij} = \frac{RAIi}{\sum RA_i} \quad \text{.................................... \textbf{Equation 7.6}}$$

Where

RAI$_i$ = the relative advancement index for the individual item

Σ RAI = the sum of the relative advancement indices

For the full sample, values can be obtained from Table E7 (Appendix E) in the calculation of the item weights. Based on the average TQMI for the sample (TQMI =3.0581), the industry median for the sample can be computed as follows:

$$\text{Overall \% of TQM} = \frac{\text{Actual}}{\text{Max}} \quad \frac{3.058}{5.000} = \mathbf{61.60\%}$$

Where the actual value is obtained from summing up the individual TQMI for the deployment constructs in Column 6, Table 7.9. One of the objectives of the study was to determine if there are any differences in Quality Management Implementation and quality outcomes across UK Construction related SMEs and if so, how and why they differ? Accordingly, the sample was classified into small and medium sized where small were organisations having less than 100 employees and medium was more than 100 but less than 500. Hence the purpose was to test the hypotheses about the differences between the two groups of organisations. The following hypotheses as shown in Chapter Two were tested using one-tailed.

$H_{5\text{-}1}$ to $H_{5\text{-}10}$: Medium-sized TQM deploying UK Construction related organisations exhibit a high level of advancement of the ten TQM constructs than small-sized TQM deploying UK construction related organisations.

$H_{6\text{-}1}$ to $H_{6\text{-}10}$: Medium-sized TQM deploying UK Construction related organisations perform better in each of the four measures of TQM and organisation performance than Small-sized TQM deploying UK Construction related Organisations.

H_7: Medium-sized TQM deploying UK Construction related organisations exhibit a high level of advancement of the ten TQM constructs than medium-sized non-TQM deploying UK construction related organisations.

7.5.3 Demonstration of Assessment

Table 7.10: Total Quality Index (TQI) and Critical Weight Factor (CWF) Comparison of Medium and Small TQM deploying organisations (n=20)

Hypothesis : Factors	Small (n = 6)		Medium (n =14)	
	CWF	TQI	CWF	TQI
1	2	3	4	5
$\mathbf{H_{5\text{-}1}}$: Executive Commitment	0.1524	81.75	0.1212	76.70
$\mathbf{H_{5\text{-}2}}$: Adopting the Philosophy	0.1092	51.50	0.0964	55.90
$\mathbf{H_{5\text{-}3}}$: Customer Focus	0.1146	55.25	0.1191	75.00
$\mathbf{H_{5\text{-}4}}$: Supplier Focus	0.0950	41.75	0.0978	57.50
$\mathbf{H_{5\text{-}5}}$: Benchmarking	0.0735	26.50	0.0829	44.60
$\mathbf{H_{5\text{-}6}}$: Training	0.0878	36.50	0.0812	42.30
$\mathbf{H_{5\text{-}7}}$: Open Organisation	0.1010	45.75	0.0978	57.18
$\mathbf{H_{5\text{-}8}}$: Employee Empowerment	0.0832	33.25	0.0984	57.60
$\mathbf{H_{5\text{-}9}}$: Zero Defects	0.0949	41.50	0.1085	66.07
$\mathbf{H_{5\text{-}10}}$:Measurement	0.0884	35.50	0.0967	56.87
Σ Critical Weight Factors	**1.000**		**1.000**	

The Critical Weight Factors (CWF) presented in Table 7.10 are derived from the mean values presented earlier in Chapter Six, Table 6.11: Mean Score Comparison of Medium and Small Deploying Organisations. Whereas the Total Quality Index (TQI) for each of the Six and re stated in this Chapter. The rationale behind the critical weight factors is similar to the regression weights obtained from the regression analysis and highlights the amount of individual contribution of the factor to TQM. What is notable about the c.w.f is that they all add up to 1.

Based on the TQI and CWF, a further comparison can be made between the small-sized and medium sized TQM deploying organisations. Furthermore, comparisons could be made based on the discriminating functions identified earlier in Chapter Six, Table 6.3: Summary of Discriminating Functions.

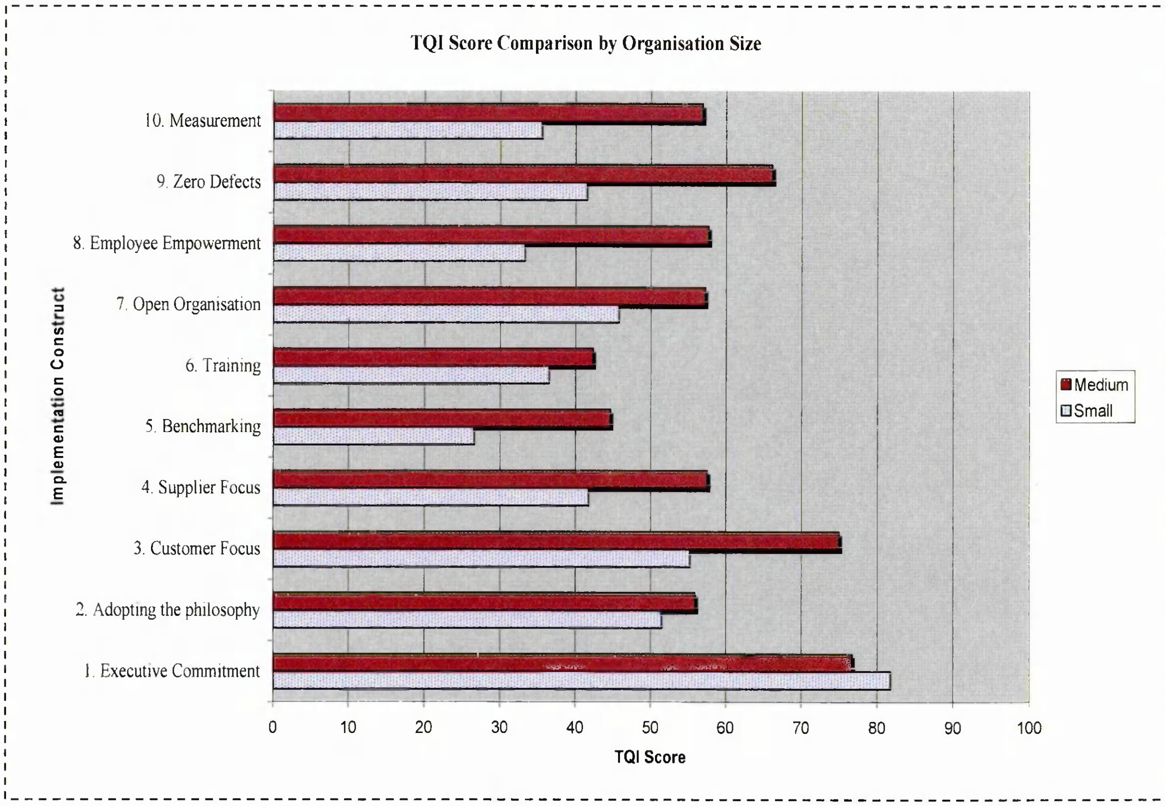

Figure 7.8: TQI Score Comparison by Organisation Size

7.5.4 Step 3: Production of the TQM Advancement Radar Chart

Having computed the Commitment (CI), Advancement Indices (RAI) and the Total Quality Management Indices (TQMI), the next Step 3 is concerned with the production of the TQM advancement Radar Chart. This entails the plotting of the relative advancement index in form of a radar chart. Tables D2 and D3 (Appendix D) shows the relative advancement indices and percentage distribution of the mean scores for each of the ten constructs underlying the TQ-SMART model.

7.5.5 Demonstration of the Application of the TQM Index and Relative Advancement Indices (RAI)

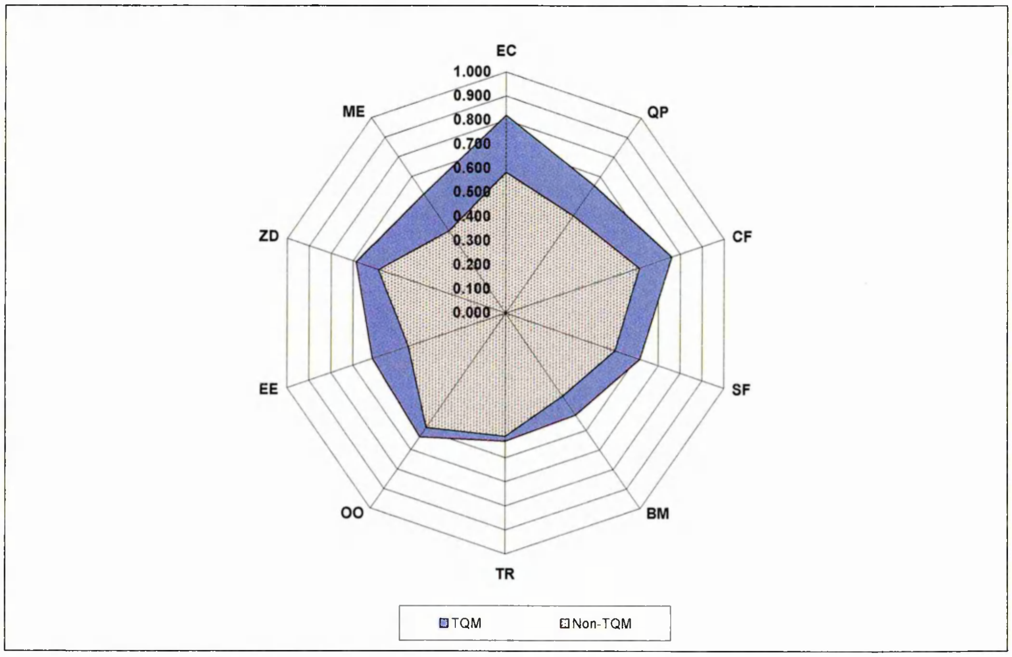

Figure7.9: TQM Advancement Radial Chart based on Relative Advancement Indices (RAI)

Figure 7.9 shows a visualisation of the comparison in the achievement of implementation constructs by TQM and non-TQM organisations surveyed in this study. It is evident that there was a marked difference in the self-assessment of achievement of implementation constructs by the two groups of organisations. However, the study indicates that there was a significant level of achievement of TQM implementation constructs by non-TQM organisations. More so, there was little difference in the achievement levels of Open Organisation (OO) and Training (TR) constructs. A detailed explanation for each of the constructs was given in the preceding sub chapter.

Several important observations can be made about the indices in Table 7.10 and illustrated in Figure 7.8

1. The Total Quality Management Indices for the Medium -sized UK Construction-related organisations are greater than those of the small-sized in ALL but one of the deployment constructs.

2. The highest TQI for the small-sized is 81.75% which is also the highest for the sample, and this is for Executive Commitment, whereas the remaining constructs scored below 55.25%.

3. The highest TQI for the Medium-sized is 76.70%.

4. TQM deployment constructs that have low index values should be of key importance to the Senior Management.

5. The overall TQI for the Small-sized construction-related organisations is 44.93% whereas the Medium-sized have 58.97%.

6. The values of the Critical Weight Factors (CWF) associated with the TQM deployment add up to one.

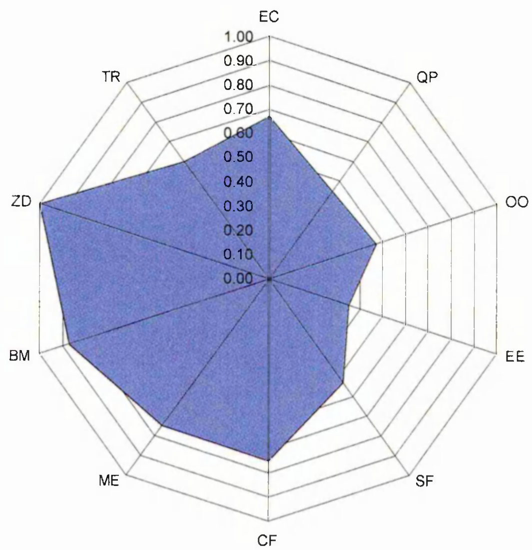

Figure 7.10: TQM Advancement Index for a Macro Organisation –Award Winners

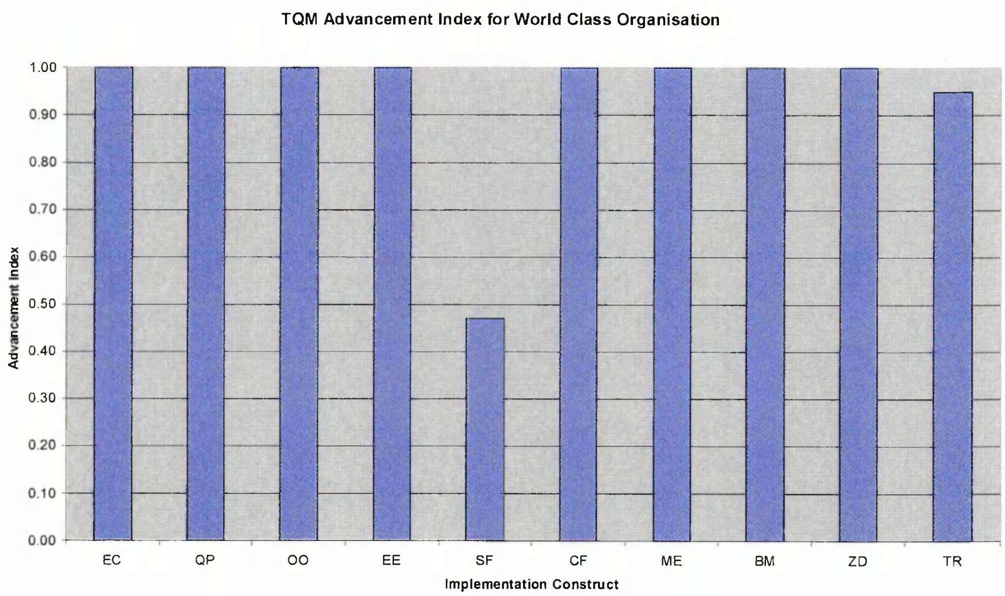

Figure 7.11: TQM Advancement Index for a Small Organisation

The graph in Figure 7.11 is a representation of TQM deploying organisation which had a high level of TQM. It is evident from the graph that the Supplier Focus (SF) dimension for this organisation is below average. The benefit of the proposed model is that senior managers can from the graph identify the level and recalculate where necessary, the mean necessary to move to the next level. This entails fixing the required standard. For example, in order to move from the RAI of 0.47 to the High level of 0.80, the difference would be 0.80 – 0.47 = 0.33 which is equivalent to increasing the existing mean value by a 1.65 score. As the supplier focus dimension has three variables, one of them is outside the control of the host organisations, i.e. requiring suppliers to adopt a quality program. The focus would have to shift to the other principle of working more closely with suppliers.

A comparison was made to show how on average the TQM Deploying organisation against the total sample and the histogram below shows the comparison.

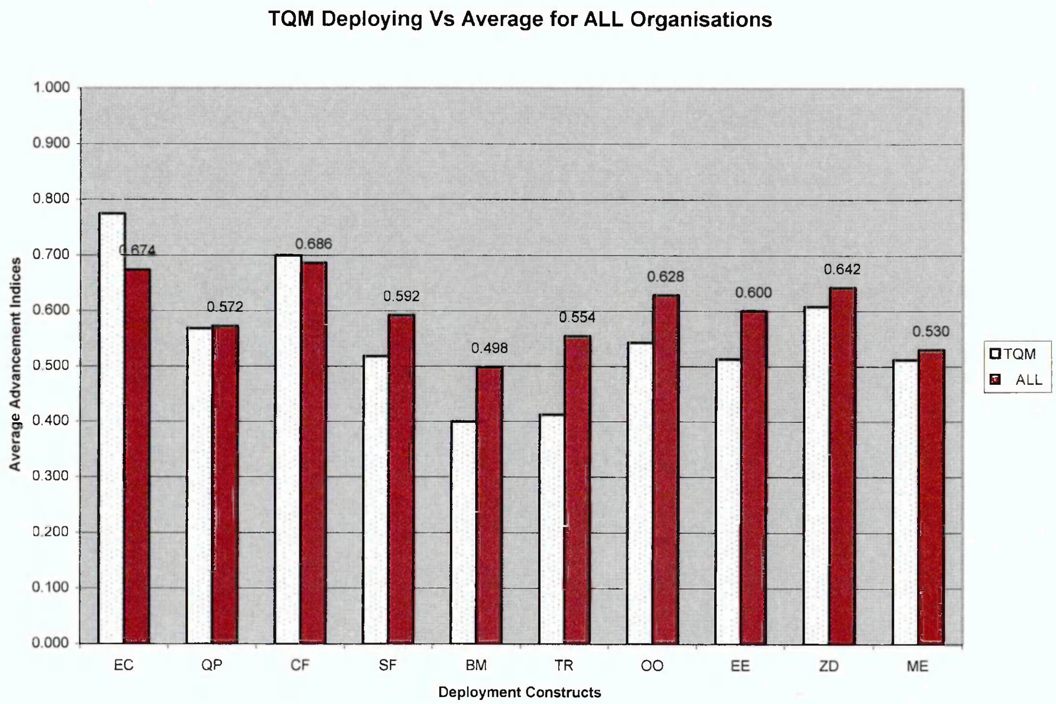

Fig 7.12: TQM Deploying vs. Average for ALL Organisations

The mean values of the TQM deployment constructs was computed into the Relative Advancement Indices (RAI) for each group and the results are plotted in fig 6.37. The graph indicates that the ten TQM practices show a consistent pattern of variation between the two groups.

Quantitative analysis to examine the differences in the level of TQM practices among the two groups was conducted using the ANOVA test, and it is discussed in detail in subsequent sub-sections. Example of the Graphical representation of an organisation classified as Middle of the Road is shown in Figure 7.13

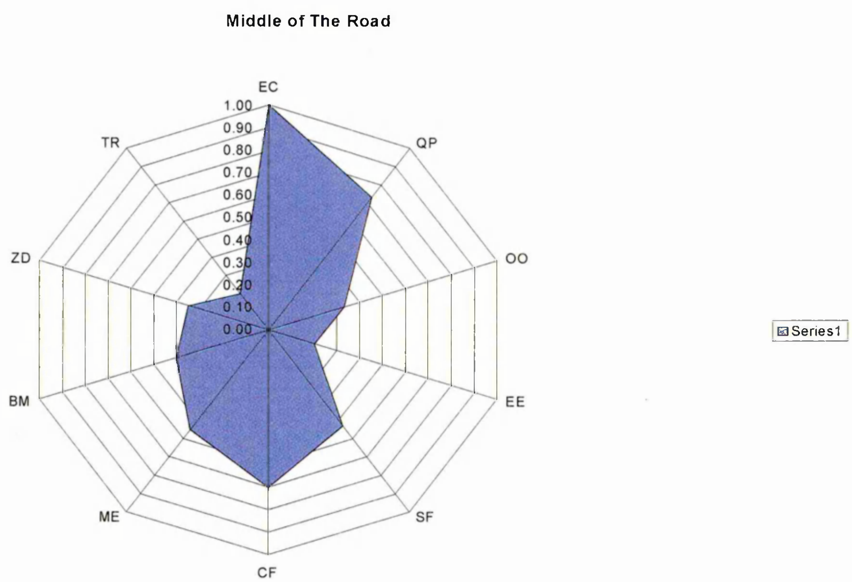

Figure 7.13: TQM Advancement Index for a Medium Organisation (Middle of the Road)

The above TQM advancement radial chart indicates the typical scoring of an organisation halfway to achieving its chartered status or world class status. Although the organisation has a highly committed Executive with a strong mentality of adopting the quality philosophy mentality and a clear customer orientation, it still is behind in terms of training its employees and management in either quality principles. Employee empowerment is low. The suggested commitment and advancement indices for such an organisation would be 0.5 (See Spiral chart for location with the classification of MM, i.e. Medium Commitment and Advancement).

7.5.6 Application of the Total Quality Management Index to the House of Quality (HOQ) Approach

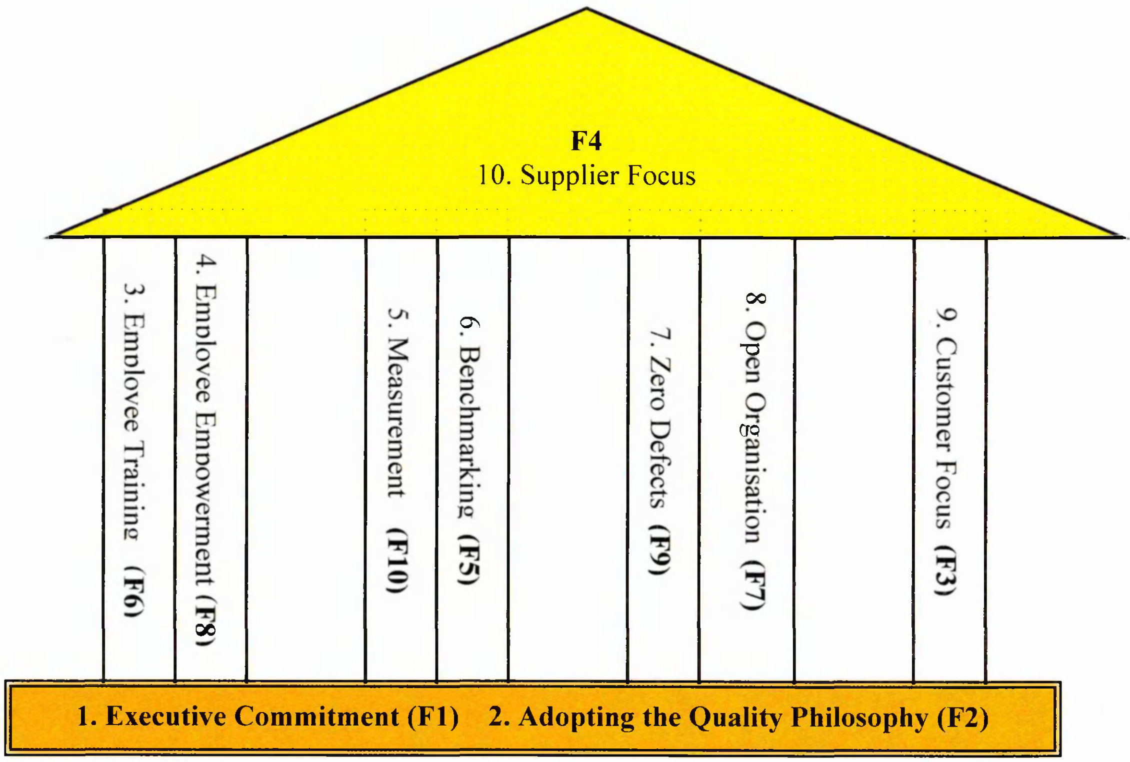

Figure 7.14: The Seven Pillars of TQM (Adapted from Motwani (2001) Definition

As the majority of the respondents were from the Contracting side of the production process, it can be inferred that they are also involved in the construction part of the process, as such for ease of interpretation and usage of language that builders might understand, the concepts of the Total Quality Management index is translated into the pictorial arrangement. Based on Motwani (2001) and Creech (1998) four pillars of quality, the following is a brief description of how the results of this study could be utilised for simplicity of understanding.

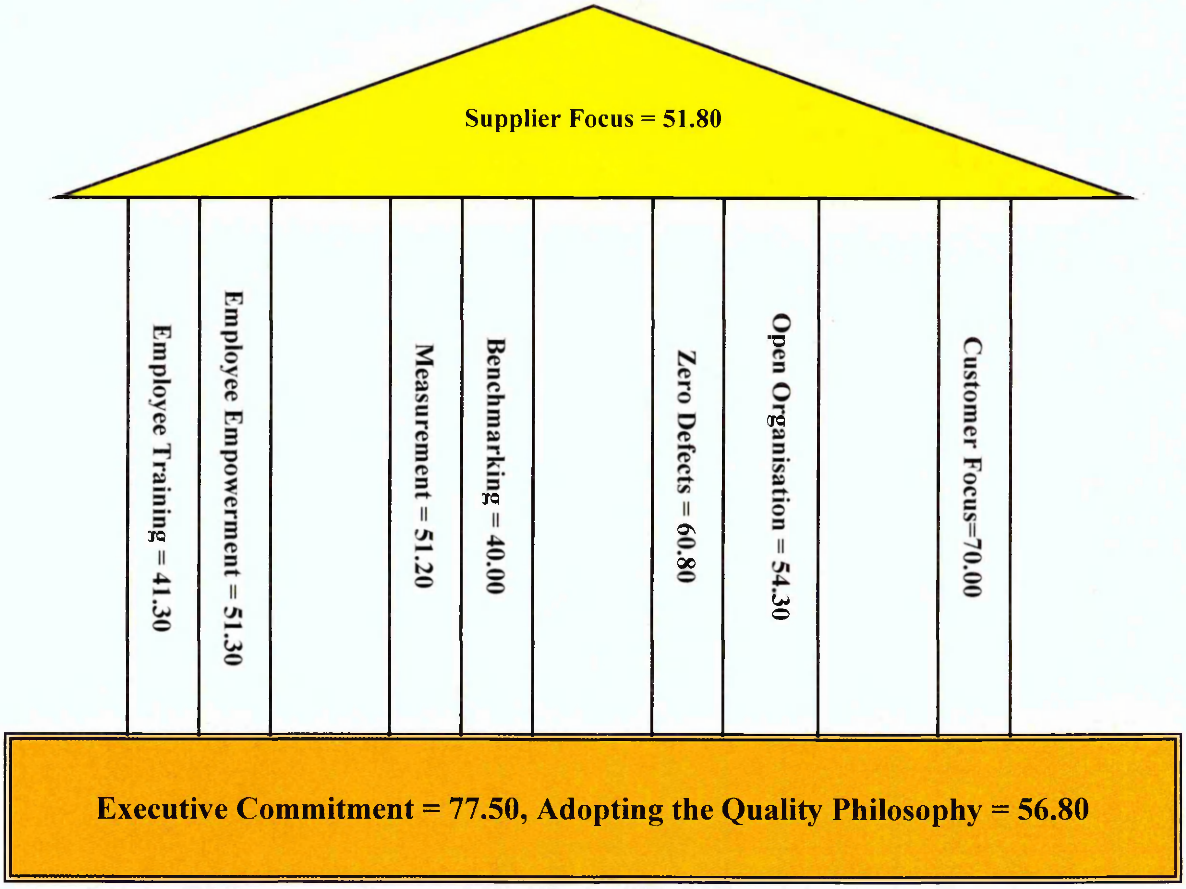

Figure 7.15: Total Quality Management Index for TQM Deploying Organisations

Foundations - For any building structure to be stable, it needs to be built on a firm foundation. Depending on the nature of the soil, some foundations may require reinforcing. As such, for any Quality Management initiative to commence, it requires the support of senior management as well as demonstration of adopting the quality philosophy.

Pillars (Columns): The interpretation is that the foundation needs to be in place before the structure can be put up.

Roof: Suppliers are becoming important in the quest for quality. Chapter Three showed that 10% of the construction faults and failures can be attributed to the suppliers; therefore, absence of their input can be equated to a leaky roof which effectively would leave the pillars exposed. It is obvious that all the three elements need be held together through a series of proper connections and cannot exist in isolation as the structure (quality initiative or program) would crumble.

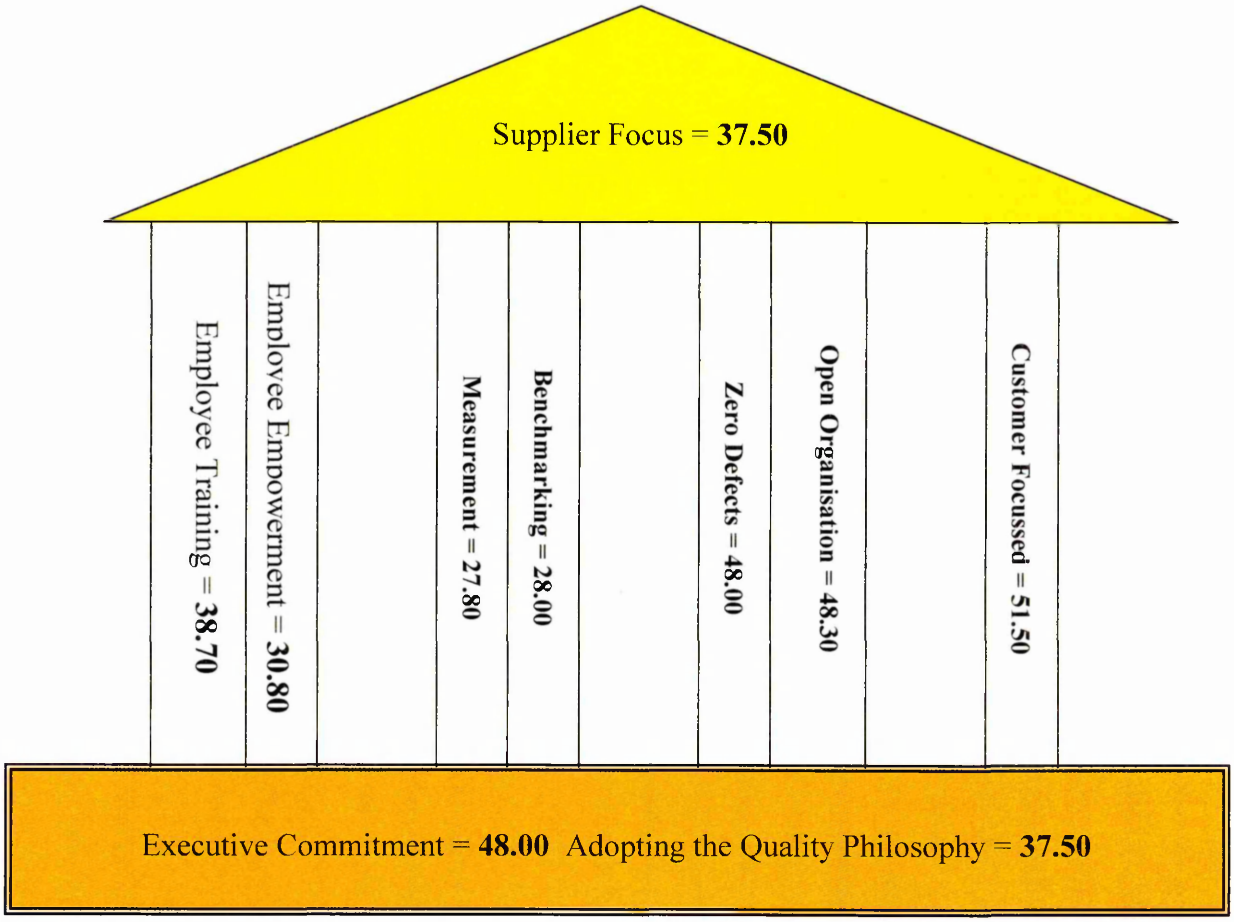

Figure 7.16: Total Quality Management Index for non- TQM Deploying Organisations

Table 7.11: Matching the Scoring System of the EFQM and Comparison of Total Quality Management Indices for TQM and non-TQM Deploying Organisations

Element	Possible Scores	Average TQM Deploying Index Scores	Average non-TQM Deploying Index Scores
Foundation	200.00	134.30	85.50
7 x Pillars	700.00	368.90	273.1
Roof	100.00	51.80	37.50
TOTAL	**1000.00**	**555.50**	**396.10**

7.5.7 Application of House of Total Quality Management

Based on the scores obtained, SMEs would be able to identify which element in the house of quality is in urgent need of improvement. Being builders or in the contracting sector, they would appreciate the ramification of a weak structure. This would, in turn offer an easier way of understanding Quality Management concepts. Each completed house would lead to a satisfied customer and increased turnover through market share, rate of return on capital employed and so on.

7.5.8 Proposed Model – TQM Spiral Classification Method

This sub section proposed the aggregation of commitment (CI) and advancement indices (AI)

$$\textbf{TQM-CI} = \sum c_1 + c_2 + c_3 + \ldots + c_{10} \ldots\ldots\ldots \quad \textbf{Equation 7.7}$$

$$\textbf{TQM-AI} = \sum a_1 + a_2 + a_3 + \ldots + a_{10} \ldots\ldots\ldots \quad \textbf{Equation 7.8}$$

Where c is the weighting assigned to the commitment construct with the maximum being 1.0, and a is the individual weighting assigned to the advancement implementation construct. These indices are obtained from the TQM Advancement Radial Chart developed by Chileshe et al (2003). Thus each organisation can generate two sets of values in the form of co-ordinates (x, y) which are then plotted on the spiral graph to identify the current classification.

Table 7. 12: The Rule Matrix for Advancement/Commitment Levels

Status	Advancement Levels			
	L	M	H	Commitment Levels
High	HL 0.2, 0.8	HM 0.8, 0.5	HH 0.8, 0.8	
Medium	ML 0.2, 0.5	MM 0.5, 0.5	MH 0.5, 0.8	
Low	LL 0.2, 0.2	LM 0.5, 0.2	LH 0.8, 0.2	

Table 7.12 shows the relationship of the sceptre with organisation maturity of the quality initiative.

Table 7.13: Classification of Organisations Based on the Advancement Commitment Matrix

Current Groupings Dale and Lacessell (1997	**Proposed Groupings**	**Classification**	**Rank**	**Weightings** (x,y)
1. World Class	**World Class Organisations (WCO)**	**HH**	**1**	**(0.8, 0.8)**
2. Award Winners	Award Winners-1 Award Winners-2	MH HM	2 3	(0.8, 0.5) (0.5, 0.8)
3. Improvers	Improvers-1 **Middle of the Road** Improvers-2	LH MM HL	4 5 6	(0.8, 0.2) (0.5, 0.5) (0.2, 0.8)
4. Drifters	Drifters-1 Drifters-2	LM ML	7 8	(0.5, 0.2) (0.2, 0.5)
5. Uncommitted	**Uncommitted**	**LL**	**9**	**(0.2, 0.2)**

The following assumption is made in the generation of commitment indices that the level of advancement is equal to the level of commitment. Chin and Pun (2002) also provide a self-assessment scoring scheme based on the evaluation grades of the following:

1. Achiever
2. Improver
3. Initiator
4. Uncommitted
5. Unaware.

7.6 Computation of Scale Performance Index

The mean score for the scale performance indicators in column 5 of Table E10 (Appendix E) and the Performance Index shown in Column 6 can be represented in form of a histogram in Figure 7.17

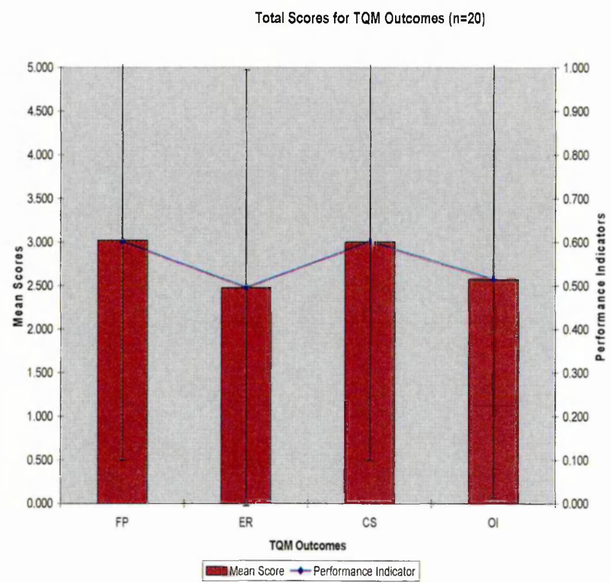

Figure 7.17: Total Scores for Performance Indicators (n=20)

Calculation of Performance Index is obtained for each of the factors as a measurement of its advancement for the financial performance, employee relations, customer satisfaction and operating indicators

$$P.I = \left(\sum_{i=1}^{5} Wi * fi \right) * \frac{100\%}{n}$$ .... **Equation 7.9**

Where i = represents the ratings 1, 3, 5

f_i = frequency of responses

n = total number of responses

w_i = weight for each rating

The frequency of responses can be obtained from Table E10 (Appendix E), whereas the total number of responses in this case is only applicable to the TQM deploying organisations (n =20). Table 7.14 presents a summary of the item score and the centroid of the performance scale.

7.6.1 Measurement of the Business and Organisational Performance Index (BOPI)

Mathematically, the Business and Organisational Performance Indicator can be computed using the following equation:

BOPI = $\sum$ (FP + OI + CS + ER) ....Equation 7.10

Where FP and OI are components of the Business Performance and CS and ER are components of the Organisational Performance. The variables representing the components are illustrated in Figure 7.18 and the results of the calculations are presented in Table 7.14. The Index BOPI is intended to give a measure of the severity of the Overall Business and Organisation Performance resulting from the implementation of TQM.

Table 7.14: Performance Indices for the TQM Organisation and Business Indicators

Performance Indicators	**Performance Advancement Index for Items**					**Average PAI**
	1	2	3	4	5	
1	**2**	**3**	**4**	**5**	**6**	**7**
1. Financial Performance	0.58	0.56	0.58	0.70	0.60	0.604
2. Employee Relations	0.54	0.42	0.42	0.68	-	0.515
3. Customer Satisfaction	0.62	0.62	0.56	-	-	0.600
4. Operating Indicators	0.56	0.48	0.46	-	-	0.500
Total Performance Centroid Score						2.219

Chapter Two provided the operationalisation of the Business and Organisational Performance indicators. As stated by Reeves and Bednar (1994) citied by Mohrman et al (1995), the financial outcomes can be classified as that concerning themselves with the organisation's increased internal efficiency and measures that focus on external effectiveness.

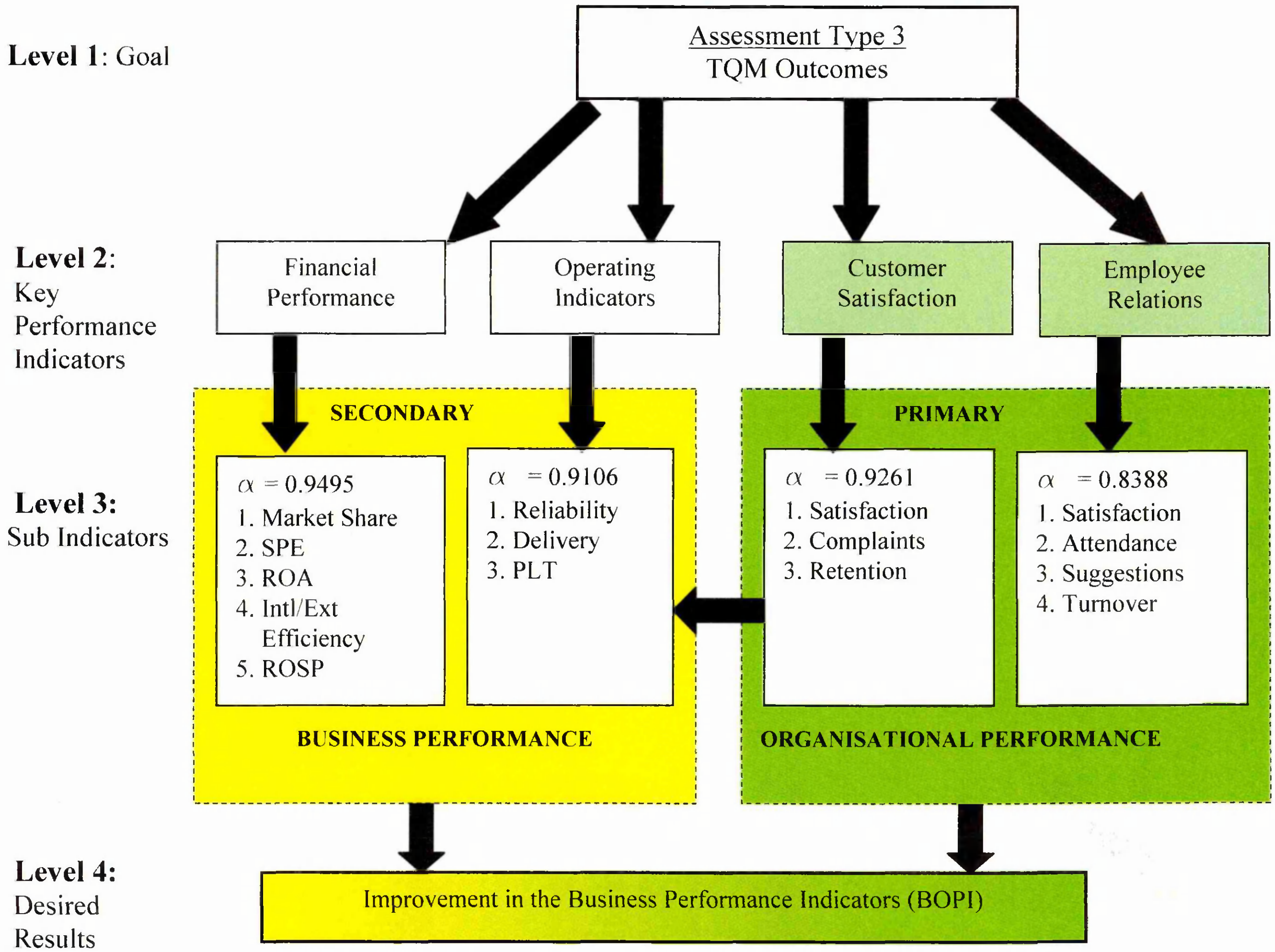

Figure 7.18: A Decision Hierarchy of TQM Outcomes

Where α = is the composite reliability of the performance scale, illustrated in column 3 of Table E11: Reliability Analysis – Scale (alpha) of TQM Performance Measurement Indicator (Appendix 11), SPE is sales per employee, ROA is Return on Assets, ROSP is Return on Sales Profitability and PLT is Product Lead Time. The variable of Product Lead Time can be equated to the supply chain performance measurement metrics. As asserted by Gunasekaran et al (2004), the reduction in order time leads to reduction in supply chain response time, and as such is am important performance measure and source of competitive advantage. (Gunasekaran et al 2004: 336).

Mohrman et al (1995) divided the eight outcomes of TQM impact in the scales, namely, direct performance of work processes, and company performance and employee outcomes. They further split the company performance into profitability and competitiveness.

Similarly, this can equate the company performance to the financial indicators as used. The market share variable of the financial performance and also treated as an individual indicator of market impact. Anderson and Sohal (1999) conceptualised "Business Performance" using such outcomes as sales, exports, cash flow, employment levels, overall competitiveness and market share. The work processes are equivalent to the customer satisfaction. According to Jashapara (2003), the following three frameworks are frequently used to conceptualise organisational performance:

1. Goal approach
2. The systems resource approach
3. The constituency approach

According to Jashapar (2003) in citing Etzion, 1964; Yutchman and Seashore, 1967; and Thompson, 1967, the goal approach focuses on the explicit goals of profitability or turnover, whereas the systems resource approach examines the key internal factors required for a firms survival. Finally the constituency approach focuses on the needs of internal and external stakeholders (Jashapara, 2003:34).

Based on the Decision Hierarchy Process, the second part of the TQ-SMART model can be conceptualised as a series of levels. Chin et al (2002) used a similar approach in studying the critical factors of TQM implementation in Shanghai manufacturing industries. The level 2 key performance indicators were split into primary and secondary measures. Primary defined because they follow directly from the actions taken during the TQM Implementation, whereas business and market share are secondary because they are a consequence of the Implementation of TQM. The Business indicators can further be split into financial performance and Market performance.

The values obtained in Tables 7.14 and 7.15 (Column 7) are used to plot the Business and Organisational Performance Radar Chart and is shown graphically in Figure 7.19. The results indicate that the industry median on the four indicators are all below the best practice mark (1.0) from Table 7.15, the max possible total performance centroid score should be 4.00, thus the Industry mean score is calculated as follows:

$$(2.219/4.00)*100 = 55.47\%$$

Table 7.15: Total Score, Centroid of TQM Performance Indicators Items and Scale

Performance Indicators	**Performance Advancement Index for Items**					**Scale** (⊖)	**BOPI** (⊖)
	1	2	3	4	5		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Financial Performance	0.58	0.56	0.58	0.70	0.60	0.604	0.2722
2. Employee Relations	0.54	0.42	0.42	0.68	-	0.515	0.2321
3. Customer Satisfaction	0.62	0.62	0.56	-	-	0.600	0.2704
4. Operating Indicators	0.56	0.48	0.46	-	-	0.500	0.2253
Total Business and Organisation Performance Index (BOPI) Centroid Scores						2.219	1.000

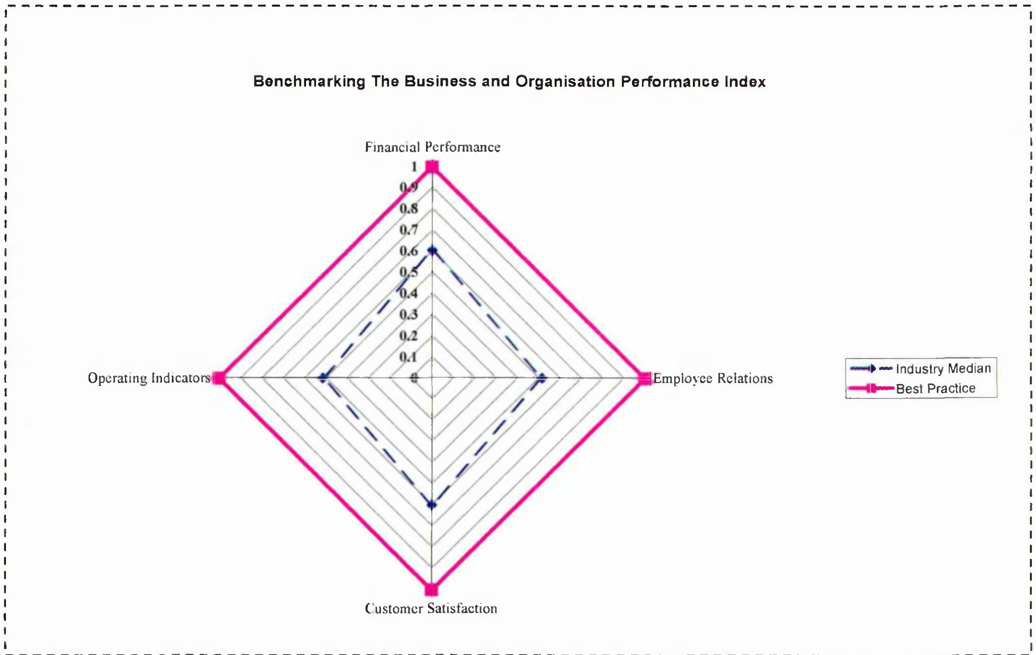

Figure 7.19: Benchmarking the Business and Organisation Performance Indicators (BOPI)

Where the overall contribution of the performance indicators to the business and Organisation Performance indicators is computed as follows; Σ Scale Θ (in Table 7.15, column 7). The interpretation of the figures in Column 8 (Table 7.15) can be equated to the unit contribution that each scale provides to the overall desired results which is shown as Level 4 in Figure 7.18

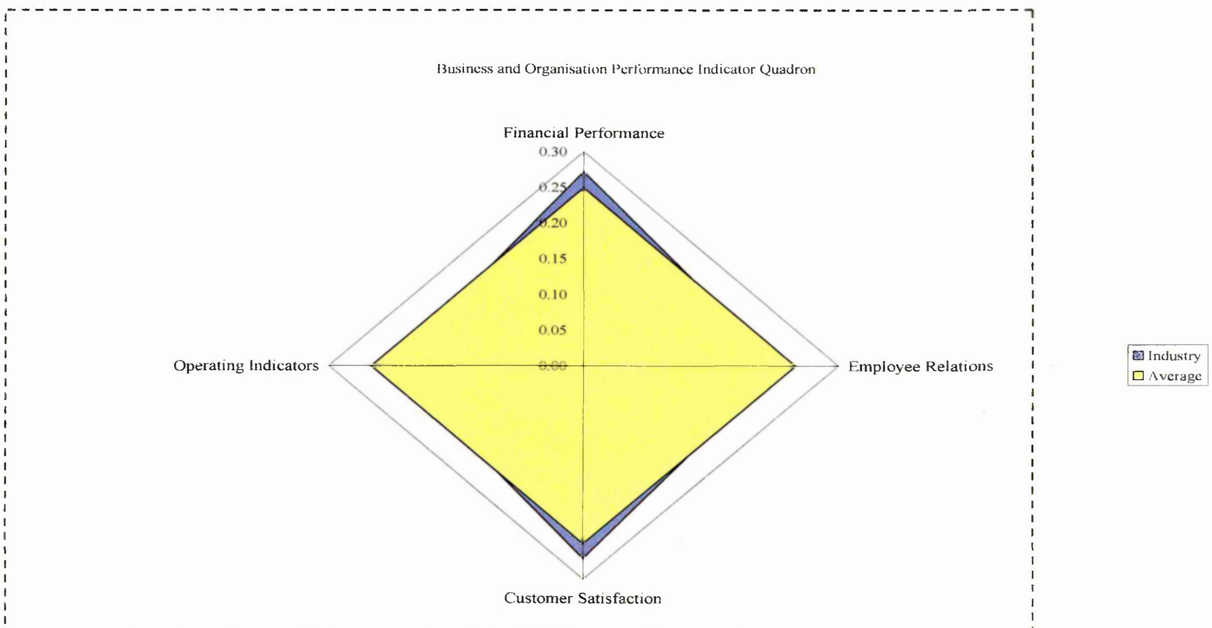

Figure 7.20: Business Organisation Performance Indicator Quadrant

Figure 7.20 provides a comparative analysis of how the respondents rate the key issues relating to Business and Organisation Performance Indicators. The values on the axis of the BOPI Quadrant represent the overall contribution of the four indicators to the composite measure of BOPI.

Table 7.16: Centroid of TQM Organisation Performance Item Indicators

PERFORMANCE INDICATOR	TOTAL SCORE	PCentroid	Item-Overall BOPI Centroid	Item-Scale Centroid
1	2	3	4	5
1.Financial Performance		**0.604**		
Market Share	58.0	0.58	0.0695	0.1921
Sales per employee (£)	56.0	0.56	0.0668	0.1854
Return On Assets	58.0	0.58	0.0695	0.1921
Internal and External Efficiency	70.0	0.70	0.0839	0.2318
Return on Sales Profitability	60.0	0.60	0.0719	0.1986
			0.3619	**1.000**
2. Employee Relations		**0.515**		
Employee Satisfaction	54.0	0.54	0.0719	0.3030
Attendance	42.0	0.42	0.0647	0.2425
Number of Useful Suggestion Received	42.0	0.42	0.0503	0.2425
Employee Turnover	68.0	0.68	0.0503	0.2120
			0.2373	**1.000**
3. Customer Satisfaction		**0.600**		
Overall Satisfaction	62.0	0.62	0.0739	0.3451
Customer Complaints	62.0	0.62	0.0739	0.3451
Customer Retention	56.0	0.56	0.0668	0.3097
			0.2157	**1.000**
4. Operating Indicators		**0.500**		
Reliability	56.0	0.56	0.0668	0.3513
Timeliness of Delivery	48.0	0.48	0.0572	0.3513
Product Lead Time	46.0	0.46	0.05489	0.2975
		2.219	**0.1845**	**1.000**

According to Dahlgaard and Nilsson (2003), the fundamental differences between an award and a survey approach to self assessment include the kind of data used, and the calculation of importance weights and performance scores. The Pcentroid values shown in the above Table 7.16 can be translated into performance scores by multiplying by 100, thus for the Financial Performance Indicator and its associated Five Indicators, it is evident that the Internal and External Efficiency score is the highest with the performance score of 70%. The importance weights can be computed on the scale level and overall measure of Business and Organisational Performance Indicator. The notable feature about the importance weights is that they should add up to 1.00. Thus for the Financial Performance Indicators, the importance weight values for the items of market share, sales per employee, return on assets, internal and external efficiency and return on sales profitability are 0.1921, 0.1854, 0.1921, 0.23178 and 0.1987 (Table 7.16, Column 5) respectively which add up to 1.00, whereas the overall BOPI value obtained from column 4 in Table 7.16 are 0.3619 for Financial Performance, 0.2371 for Employee Relation, 0.2157 for Customer Satisfaction and 0.1845 for Operating Indicators.

7.6.2 Numerical Example of the BOPI Application

Table 7.17 : TQM Organisation Performance Scores – Organisation A

PERFORMANCE INDICATOR	ITEM SCORE	Average Score	Item Centroid	Scale Centroid
1	2	3	4	5
1.Financial Performance		**3.00**		
Market Share	3.00		0.2000	0.1111
Sales per employee (£)	3.00		0.2000	0.1111
Return On Assets	3.00		0.2000	0.1111
Internal and External Efficiency	3.00		0.2000	0.1111
Return on Sales Profitability	3.00		0.2000	0.1111
			1.000	
2. Employee Relations		**1.50**		
Employee Satisfaction	1.00		0.1667	0.03703
Attendance	1.00		0.1667	0.03703
Number of Useful Suggestion Received	3.00		0.4999	0.11111
Employee Turnover	1.00		0.1667	0.03703
			1.0000	
3. Customer Satisfaction		**1.00**		
Overall Satisfaction	1.00		0.3333	0.03703
Customer Complaints	1.00		0.3333	0.03703
Customer Retention	1.00		0.3333	0.03703
			1.0000	
4. Operating Indicators		**1.00**		
Reliability	1.00		0.3333	0.03703
Timeliness of Delivery	1.00		0.3333	0.03703
Product Lead Time	1.00		0.3333	0.03703
			1.0000	
		5.40		
	27.00	**1.80**		**1.000**

The scale centroid is similar to the Critical Weight Factors which state the unit contribution of each performance variable to the whole business and organisation performance indicators. For Organisation A, the maximum possible score is 15* 5 = 75 where 15 is the total number of indicators in the Business and Organisation Performance scale whereas 5 is the maximum possible weighting. The performance index is thus computed as follows:

27/75 = **36%**

The values of the Industry and Organisation Performance scores can be plotted and are illustrated in the following diagram:

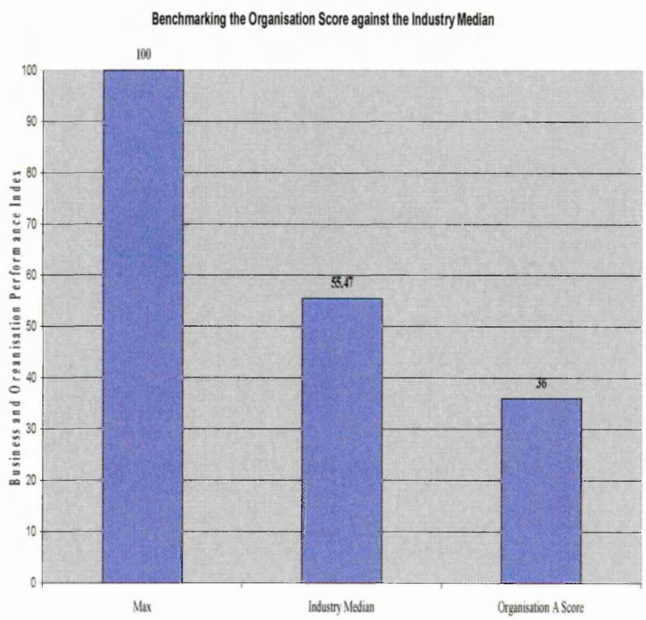

Figure 7.21: Benchmarking the Industry Median against the Organisation Performance

Methodology for the Process Matrix

The Total Quality Management Performance Index Model uses the Quality Function Deployment approach as illustrated in the following flow chart in Figure 7.22

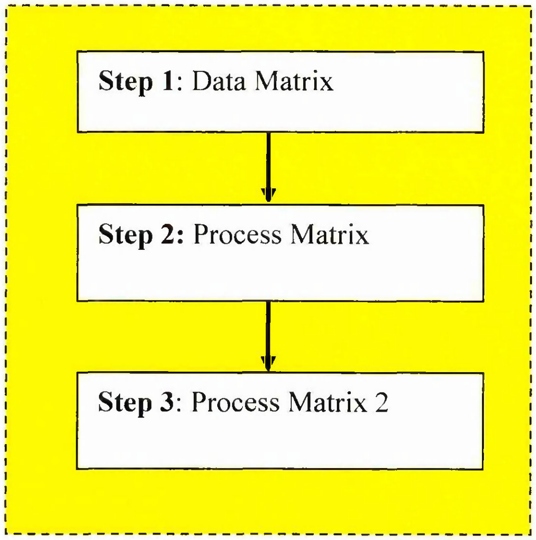

Figure 7.22: Steps in the Formulation of the TQM-BOPI Matrix

The main steps involved in the formulation of the TQM-BOPI Matrix are summarised as a flow diagram shown in Figure 7.22. Issues in applying the methodology in each of the steps of Figure 7.22 are addressed in the following:

Step 1- Data Matrix: Information for the raw data is the critical weight factors of the TQM deployment constructs and the Business and Organisation Performance Indicators which are in Tables 7.1, 7.6 and 7.9 for TQM and Tables 7.5, 7.12, 7.13, 7.14 and 7.16 for the BOPI.

Step 2 and 3 - Process Matrix: The matrix is illustrated in Table 7.18 and a description of the elements contained in the rows and columns are provided for in the methodology for the Total Quality Management- Business and Organisation Performance sub section.

Table 7.18: Data Matrix - The Maximum Achievable Level of Organisational Performance (For TQM Deploying Organisations)

			Total Quality Management (TQM) Deployment Constructs										Maximum Performance
							❷						
Bussiness & Organisation Performance Indicators (BOPI)	Importance						❻						
	Weights	Status					❼						
❶	❹	❺					❸						
Maximum Level of Performance													❾

Table 7.19: Process Matrix 1- The Maximum Achievable Level of Organisational Performance (For TQM Deploying Organisations)

Business & Organisation Performance Indicators (BOPI)	Importance		Total Quality Management (TQM) Deployment Constructs										Maximum Performance
			EC	**AQP**	**CF**	**SF**	**BM**	**TRA**	**OO**	**EE**	**ZD**	**ME**	
			0.1279	0.1014	0.1186	0.0952	0.0811	0.0780	0.0983	0.0952	0.1045	0.0952	
	Weights	Status	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	
FINPER1	0.0692	5.00	**0.4915**	**0.4270**	**0.4680**	**0.4113**	**0.3748**	**0.3788**	**0.4190**	**0.4098**	**0.4393**	**0.4098**	4.23
FINPER2	0.0671	5.00	**0.4855**	**0.4210**	**0.4620**	**0.4053**	**0.3688**	**0.3728**	**0.4130**	**0.4038**	**0.4333**	**0.4038**	4.17
FINPER3	0.0692	5.00	**0.4915**	**0.4270**	**0.4680**	**0.4113**	**0.3748**	**0.3788**	**0.4190**	**0.4098**	**0.4393**	**0.4098**	4.23
FINPER3	0.0835	5.00	**0.5273**	**0.4628**	**0.5038**	**0.4470**	**0.4105**	**0.4145**	**0.4548**	**0.4455**	**0.4750**	**0.4455**	4.59
FINPER5	0.0716	5.00	**0.4975**	**0.4330**	**0.4740**	**0.4173**	**0.3808**	**0.3848**	**0.4250**	**0.4158**	**0.4453**	**0.4158**	4.29
EMPREL1	0.0644	5.00	**0.4795**	**0.4150**	**0.4560**	**0.3993**	**0.3628**	**0.3668**	**0.4070**	**0.3978**	**0.4273**	**0.3978**	4.11
EMPREL2	0.0501	5.00	**0.4438**	**0.3793**	**0.4203**	**0.3635**	**0.3270**	**0.3310**	**0.3713**	**0.3620**	**0.3915**	**0.3620**	3.75
EMPREL3	0.0501	5.00	**0.4438**	**0.3793**	**0.4203**	**0.3635**	**0.3270**	**0.3310**	**0.3713**	**0.3620**	**0.3915**	**0.3620**	3.75
EMPREL4	0.0811	5.00	**0.5213**	**0.4568**	**0.4978**	**0.4410**	**0.4045**	**0.4085**	**0.4488**	**0.4395**	**0.4690**	**0.4395**	4.53
CUSTSAF1	0.0739	5.00	**0.5033**	**0.4388**	**0.4798**	**0.4230**	**0.3865**	**0.3905**	**0.4308**	**0.4215**	**0.4510**	**0.4215**	4.35
CUSTSAF2	0.0739	5.00	**0.5033**	**0.4388**	**0.4798**	**0.4230**	**0.3865**	**0.3905**	**0.4308**	**0.4215**	**0.4510**	**0.4215**	4.35
CUSTSAF3	0.0668	5.00	**0.4905**	**0.4260**	**0.4670**	**0.4103**	**0.3738**	**0.3778**	**0.4180**	**0.4088**	**0.4383**	**0.4088**	4.22
OPEIND1	0.0668	5.00	**0.4855**	**0.421**	**0.462**	**0.4053**	**0.36875**	**0.37275**	**0.413**	**0.4038**	**0.4333**	**0.4038**	4.17
OPEIND2	0.0572	5.00	**0.4615**	**0.397**	**0.438**	**0.3813**	**0.34475**	**0.34875**	**0.389**	**0.3798**	**0.4093**	**0.3798**	3.93
OPEIND3	0.0548	5.00	**0.4555**	**0.391**	**0.432**	**0.3753**	**0.33875**	**0.34275**	**0.383**	**0.3738**	**0.4033**	**0.3738**	3.87
Maximum Level of Performance			7.281	6.314	6.929	6.077	5.530	5.590	6.194	6.055	6.497	6.055	**62.47**

Matrix ❽

Max TQM-BOPI Level ❾

Table 7.20a: Process Matrix 2- The Actual Level of Organisational Performance

Business & Organisation Performance Indicators (BOPI)	Importance		Total Quality Management (TQM) Deployment Constructs										Maximum Performance
			EC	AQP	CF	SF	BM	TRA	OO	EE	ZD	ME	
	Weights	Status	0.1671	0.1412	0.1350	0.1540	0.0390	0.0578	0.1030	0.1254	0.0380	0.0380	
			4.33	3.67	3.50	4.00	1.00	1.50	2.67	3.25	1.00	1.00	
FINPER1	0.1111	3.00	**0.5284**	**0.4258**	**0.4029**	**0.4747**	**0.1862**	**0.2100**	**0.3042**	**0.3704**	**0.1857**	**0.1857**	3.27
FINPER2	0.1111	3.00	**0.5284**	**0.4258**	**0.4029**	**0.4747**	**0.1862**	**0.2100**	**0.3042**	**0.3704**	**0.1857**	**0.1857**	3.27
FINPER3	0.1111	3.00	**0.5284**	**0.4258**	**0.4029**	**0.4747**	**0.1862**	**0.2100**	**0.3042**	**0.3704**	**0.1857**	**0.1857**	3.27
FINPER3	0.1111	3.00	**0.5284**	**0.4258**	**0.4029**	**0.4747**	**0.1862**	**0.2100**	**0.3042**	**0.3704**	**0.1857**	**0.1857**	3.27
FINPER5	0.1111	3.00	**0.5284**	**0.4258**	**0.4029**	**0.4747**	**0.1862**	**0.2100**	**0.3042**	**0.3704**	**0.1857**	**0.1857**	3.27
EMPREL1	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
EMPREL2	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
EMPREL3	0.1111	3.00	**0.5284**	**0.4258**	**0.4029**	**0.4747**	**0.1862**	**0.2100**	**0.3042**	**0.3704**	**0.1857**	**0.1857**	3.27
EMPREL4	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
CUSTSAF1	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
CUSTSAF2	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
CUSTSAF3	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
OPEIND1	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
OPEIND2	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
OPEIND3	0.0370	1.00	**0.3803**	**0.2776**	**0.2548**	**0.3265**	**0.0380**	**0.0619**	**0.1560**	**0.2223**	**0.0375**	**0.0375**	1.79
Maximum Level of Performance			6.593	5.053	4.710	5.787	1.459	1.817	3.229	4.223	1.452	1.452	35.77

Total Quality Management Performance Index = $\frac{\text{Actual LP}}{\text{Max LP}} = \frac{35.77}{62.52}$ **=57.22 %**

Actual TQM-BOPI Leve
❾

Methodology For the Total Quality Management-Business and Organisation Performance Indicator Matrix.

The Total Quality Management -Organisation and Business Performance Indicator Matrix (TQM-BOPI) model uses the QFD approach as shown in Table 7.18. The steps and details in the calculation are as follows:

- Column ❶ includes 15 'business and organisation performance indicators', which were modified from Usilaner and Dulworth (1992) measurement of the success of TQM and assessment of performance. These indicators represents the outcomes of the TQM implementation process and their brief descriptions are presented in Chapter Two, sub section 2.8.2.1 (page 76). The relative importance were reported by the Quality Mangers in a questionnaire survey on a scale of 1 to 5 where 1 represents 'not at all', 3 'hardly' and 5 'greatly'

- Row ❷ : includes 'ten total quality management constructs' which were modified from the Powell (1995) instrument. They represent the critical success factors necessary for the implementation of TQM. Their brief descriptions were presented in Chapter Two (Table 2.2). The relative importance of TQM constructs were reported by Quality Managers of UK Construction Related SMEs in a questionnaire survey on a scale of 1 to 5 where 1 represents ' have not begun implementation but intend to' and 5 'highly advanced in implementation'

- Matrix ❸ : represents the strength of the relationships between the TQM deployment constructs (column ❶) which relates to the process element and the business and organisation performance indicators (row ❷) which relates to the outcomes of the implementation process.

- Column ❹: features the critical weight factors for the business and organisation performance indicators as computed in Equation 7.2

- Column ❺ : represents the status of the business and organisation performance indicators under the conditions of the world class organisations (i.e maximum score of 5)

- Row ❻: features the critical weight factors for the TQM deployment constructs as computed in Equation 7.2

- Row ❼ : represents the status of the TQM deployment constructs under the conditions of the world class organisations (i.e maximum score of 5)

- Matrix ❽ : the point scores were calculated by the synthesis of the information in attributes ❸, ❹, ❺, ❻, and ❼ according to equation 7.11

- Cell ❾ : in Table 7.20a is the actual level of the Total Quality Management-Business and Organisation Performance Indicator Level under the actual conditions for the Organisation 8 which is computed using the procedures outlined.

7.6.3 Numerical Example for the Application of Performance Index

The importance weights or centroid of gravity for the TQM deployment construct and the Organisation and business performance indicators are combined to produce a matrix.

The results are indicated in Table 7.19 which is the actual level of organisation performance, TQM deploying UK Constructional related SME's would expect to achieve from the implementation of Total Quality Management. The deployment constructs are in the horizontal column abbreviated as EC for Executive Commitment, AQP for Adopting the Quality Philosophy, CF = Customer Focus, SF = Supplier Focus, BM = Benchmarking, TRA = Training, OO = Open Organisation , EE = Employee Empowerment, ZD = Zero Defects and ME = Measurement. The vertical column represents the Organisation and Business Indicators. The values in the matrix are obtained from the average of the sum of the Importance weightings multiplied by the status figure, which in both cases equals to 5.00. The value of 5.00 is the highest the respondent could score on the Likert scale of 1 to 5 for the TQM deployment constructs and 1 to 5 for the Organisation and Business Indicators.

For a world class organisation, the maximum highest score expected in each deployment construct would be a perfect 5, which would equate to the importance weighting or centroid value of 0.1. The matrix generated the overall maximum level of Organisation Performance equal to 62.47 from the TQM deploying organisations in the sample.

Therefore, the generated Total Quality Management Performance Index (TQMPI) for the sample is 62.47.

Table 7.20a shows the application of any organisation against the median of the Industry, in this case the scores for the Organisation No. 8 are generated as shown in Table 7.2. The total score achieved is 35.77. This value can now be used to compare against the Industry median as follows:

$$\textbf{TQMPI} = \frac{\textbf{Actual Level of TQM Organisation Performance}}{\textbf{Maximum Industry Median}} \qquad \textbf{Equation 7.12}$$

The Equation 7.12 is adapted from Arditi and Lee (2003) who used it as a mechanism for corporate service quality performance measurement model. The only difference is that the matrix was generated by including the strength of relationships between the vertical and horizontal variable from the independent assessors. Specifically, the tool was developed for construction owners to rank the design and build (D/B) firms relative to corporate service quality, as well as D/B firms to benchmark themselves against their competitors. However, this method of Quality Function Deployment has been used before by other researchers. This is normally called the "house of quality" in other studies such as Shillito (1994), Hoyle (1998)

$$\text{TQMPI} = \frac{35.77}{62.47} * 100 = 57.22\%$$

What is novel about its application to this study, is that in this particular example, all the TQM deployment constructs are assumed to carry equal weightings in the contributions to the TQM deployment process.

The results of the process matrix indicate that the Executive Commitment construct has the highest impact on the organisation performance of the organisation. This is indicated by the total value which is obtained by summing up the product of the matrix for each individual construct. In this case, Executive Commitment has a total median score of 6.593 Table 7.20a). On a comparative basis, the organisation has a score of 7.281 (Table 7.19) which is above the Industry median. Similarly, the total score in the first organisation indicator which is designated as "FINPER1" has a total score of 3.27 which is lesser than the Industry median of 4.23. The potential of application of this method would be Internal benchmarking across the Strategic Business Units of any particular organisation. The competing units would compare their scores against the organisation median, thus assist management in making strategic decisions. From the matrix, it can be noted that the Benchmarking Construct is low in terms of contributing to the overall performance as the score of 5.525 is the lowest across all the ten constructs.

7.6.4 Application of TQ-SMART as a Benchmarking Tool

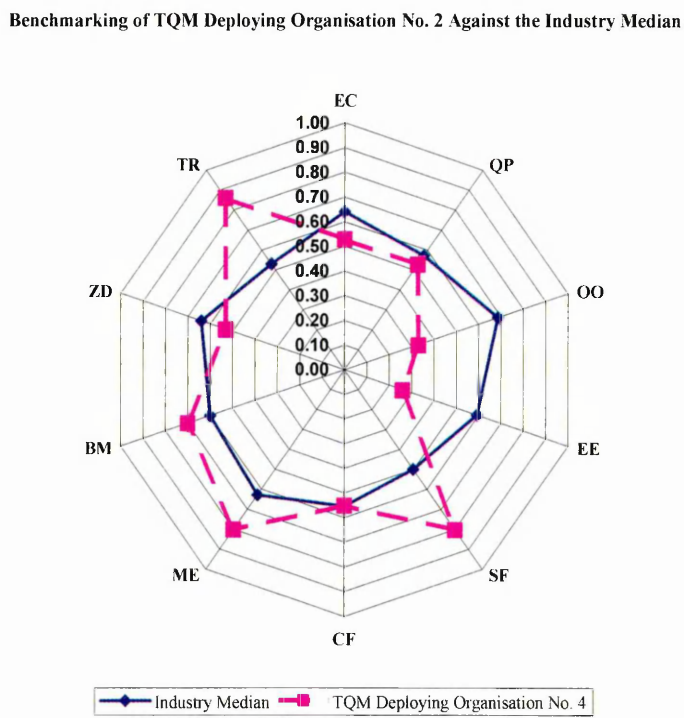

Figure 7.23: Example of Benchmarking of Organisation No.4 against Industry Median

7.6.5 Definition of Self-Assessment

The generic definition of self-assessment is a comprehensive, systematic and regular review of an organisation's activities and results referenced against the EFQM excellence model. The self-assessment process allows the organisation to discern clearly its strengths and areas in which improvement can be made and culminates in planned improvement weakness.

7.6.6 Definition of TQ-SMART

- Total Quality (TQ): The completeness in the observation and deployment of the ten implementation constructs and the four business and organisation performance indicators.
- Self (S) : The organisation carries out the procedure, which can then be compared against the validated model such as the EFQM.
- Monitoring (M) : Existing levels of quality initiatives in TQM deploying organisations.
- Assessment (A) : Evaluation of the TQM advancement, determination of existing quality initiative levels in meeting the requirements.
- Rating (R): Classification of Organisations into different levels of commitment according to the Ψ value, based on the commitment and advancement indices. This in turn leads to the nine groupings.
- Tool (T): Mechanism or Instrument for carrying out the assessment and monitoring activities. The tool has been evaluated in the validation process within 10 organisations.

Overview of the TQ-SMART

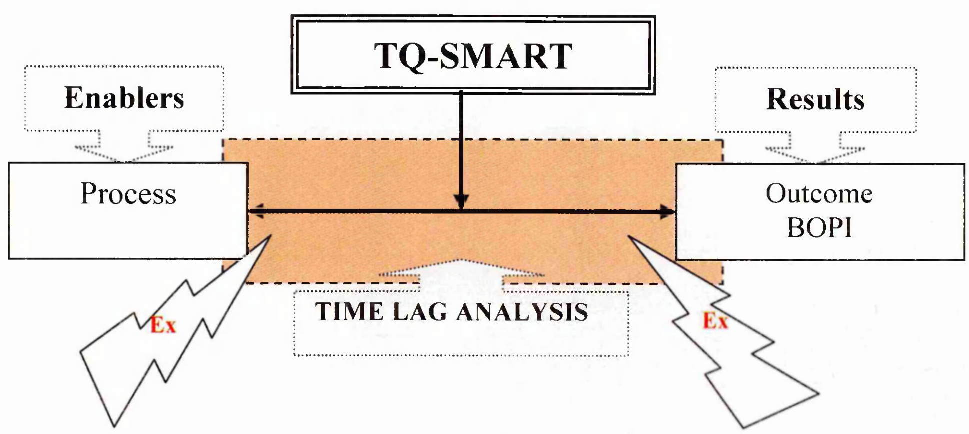

Figure 7.24: Simplified Overview of the Model

Ex - The Environmental or Market exogenous shocks obscuring the intervention.

Zairi (1994) defines Self-assessment as an effective technique to measure the culture of quality within an organisation.

7.7 Assessment of Measurement model fit.

For any model to be accurate, it must represent the data collected as closely as possible. Various methods exist for determining the Goodness of Fit of any model. Notable among them are adjusted Goodness-of -Fit Index, Bentler-Bonnet Index etc. Goodness of Fit is defined by Field (2000) as the degree to which a statistical model represents the data collected. For example, this can fall into three categories, namely: Good fit, Moderate fit and Poor fit. Therefore, the primary task in this model testing and model validating procedure was to determine the goodness of fit. In order to assess their unidimensionality and internal consistency, the ten scales were subjected to ten limited information factor analyses (Anderson and Gerbing 1998)

There is a range of methods for the assessment of fit, and these are indicated in the following flow chart in Figure 7.25.

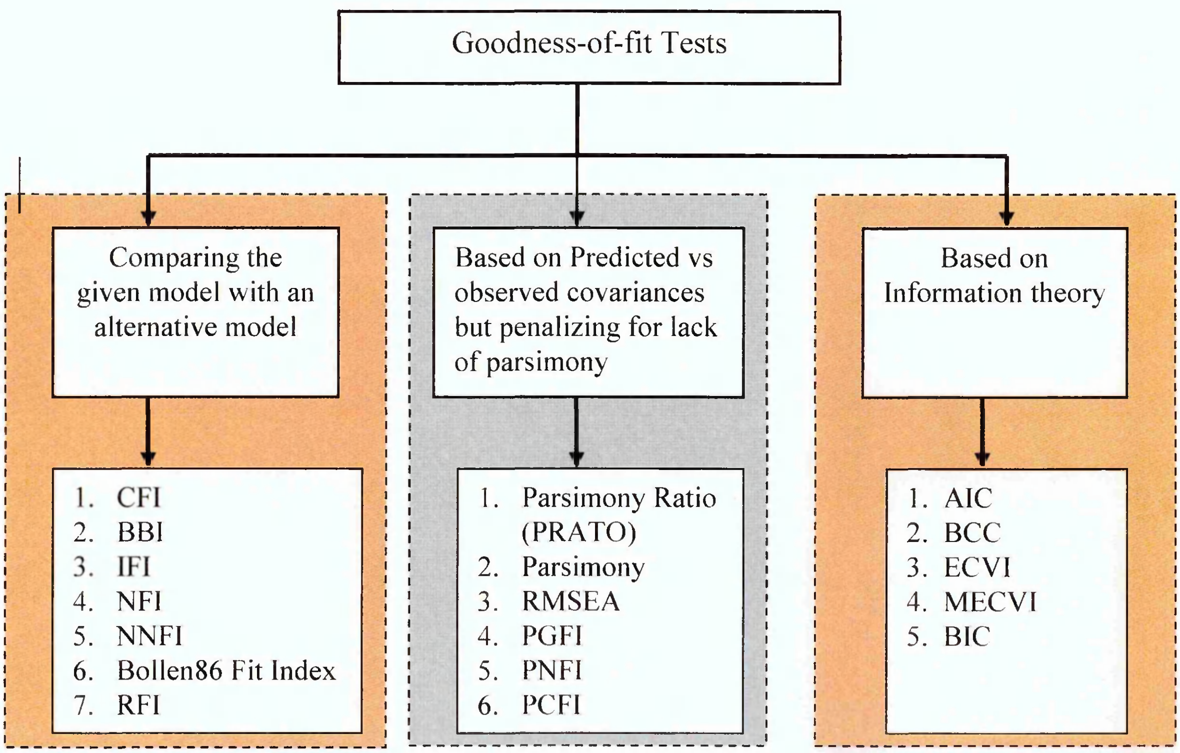

Figure 7.25- Various Types of Goodness-of-Fit Indices

The study adopted attempted to use the following five criteria for assessing overall fit Chi-square (χ^2), Ratio of Chi Square to Degrees of freedom (χ^2 / df), normed fit index (NFI), Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). As reported by Segar and Grover, 1993 cited in Curkovic et al (2000), it is recommended that researchers use additional measures. The rationale is that the χ^2 is quite sensitive in different ways to both small and large sample sizes. (Hair et al, 1998). Table G, columns 2, 5 and 8 (Appendix G) presents the results of the initial one factor model, second order factor and the two factor models . The χ^2 value for the second order factor model was 1091.89 (df =517) which was satisfactory, as this generated a discrepancy /. df ratio of 2.112..

Output from the analysis as shown in Appendix G provides the following information of the chi-square and degrees of freedom values for the null model and the TQ-SMART model. The rest of the assessment of fit indices which are normally utilised would be computed as follows

For the Tucker-Lewis Measure

$$\mathbf{TL = [(\chi^2_{null} / df_{null}) - (\chi^2_{proposed} / df_{proposed})] / [(\chi^2_{null} / df_{null}) - 1} \quad \text{.. } \mathbf{Equation 7.13}$$

Normed Formed Index is normally computed as follows.

$$\mathbf{NFI = [(\chi^2_{null} - \chi^2_{model}) / \chi^2_{model} - 1]} \text{............................} \mathbf{Equation\ 7.14}$$

The ratio of the chi square to the degrees of freedom provides information on relative efficiency of competing models in accounting for data (Lin et al 2000).

$$\mathbf{NFI =} \quad \chi^2 / df \quad \text{..} \quad \mathbf{Equation\ 7.15}$$

According to Li and Yang (2003), the ratio of the chi-square to the degrees of freedom provides information on relative efficiency of competing models in accounting for data.

RMSEA : The root mean square estimates the lack of fit in a model compared to a perfect (saturated) model. The RMSEA value of less than 0.05 indicates a good fit model.

Curkovic et al (2000) suggest that in order to assess the measurement properties of a construct, it must be subjected to the following tests; unidimensionality and convergent validity, discriminant validity, criterion-related validity, nomologicalvalidity and reliability. Each of the tests are discussed in the earlier Chapter Six.

The fit of the TQ-SMART model was assessed using Chi-square, the average off diagonal standardised residual, and the Comparative Fit Index (CFI) (Bentler 1989). According to Field (2000), the off-diagonal standardised residuals reflect the extent to which covariance between manifest variable has not been accounted for by any models under consideration. Based on the ratio of the Chi-square to the degrees of freedom (>2), this value should not exceed twice the degrees of freedom. Other ft indices also suggest a good fit; the GFI is high (.95) and the average off-diagonal standardised residual is low. However, Curkovic et al (2000) argue that χ^2 divided by its degrees of freedom, should be less than 3, as the value obtained for this model is 2.112, it can be concluded that the observed and estimated matrices do not differ considerably. Despite the usage of the Structural Equation Modelling, the univariate statistics had the following output of mean, standard deviation, skewness and Kurtosis. Figure 6.12 in subsection 6.2.20 highlights the steps for checking the normality. These measures as suggested by Curkovic et al (2000) were checked to deter any indications of departures from normality. None were found in the results as the values for skewness was ≥ 2, and the same applied for the kurtosis which were found to be ≥ 7. The results of the QQ plots for diagnosing normality are presented in Appendix D (Graphs D1 through D10 for the ten TQM deployment constructs)

The 3 factor mechanistic model was further subjected to Structural Equation Modeling. The following fit measures were obtained; the chi-square (labeled *Discrepancy* in the output shown in the Appendix G (Table G6, Column 8) value of

13.966 with five degrees of freedom was significant at the 0.05 level: its *p*-value is 0.016. This finding suggests that the mechanistic model does not fit the data acceptably in the population from which the sample was drawn. Further corroborating evidence in the unfitness of the model is provided by the RMR fit statistic, the obtained value of 0.136 was well above the desired 0.10 cutoff. Similarly, the Tucker-Lewis Index result of 0.906 is below the 0.95 threshold denoting unsatisfactory model fit. However, Harrison-Walker (2001) in citing Hu and Bentler (1999) caution that RMSEA substantially over-rejects both simple and complex true population models at sample size, less than or equal to 250.

Table 7.20 presents the results of the assessment of fit of the three models. The summary of results are extracted from Tables G1 (Column 8), G2 (Column 2) and G5 (Column 8) in Appendix G.

Table 7.20: Goodness-of-fit indices for Structural Equation Modelling

Fit Measures	One Factor TQM Model (34 Variables)	Second Order Factor Model (10 Constructs and 34 Variables) **(Figure 7.27)**	Second Order Factor Model after respecification (10 Constructs and 34 Variables) **(Figure 7.28)**
Discrepancy (χ^2)	1757.31	139.350	38.40
df	527	35	26
Discrepancy/df	3.335	3.981	1.543
RMR	0.264	0.216	0.096
TLI	0.370	0.492	0.907
CFI	0.409	0.605	0.940
Number of Parameters	68	20	26

It can be argued, that the re specified second order ten factor TQM model as illustrated in Figure 7.28 satisfies the three measurement criteria. The discrepancy df ratio (χ_2/df) is less than 3 as compared to the two other models. It is also evident from Table 7.20 that a reduction in the number of parameters improves the model fit..

7.7.1 Example of Assessment Model Fit

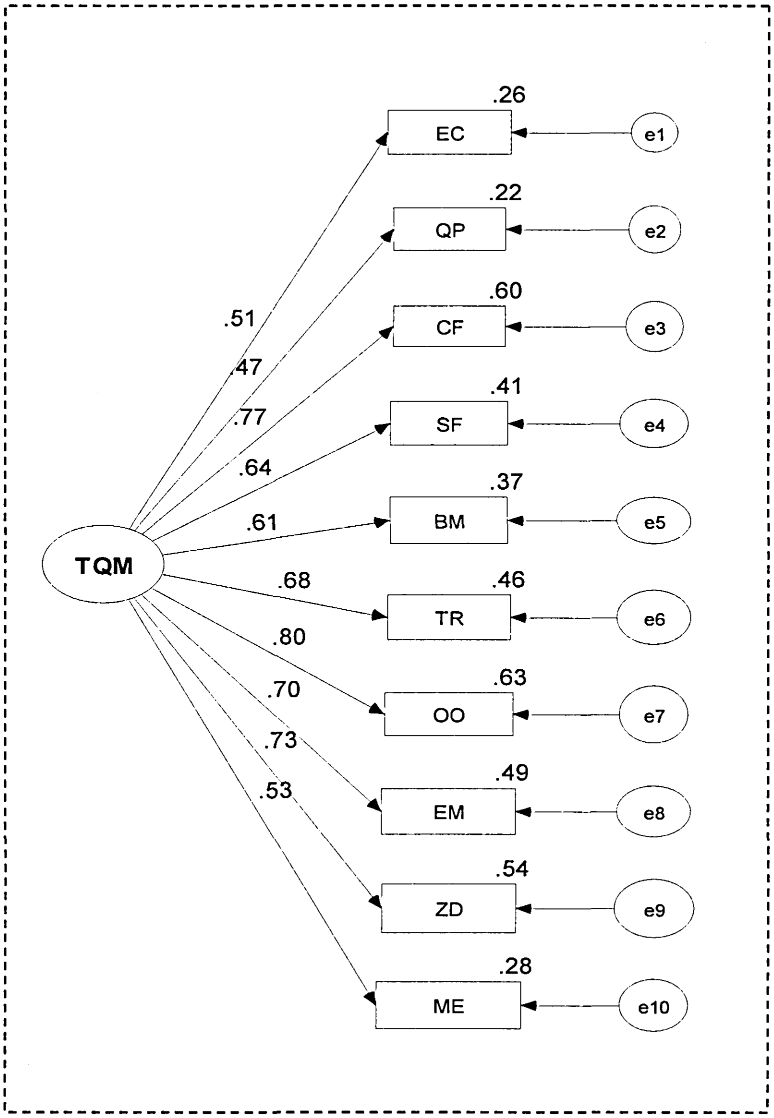

Figure 7.26 One Factor TQM Model for non-TQM Deploying Organisations

Goodness-of-fit measures for comparison of multitrait-multi-method models

The standardised parameters for the Multitrait-multi-method model are displayed in Figure 7.26. Each set of standardised measurement coefficient shows the relative influence of a concept variable and an error variable or a measured variable. The square of a standardised coefficient shows the proportion of observed variance to the specified causes, the error term. For example, TQM contributes 25% (0.51^2) of the unit variance of Executive Commitment.

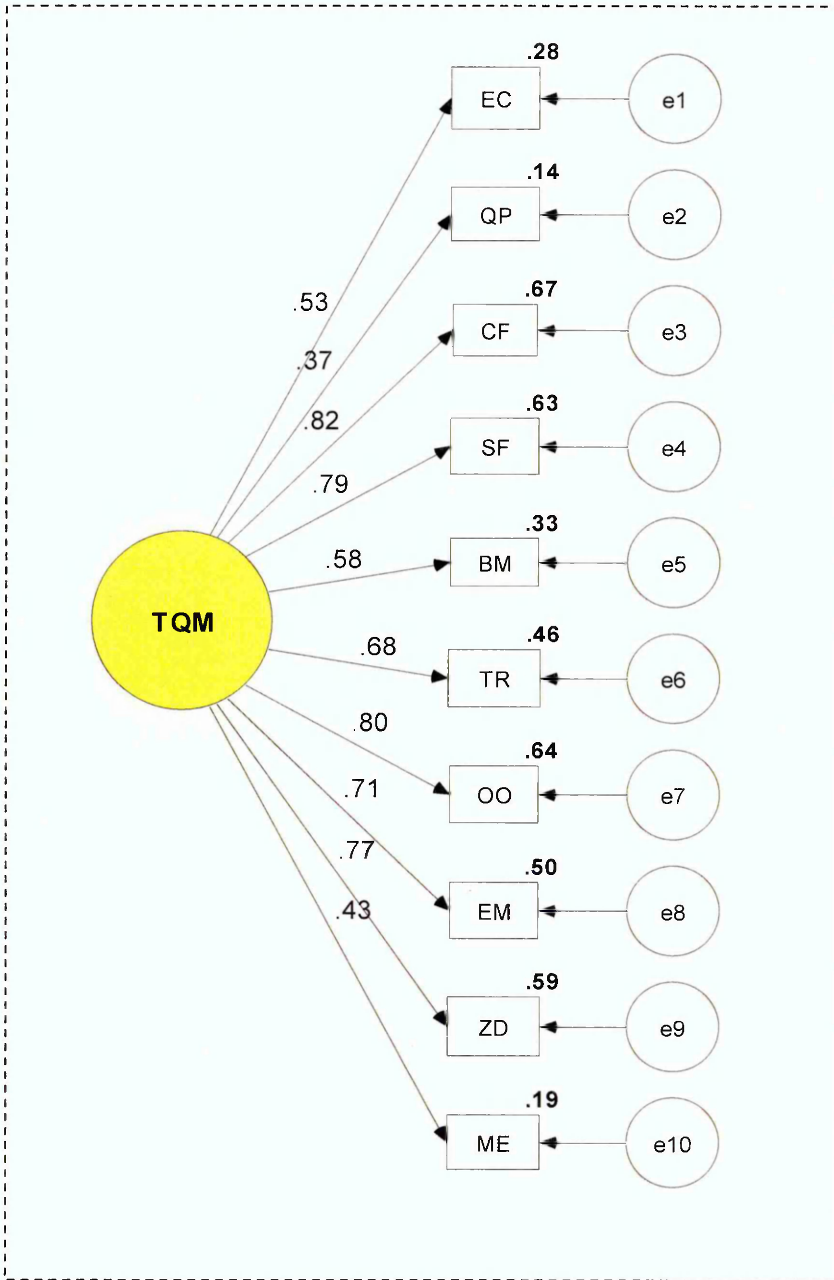

Figure 7.27 - One Factor TQM Model for non-TQM Deploying Organisations

The above model generated the following revised fit measures as indicated in Table G2, Column 2 (Appendix G): χ^2= 139.35, df = 35 p = 0.000, χ^2/df = 3.981, RMR =0.216, GFI =0.581, AGFI =0.342, NFI = 0.549, IFL = 0.619, TLI =0.492, CFI = 0.605, RMSEA = 0.266 and parsimony ratio = 0.778

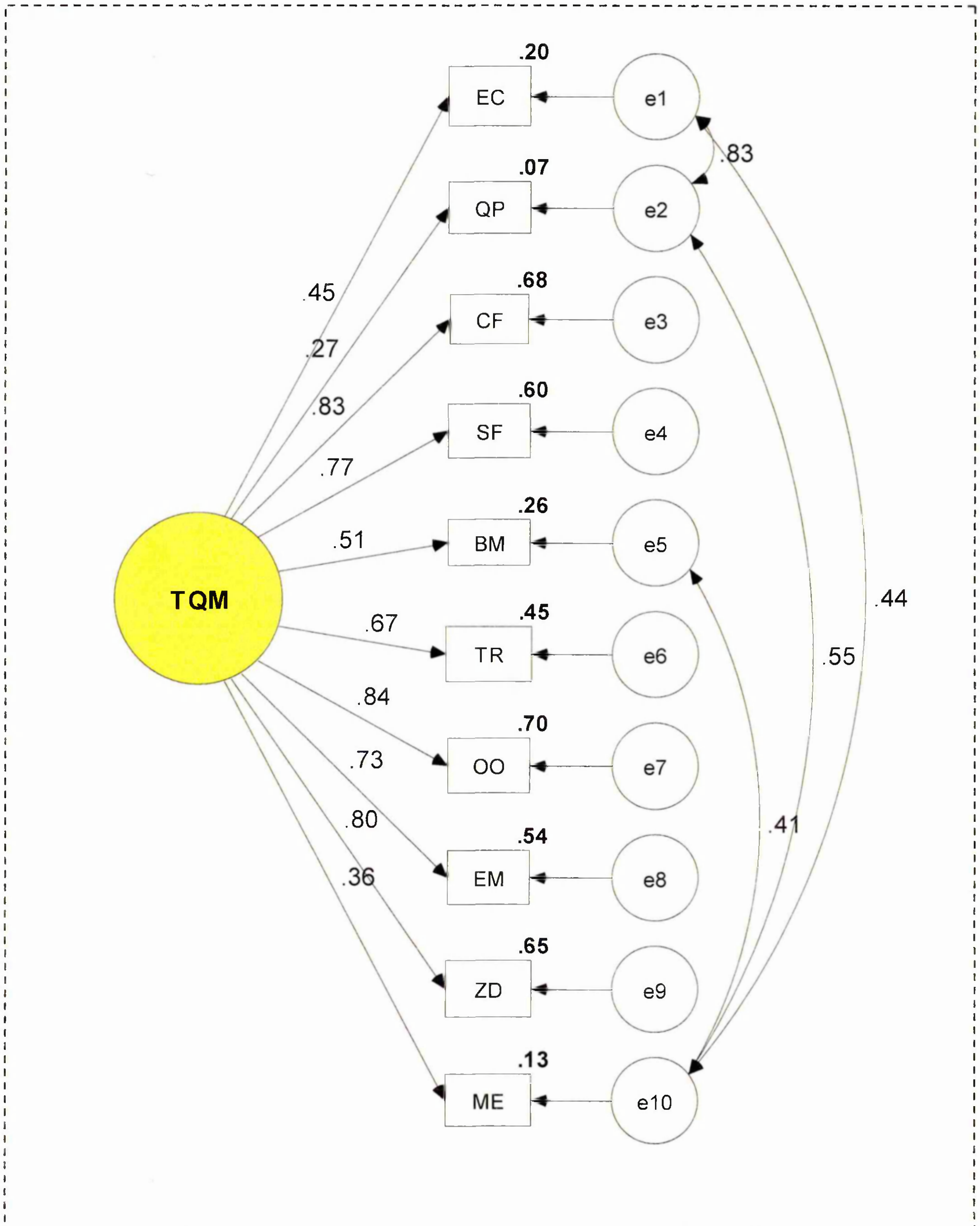

Figure 7.28 - One Factor TQM Model for non-TQM Deploying Organisations (After Re-Specification)

By allowing the following co-variances e_1 and e_2, e_1-e_{10}, e_2-e_{10}, e_5 and e_{10}, the above model generated the following revised fit measures as shown in column 5 of Table G2 (Appendix G):

χ^2= 59.055, df = 31 p = 0.002, χ^2/df = 3.981, RMR =0.142, GFI =0.785, AGFI =0.618, NFI = 0.809, IFL = 0.899, TLI =0.846, CFI = 0.894, RMSEA = 0.147 and parsimony ratio = 0.689.

However, although the statistics of GFI, NLI and CFI are near adequate, the modification indices generated by the solution suggested that a further co-varying of the following errors; e_1-e_9, and e8-e10 would result in the drop of the chi-square statistic by 6.683 and 4.373 respectively.

Results of Re-specification 2

By allowing the following co-variances e_8 and e_{10}; and e_1 and e_9, the above model generated the following revised fit measures as shown in column 8 of Table G2 (Appendix G): χ^2= 44.748 df = 29 p = 0.031, χ^2/df = 1.543, RMR =0.136, GFI =0.817, AGFI =0.654, NFI = 0.855, IFL = 0.944, TLI =0.907, CFI = 0.940, RMSEA = 0.114 and parsimony ratio = 0.644. However, although the statistics of GFI, NLI and CFI are adequate (>0.9) the modification indices generated by the solution suggests that a further co-varying of the following errors ; e7-e8,would result in the drop of the chi-square statistic by 5.408. Thus the following data represents the results of the modification:

Results of Re-specification 3

By allowing the following co-variances e_7 and e_8 model in Figure 7.28 generated the following revised fit measures as shown in column 8 of Table G5 (Appendix G):
χ^2= 38.4 df = 28 p = 0.092, χ^2/df = 1.370, RMR =0.129, GFI =0.842, AGFI =0.691, NFI = 0.876, IFL = 0.963, TLI =0.937, CFI = 0.961, RMSEA = 0.096

The results of the re-specification indicate a marked improvement in the following fit indices between respecification 2 and 3: χ^2 (44.748 $\rightarrow$ 38.4), χ^2/df = (1.543 $\rightarrow$ 1.370); RMR (0.136 $\rightarrow$ 0.129), TLI (0.907$\rightarrow$ 0.937), CFI (0.940 $\rightarrow$0.961)

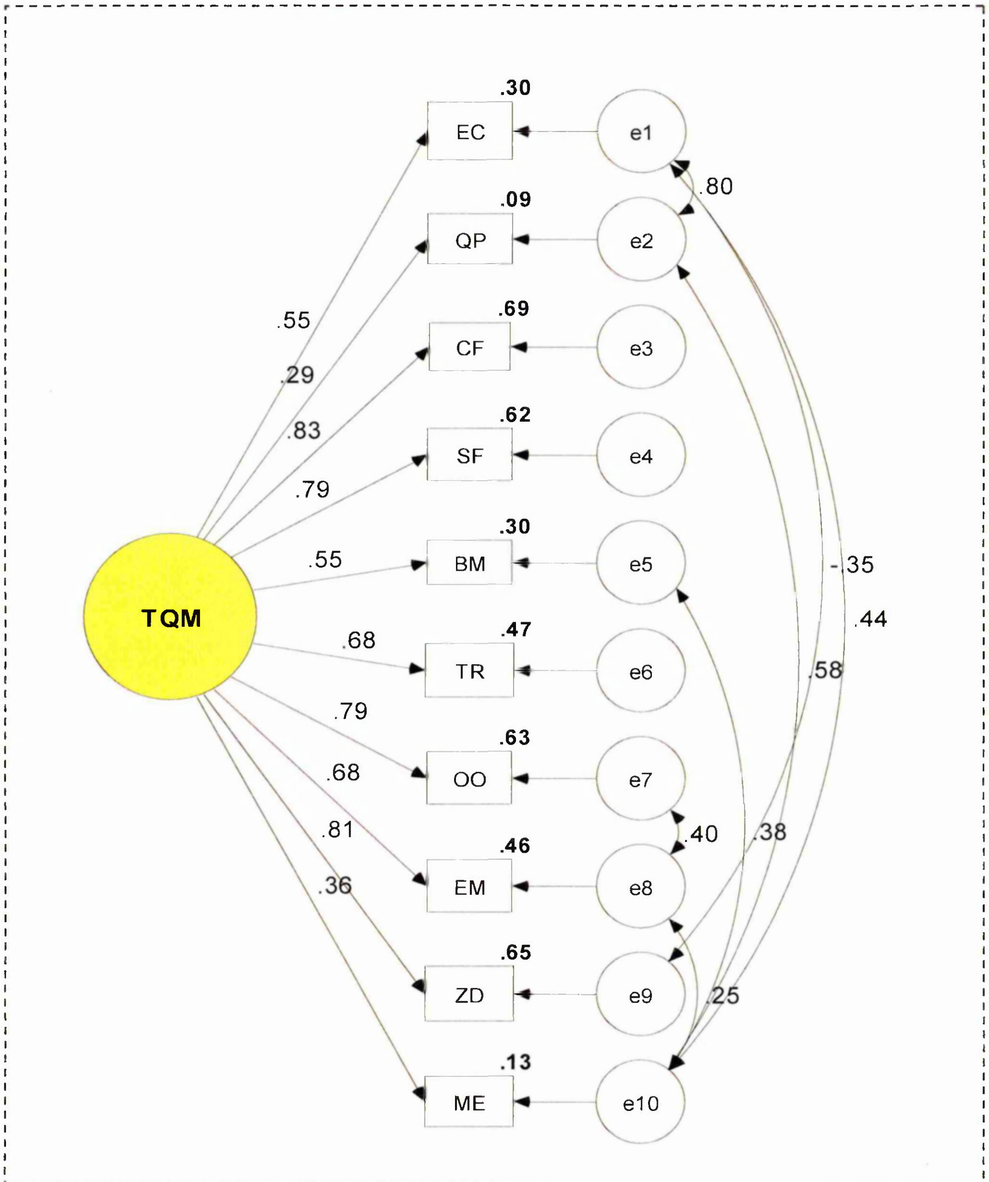

Figure 7.29: One Factor TQM Model for non-TQM Deploying Organisations (After 2nd Re-Specification)

7.8 Emerging Intelligent Systems based Technologies as a Vehicle for TQM Systems

This section is exploratory, and is recommended for future application of fuzzy scoring to the indices generated. Instead the TQMI generated are used for the thesis. It is meant to be a comparative only.

7.8.1 Potential Application of Fuzzy Reasoning to Assessment Rating

The fundamental idea behind fuzzy logic is based on the observation that human thinking is not just two-valued or multi-valued logic, but logic with continuous degree of truth. Fuzzy logic uses degrees of membership in sets rather than a strict (yes/no) membership. The degree of membership is the possibility (expressed as a number between 0 and 1) of a particular value belonging to a fuzzy set (Zadeh, 1974). Accordingly, complex-computing tasks can be made simpler if the questions have imprecise or fuzzy answers, rather than precise or crisp ones. This provides a remarkably simple way to draw definite conclusions from vague, ambiguous or imprecise information.

The assessment problem is addressed as a fuzzy constraint satisfaction problem. Constraints are mathematical tools used to model decision-making problems. Classical constraint satisfaction is comprised of boolean (yes/no) or hard constraints. Fuzzy constraint satisfaction relaxes the constraints to allow intermediate degrees of satisfaction. For example, on survey questionnaires it is commonly expected to offer qualitative answers, such as, “definitely disagree” or “moderately agree”. On a numeric scale of 1 to 5, a “moderately agree” answer would correspond to the fuzzy number, "about 3". This is illustrated in the Figure 7.30, below.

```
1.0 +                 +
    |                / \
    |               /   \
0.5 +              /     \
    |             /       \
    |            /         \
0.0 +-----------+-----+-----+-------------
                |     |     |
               2.5   3.0   3.5
```

Figure 7. 30: Proposed Fuzzy Set for “about 3” or “moderately agree”.

The next step in solving a constraint satisfaction problem, is to apply an instantiation of all input variables, and determine the degree to which all constraints will be satisfied. Several techniques have been proposed for this step, which are essentially variations of conjunctions and disjunctions from classical logic. The minimum operator is a common t-norm operator for solving conjunction of several constraints:

$$C_{t-norm} \underset{=}{def} \min(a_1, a_2, \cdots a_n) \quad \textbf{.......................... (Equation 7.15)}$$

The degree of advancement of each variable would be used in fuzzy integration to evaluate any alternative.

7.8.2 Conversion of Ratings to TQMI Scores

This utilises the fact that the ideal value (maximum or minimum) is outside the range of scores. Each attribute value is made relative to an ideal maximum attribute value as follows:

$$\textbf{TQMI} = \frac{X - X_{min}}{X_{max} - X_{min}} \quad \textbf{..........................(Equation 7.16)}$$

Where X is an attribute value, X_{min} is the minimum attribute value and X_{max} is the maximum attribute value.

When the above occurs then all attribute values are related to the maximum. This will result in the scores (which are fuzzy) being transformed to sets of fuzzy set scores in the range 0 to 1. This is the 'Fuzzy Set Method' that is usually employed. For simplicity of applying the model, it was decided to use the Total Quality Management Index which would still yield satisfactory results. For example, for the variable Executive Commitment with a mean value of 4.10, the possible maximum score is 5.0 and minimum is 1.0, therefore, the total quality management index was computed as follows:

$$TQMI = \frac{4.10 - 1.0}{5.0 - 1.0} = 0.775$$

The same method is applied for the remaining constructs and the values (see table 1, columns 4 and 7) are plotted to produce either the TQM Advancement Chart (Figure 6.3 and 6.4). This produces a value as opposed to the usage of the mean, which would be derived as follows: 4.10/ 5.0 = 0.802, which would not reflect the true status of the Implementation process.

Model Comaprison

According to Yi et al (2003)), two commonly used criteria for model comparison are the ratio of chi-square to degree of freedom and the normed fit index. As an illustration, the goodness of fit indices for the original one factor model as extracted from Table G1 (Columns 8 and 10) , Appendix G, for the independence and model are presented in Table 7.21

Table 7.21: Comparison of Fit indices of the Model and Baseline Model

Fit Indices	Model	Baseline
Chi-square (χ^2)	1757.31	2641.159
Degree of freedom (df)	527	561
Goodness of fit index (GFI)	0.326	0.148
Adjusted Goodness of fit index (AGFI)	0.239	0.097
Root mean square residual (RMR)	0.264	0.639
Normed Fit Index (NFI)	0.335	0.000
Relative Fit Index (RFI)	0.292	0.000
Incremental Fit Index (IFI)	0.418	0.000
Tucker-Lewis-Index (TLI)	0.370	0.000
Comparative Fit Index (CFI)	0.409	0.000

7.9 Comparison of Existing Models - EFQM and MBNQA

A comparison and application of existing models such as the EFQM in Europe, MBNQA in the United States has attracted attention of several researchers (Eskildsen et al, 2001; Li and Yang, 2003; Watson and Chileshe, 2003a, and Watson and Chileshe, 2003b). The EFQM Excellence Model is the most widely used organisational model in Europe, and can be used for a number of activities, where organisations assess themselves in order to identify where they need to focus improvement activity.. In accepting the EFQM, the major limitations are under representation of the dynamic effects of TQM, which leads to simplified TQM efforts with reduced organisational effectiveness. Furthermore, as Leonard and McAdam (2002) concluded, the dominance of the EFQM in Europe and the Malcolm Baldrige National Quality Award in the USA can lead to an unquestioning acceptance of these models as being wholly representative of TQM. In order to address this limitation, the proposed model, TQ-SMART addresses the dynamic effects of TQM at strategic level. Chapter eight will comment on the shortcomings of the models in more details.

7.9.1 Shortcomings of Other Models

The failing of the models can be identified in the gap and the by addressing those issues, TQ-SMART is effectively contributing in those areas. According to Ahire et al (1996), empirically validated scales can be used directly in other studies in the field for different populations. They also yield valid tools for practitioners for assessment, benchmarking and longitudinal evaluation of their programs. The TQ-SMART Model and research methods used in this research have several implications for Managers in the UK Constructional related SMEs. First, TQ-SMART could be utilised to produce a profile of organisation-wide quality management (see Motwani et al, 1997), secondly the TQMI generated can assist Management in identifying areas requiring improvement. By setting a threshold for excellence as 75 per cent, any deployment construct below the threshold would be target for improvement; this would lead to an improvement in Productivity and Turnover and Profits as targeted in the Egan Report.

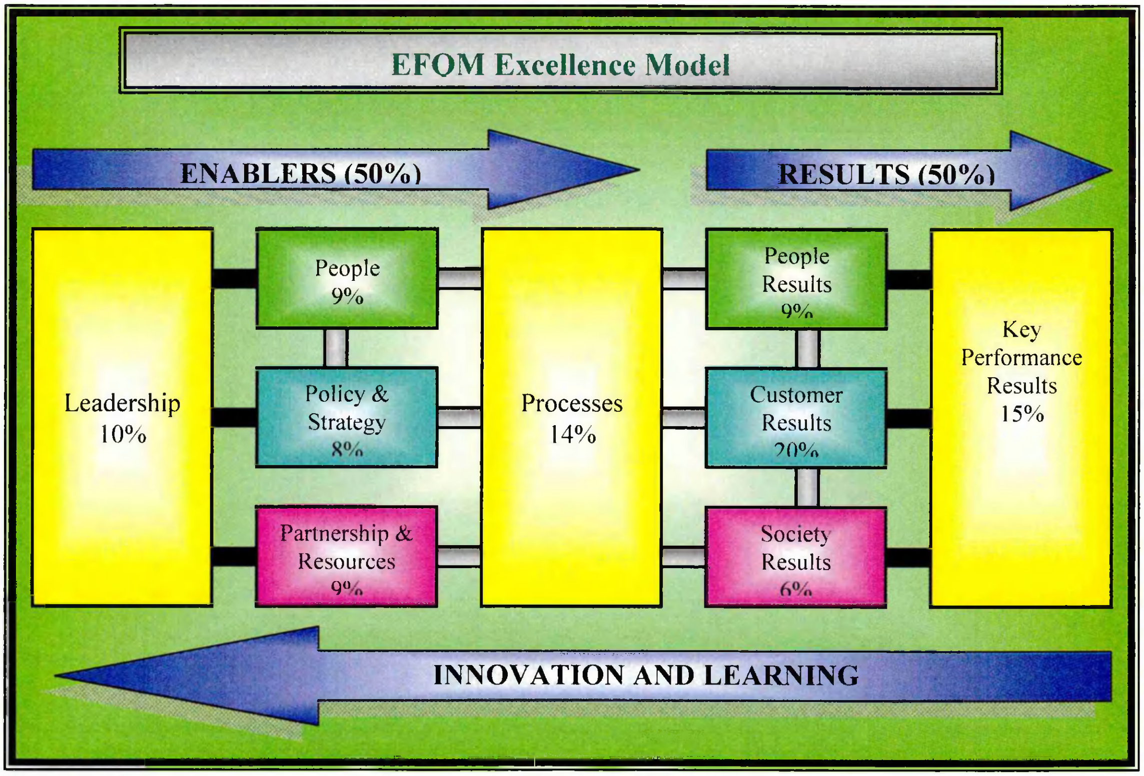

Figure 7.31: The EFQM Excellence Model

Sharma and Gadenne (2002) observe that most TQM frameworks that are available now may not been tested for their applicability across different industry groups such as service or construction sectors in addition to the manufacturing sector. From Fig 7.31, it is evident that the EFQM Excellence Model places more emphasis on the Customer focus as it has the largest percentage (20 per cent) or 200 maximum available points. Furthermore the model is not empirically tested and validated. Yusof and Aspinwall (2000) classified existing frameworks into three types; Consultant based, Academic based and Award based such as the EFQM Excellence Model whose basis is used for the comparison.

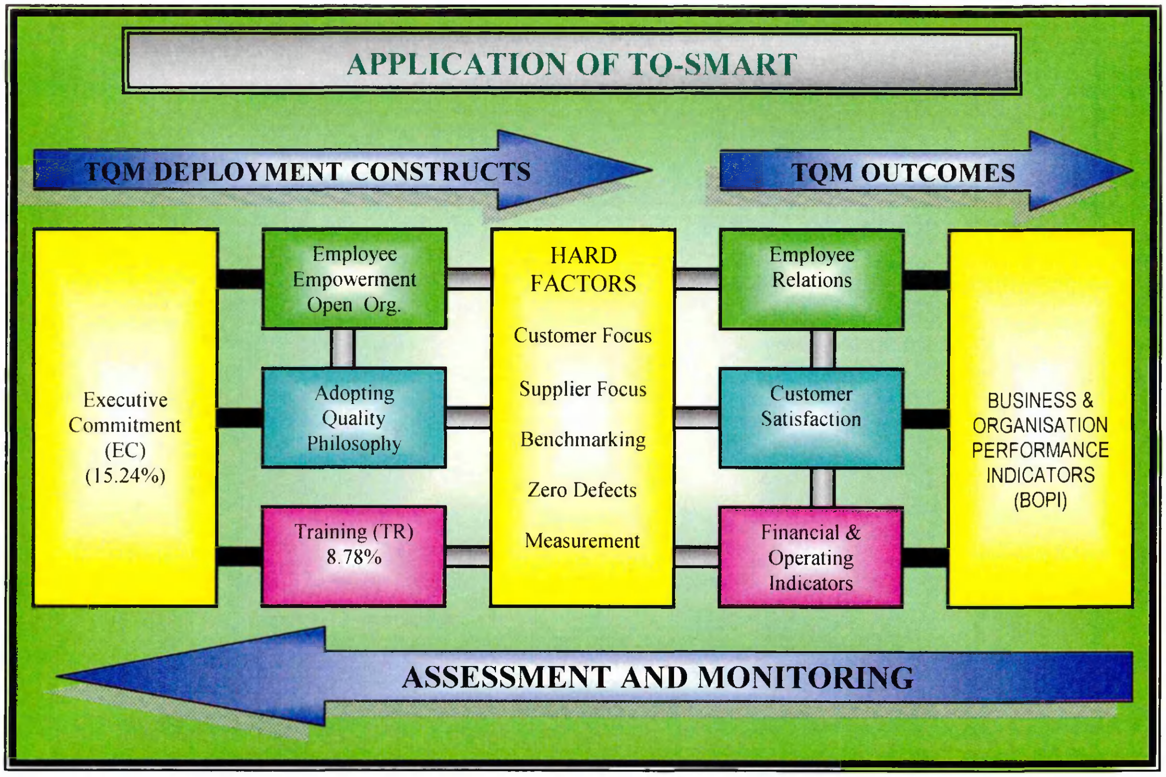

Figure 7.32: Juxtaposing the TQ-SMART on the EFQM Excellence Model

The "TQM deployment constructs" in the application of TQ-SMART part can be likened to the process criteria, which is (the degree to which improvements in organisation function that are expected are actually observed) to measure QM effectively as opposed to the outcome criteria. Hackman and Wageman (1995) defined the process criteria of effectiveness as the degree to which the improvements in organisational functioning that are expected actually are observed.

7.9.2 Comparison of TQ-SMART to Other Models: The Case of the EFQM Model (2b-2a) = Contribution

Figure 7.32 presents the elements of TQ-SMART, whereas the EFQM Excellence Model has enablers as the desirable elements to be in place to achieve the results in People, Customer and Society. TQ-SMART has the TQM deployment constructs, which could be self-administered through the questionnaire as utilised in this study. Instead of Results, this model has the TQM outcomes made up of Business and Organisational Performance indicators (BOPI), which make up the Organisation

Performance. The Business indicators can further be split into financial and Market performance. The major limitation of the EFQM, is that the linkages from the leadership element through the People, Policy and Strategy, are allocated percentages which are arbitrary values, meaning that they are not empirically validated. The same applies to the "Results" section of the framework.

On the other hand, SEM was employed to develop the new Total Quality- Self-Monitoring and Assessment Rating Tool (TQ-SMART) Model, using the **A**nalysis of **Mo**ment **S**tructures (AMOS) software programme. This enables the contribution of each deployment constructs to be assessed through the loading factors or regression weights. Through the goodness-of-fit indices, the model could be respecified to suit the sample. Furthermore, whereas the EFQM Excellence Model suggests that the Enablers and Results carry equal weightings of 50 per cent; this assumption is not empirically validated. Through a series of CFA, TQ-SMART could confirm which factors contributed mostly to organisation performance.

Another notable shortcoming according to Sousa and Voss (2002) is that the existing scope of the major quality awards assessment frameworks has been continuously enlarged making them overall "business excellence" models rather strictly "quality models". Fillipini (1997) suggests various approaches to be combined in order to support theory development, in particular when using surveys as;

Re examination of many concepts, models and prescriptive ideas present in Quality Management literature in order to extract propositions and preliminary theories. As observed by Flynn and Saladin (2001), the EFQM can be said to specify cause and effect, implying which practices will lead to various desired outcomes (Flynn and Saladin, 2001:618). For example, the model shown in Figure 7.15 suggests that Processes are the most important constructs of the enablers as evident by the 14% allocated to it, and customer results are considered as the most important of the desired outcomes or "results" based on the number of points or percentage allocated, 200 or 20%.

The relationship or correlation between the soft and hard factors ($\Phi = 0.68$) was high, suggesting that they complimented one another.

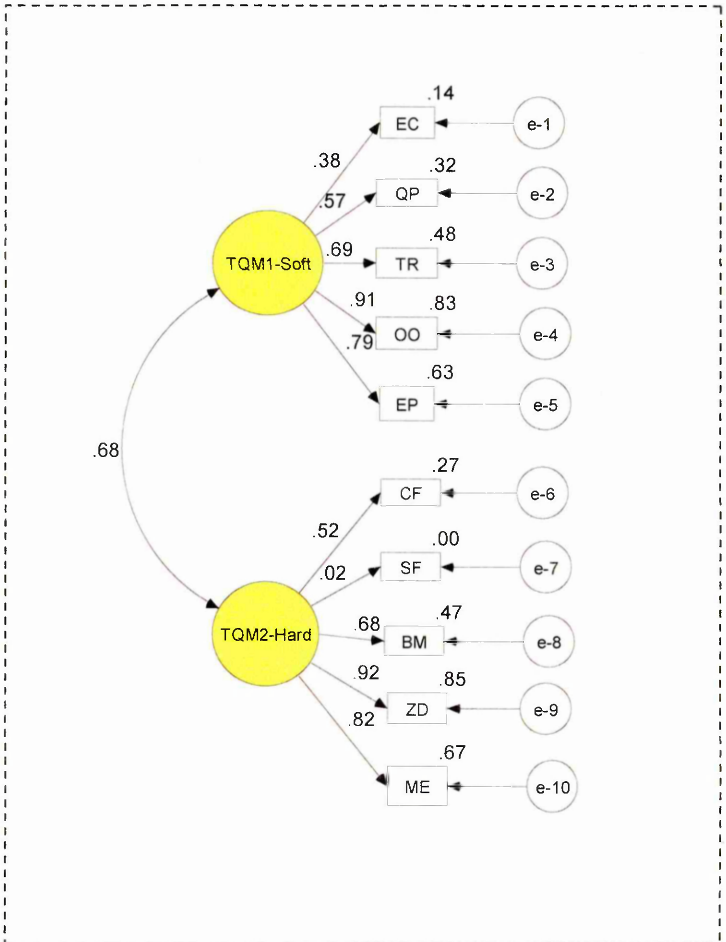

Figure 7.33 Graphical representation of the Confirmatory Factor Analysis for TQ-SMART

Figure 7.33 shows the weights attached to the ten deployment constructs. The values are generated through the Total Quality Management Index where the factor weights all add up to one. The percentages are derived by multiplying the factor weights by 100. It is evident that the TQ-SMART attached 15.84% to executive commitment for the small UK TQM deploying constructional organisations. The values for the remaining factors can be found in Chapter 6..

As opposed to the EFQM Award (Framework) whose aim is stimulating national or regional organisations to take the appropriate steps, the People (9%), Customer (20%)

and Society (6%) The TQ-SMART is intended to contribute further to building a theory on TQM. This is achieved by empirically validating the TQ-SMART through the usage of Structural Equation Modelling (SEM) to assess the actual factor loadings (λi) and their associated measurement errors. This is a key area as Forza and Filippini (1998) found the lack of adequate theoretical formulation of TQM as one of the critical aspects lacking in TQM research. Furthermore, usage of SEM enables the explanation of the phenomena being observed by analysing causal relationships between variables (Filippini, 1997)

Figure 7.32 shows the TQM deployment constructs of the TQ-SMART Model. The ten deployment constructs as shown in Figure 7.33 were initially subjected to validity and reliability tests before a single score could be calculated to represent each construct. This is equivalent to the left-hand side of Figure 7.27. The TQM_2-Hard refers to the process construct, or what is known as process management. Various authors have different names for the 'hard factors', though the common generic term used is that of 'Core dimensions', which are also known as formal tools, tangibles, mechanistic, and control. As opposed to current literature, which excludes customer and supplier focus from the Process Management, this model includes them as part of process management as the indicators or manifest variables of the customer and supplier focus, includes such items as, "actively seeking customer inputs to determine their requirements", "using customer requirements as the basis for quality" and "requiring suppliers to meet stricter quality specifications", which constitute variation.

Any form of variation is part of Process Management. It is clear from Figure 7.33 that individual factor loadings vary. For example, Zero Defects and Measurement constructs have the highest factor loadings (λ_1=0.92 and λ_2 =0.82) respectively, whereas for the TQM_1-Soft part of the model, Open Organisation and Employee Empowerment constructs have the highest factor loadings of (λ_1=0.91 and λ_2=0.71). This finding is consistent with the literature on the contribution of infrastructure and core elements to TQM. The values above the boxes in Figure 7.33 represent the amount of variance accounted for by each construct. This is the equivalence of squared correlation in multiple regression. The values should be above .50 i.e. the construct should account for at least 50% of the amount of variance. From the model it is notable that for the TQM_1-Soft Model, all construct apart from the executive commitment (R^2 =0.14) and adopting the quality philosophy (R^2=0.32) have more than 50 % of variance. The TQM_2-Hard have customer focus, and supplier focus have the variance as less than 50 %.

- **Multi-Collinearity Problems**

As observed by Dahlgaard and Nilsson (2003), the Quality Management practices used in organisations are strongly correlated with one another, as such the relationship between the enablers and results of the EFQM Excellence model is obscured due to multi-collinearity problems. This is further elaborated upon in Chapter Eight.

7.10 Re-Development and Specification

(a) Stage 1: Initial Measurement Model

Figure 7.34 shows the measure of fit between the empirical data and the model

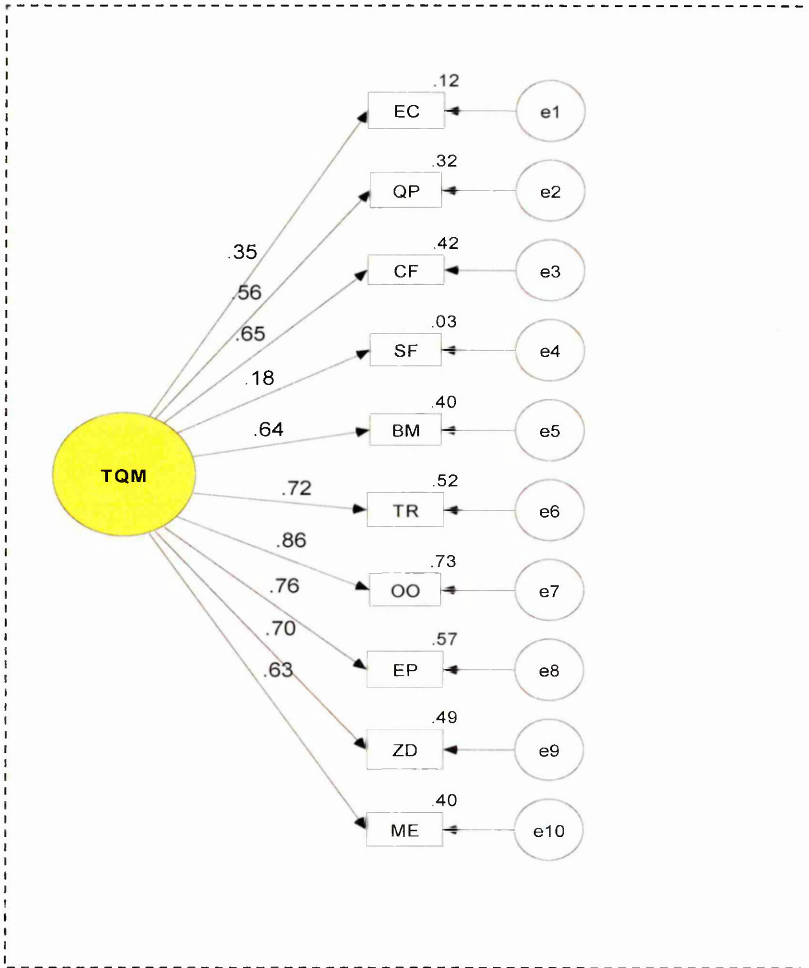

Fig 7.34 - One Factor TQM Model (Before Re-specification)

The above model generated the following fit measures: χ^2= 52.89, df = 35, p = 0.027, χ/df = 1.51, RMR =0.125, GFI =0.691, AGFI =0.691, NFI = 0.552, TLI = 0.685, CFFI = 0.755 and RMSEA = 0.164. The modification indices suggests that by co-varying e_1 with e_2, the χ would drop by 10.286 and by co-varying e_9 with e_{10}, it would further drop by 8.125. Figure 7.34 is the re-specified model.

$\chi^2 = 52.89$, df = 35, $p = 0.027$ (Unacceptable fit)
χ^2/df = 1.511 (Acceptable fit) - overfit
GFI = 0.691 (Unacceptable fit)
TLI = 0.685 (Unacceptable fit)
RMSEA = 0.164 (Unacceptable fit)

For the measurement model in Fig 7.34, four of the five measures are reasonable or outside of the acceptable fit range.

(b) Stage 2: Improved Measurement Model

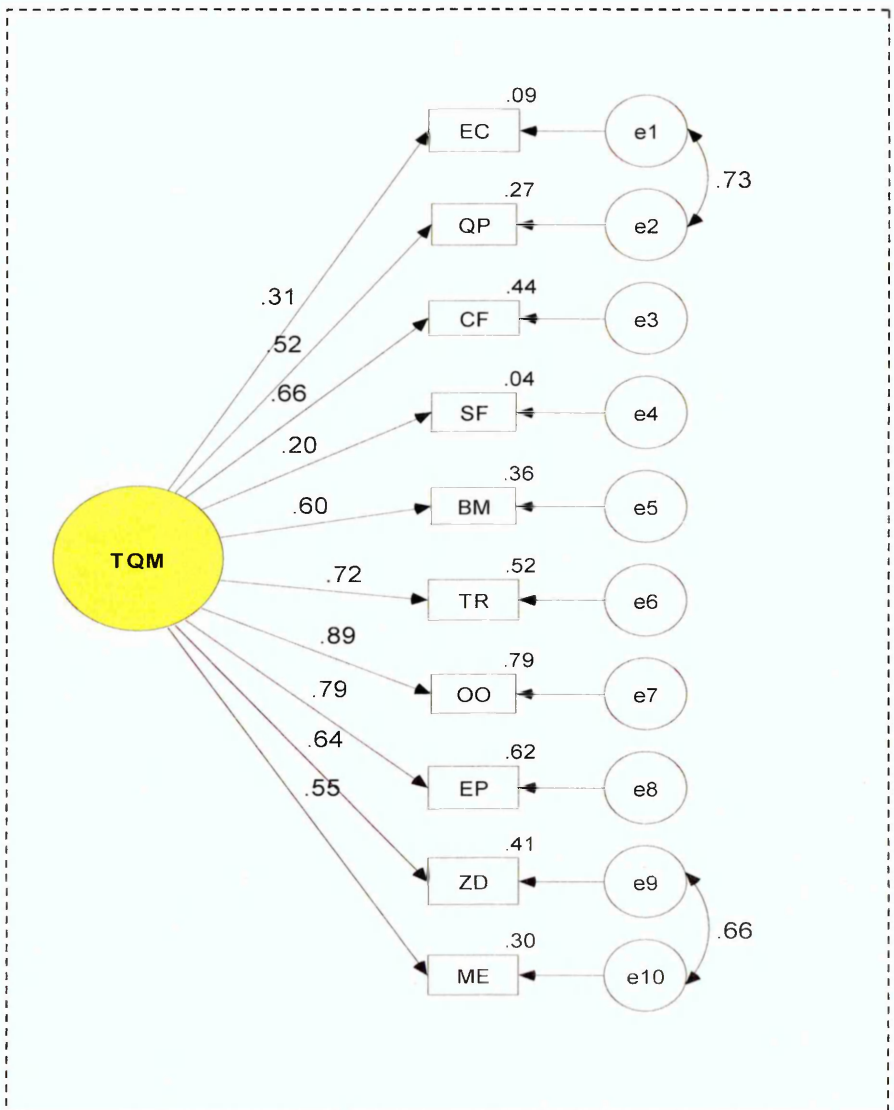

Figure 7.35: One Factor TQM Model (After Re-Specification)

The above re-specified model generated the following revised fit measures: χ^2= 29.20, df = 33.3, p = 0.659, χ/df = 0.87, RMR =0.100, GFI =0.796, AGFI **=0.691**, NFI = **0.552**, IFL = 1.045, TLI =1.072, CFI = 1.00, RMSEA = 0.000 and parsimony ratio = 0.733

χ^2 = 29.20, df = 33.3, p = 0.659	(Acceptable fit)
χ^2/df = 0.87	(Acceptable fit) - overfit
GFI = 0.796	(Reasonable fit)
TLI = 1.072	(Acceptable fit)
RMSEA = 0.000	(Reasonable fit)

Data fits the improved model

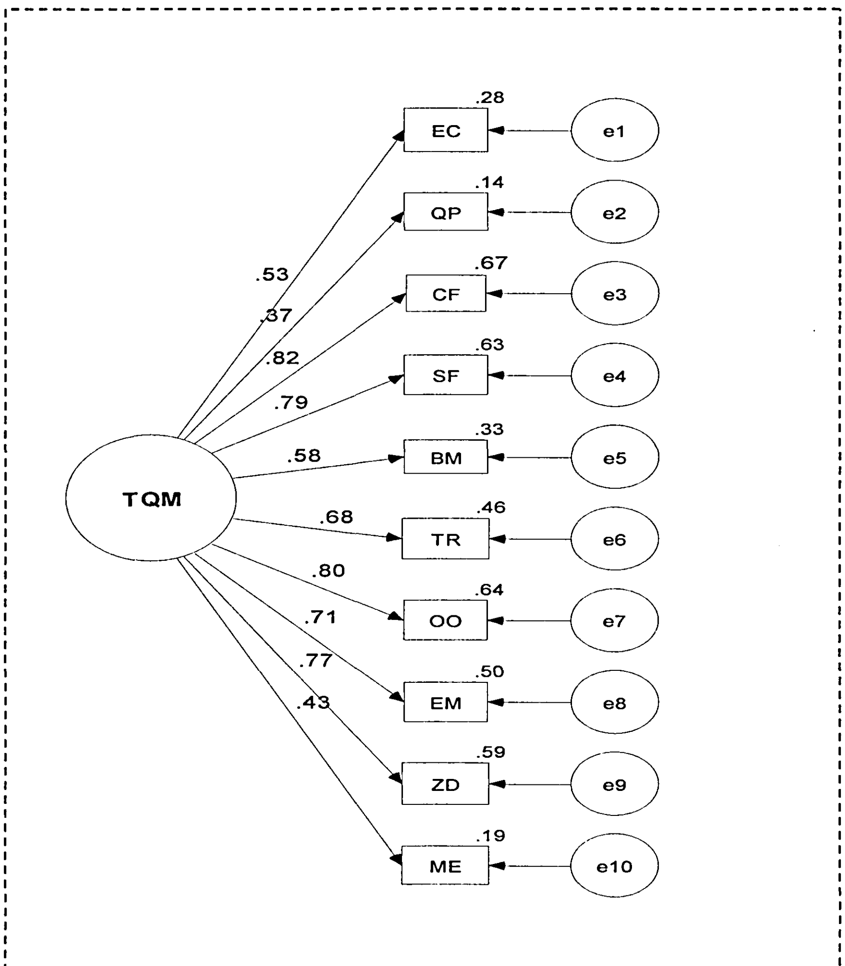

Figure 7.36 - One Factor TQM Model (Before Re-Specification) for non-TQM Deploying Organisations

The above model generated the following revised fit measures: χ^2= 139.35, df = 35 p = 0.000, χ^2/df = 3.981, RMR =0.216, GFI =0.581, AGFI =0.342, NFI = 0.549, IFL = 0.619, TLI =0.492, CFI = 0.605, RMSEA = 0.266 and parsimony ratio = 0.778

The improved measurement model in Figure 7.35 shows a comparatively better data fit in terms of the absolute indices (i.e. χ^2/df, GFI, TLI and RMSEA). The y also provide substantial improvement over the model in stage 1 (Figure 7.34) as evidenced by improving the GFI indices from 0.691 to 0.796.

Summary of TQ-SMART and EFQM Excellence Model

Currently the EFQM provides two evaluation tools – the Pathfinder Card and the RADAR Scoring Matrix. The advantage of the TQ-SMART over the EFQM, is based on the presentation of the results in a graphical manner (TQM Advancement Radar). Also, using a simple summary evaluation sheet, TQ-SMART provides organisations with a quick glance at the unused capabilities. It also clearly shows the present position of an organisation on its journey to achieving the World Class Chartered Status on a Spiral Graph. This is based on simple weighted co-ordinates generated from the evaluation using the aggregate scoring system. Other existing models which are not being used in this comparison are The Sheffield Model and the Kanji Model.

The following table summarises the similarities and differences between the two approaches:

Table 7.22 : Comparison of Scoring between TQ-SMART and EFQM

No.	RAI Range	TQ-SMART Score	EFQM	Lascelles and Dale (1993)	Proposed Classification (This Study, 2004)
1	0.0 – 0.2	up to 72	1.Uncommitted	1. Uncommitted	1. Uncommitted
2	0.2 – 0.4	73-144	2.Committed	2. Drifters 3. Tool-pushers	2. Drifters-1 3. Drifters-2
3	0.4 – 0.6	145-216	3. Adopters	4. Improvers	4. Middle of the Road 5. Improvers-1 6. Improvers -2
4	0.6 – 0.8	217-288	4. TQM	5. Award winners	7. Award Winners-1 8. Award Winners-2
5	0.8 – 1.0	289-360	4. World Class Organisation	6. World class	9.World Class Organisation

Whereas the European Construction Institute (1996) Achievement matrix was intended to provide organisations, projects, sites or sections with a tool for determining their progress, and had Management understanding levels of (0-11), Uncertainness (12-24), Awakening (25-32), Enlightenment (33-44), Empowerment (45-54) and Wisdom (55-60). This study draws the similarities of the EFQM, Dale and Lascelles (1997), Six levels of Quality Maturity and the ECI into a simple matrix ,so that the scores achieved from this study can be equated to the different existing classification. The matrix is shown in Appendix K.

7.11: TQ-SMART and EFQM Excellence Model: A Comparative Approach

Table 7.23 : Comparative Factors between TQ-SMART and EFQM

Assessment Framework Models		
Criteria	TQ-SMART	EFQM
1. **Method of Assessment**	Spiral Approach Matrix Approach	Proforma Approach (PA) Matrix Approach
2.**Criteria for Assessment**	10 TQM Constructs 34 Variables	9 Criteria PA – 32 Sub Criteria
3.**Evaluation Tool**	2.1 TQM Advancement Radar 2.2 Spiral Approach	2.1 Radar Scoring Matrix 2.2 Pathfinder Card
4. **Scoring System**	RAI 0 - 1.0 36^{o} - 360^{0}	Maximum 1000 points
5. **Classification**	World Class Organisation Award Winners-1 Award Winners-2 Improvers-1 Improvers-2 Middle of The Road Drifters-1 Drifters-2 Uncommitted	World Class Organisation Award Winners Improvers Drifters Uncommitted Each grade represents a different TQM maturity level
6. **Presentation**	Spiral Graph Advancement Matrix Advancement Radial Chart	Tabulated Enablers and Results
7. **Components Processes**	7.1 Executive Commitment 7.2 Quality Philosophy 7.3 Open Organisation 7.4 Employee Empowerment 7.5 Supplier Focus 7.6 Customer Focus 7.7 Measurement 7.8 Benchmarking 7.9 Open Organisation 7.10 Zero Defects	**Enablers:** 7.1 Leadership (10%) 7.2 Policy & Strategy (8%) 7.3 People (9%) 7.4 Partnership and resources (9%) 7.5 Processes (14%)
8. **Outcomes**	**BOPI** 7.11 Financial Performance 7.12 Operating Indicators 7.13 Customer Satisfaction 7.14 Employees Relations	**Results** : 7.6 People Results (9%) 7.7 Customer Results (20%) 7.8 Society Results (6%) 7.9 Key Performance Results (15%)

The evaluation tool as used by the EFQM Called Radar Logic consists of ; Results, Approach, Deployment, Assessment and Review. Therefore, the potential to be gained by UK Construction-Related SMEs from using the TQ-SMART can be illustrated as follows:

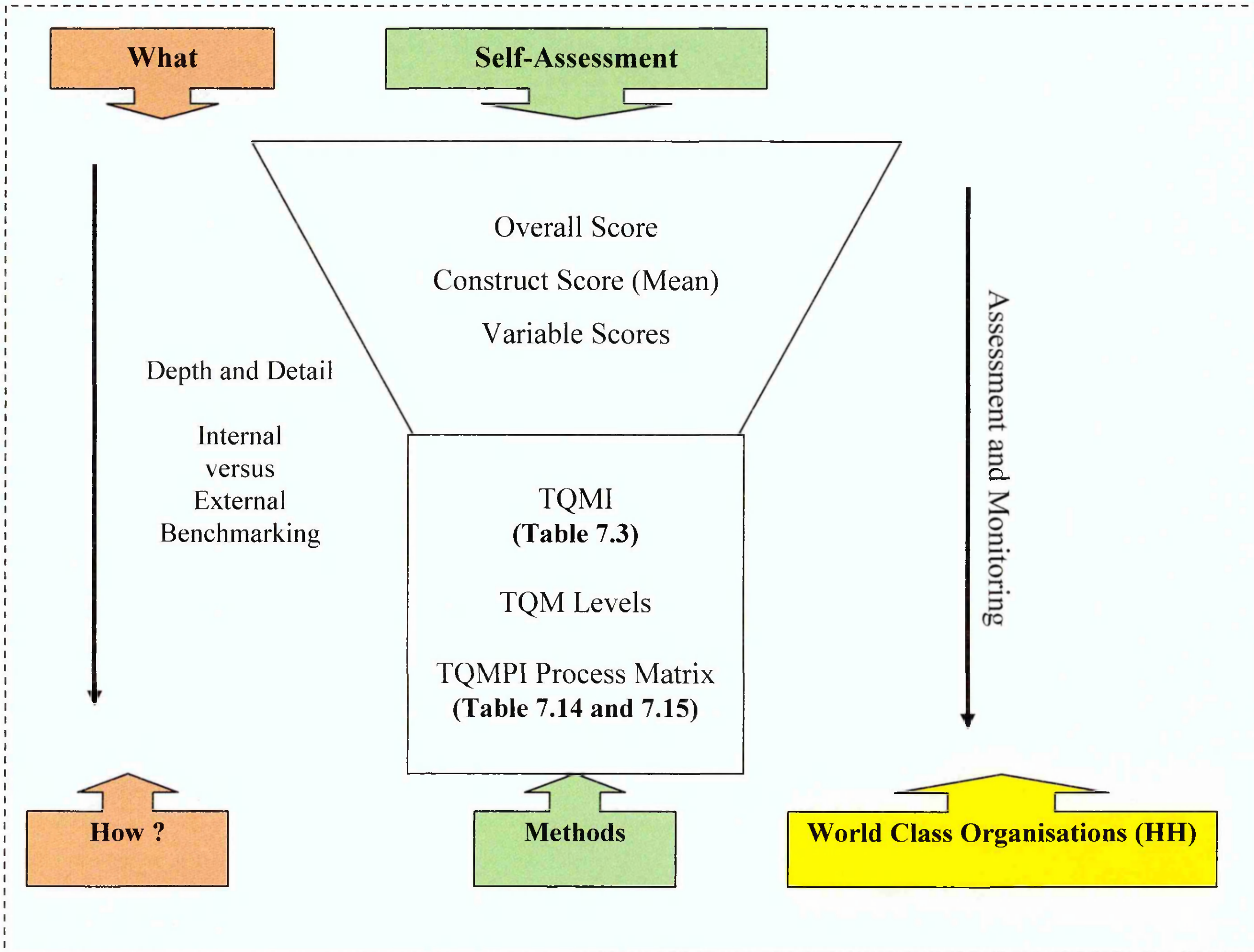

Figure 7.37: Potential from Using the TQ-SMART Model: The Benchmarking Initiative
(Adapted from Pupius, 2002)

Whereas the EFQM Excellence Model assesses and scores performance by criteria, and employs the writing of a lengthy report, plus a critique by an assessor team, (Dahlgaard and Nilsson, 2003), the TQ-SMART which is a survey based approach requires Quality Managers to complete a 34 variable questionnaire pertaining to the TQM deployment constructs identified as critical success factors, the 15 items of the Business and Performance Indicators instrument, the 5 item Competitive Environment Factors and the 7 associated benefits.

7.11.1 Application of the Spiral Approach

This section attempts to explain the rationale and meaning behind the spiral approach. Only organisations having the same level of commitment & advancement, will lie on the diagonal route that ranges from three levels, Low, Medium & High. This three-dimensional classification of organisations led to nine possible types of organisations (Chart 1), whilst in the current classification, all the five categories lie on the diagonal. This proposed method takes into account loss of focus in either advancement or commitment. Consequently the new group of Improvers namely Improver-A and B respectively, Award Winner 1 & 2 would be expected to lie on either side of the neutral axis as illustrated in Chapter 5 (Figure 5.1). The other new grouping of "Middle of the Road" allows time for reflection of what lies ahead in order to achieve the desired goal.

7.12 Summary

This section endeavours to apply fuzzy reasoning to the rating of deployment of TQM within small and medium sized organisations. It does acknowledge that qualitative measures are growing and becoming increasingly important to quality processes. TQM relies on such measures as customer satisfaction, employee commitment, team performance, supplier co-operation, and organisation's reputation, (Shepherd and Helms, 1995).

Valid measurement is the sine qua non of science. Without sound measurement techniques there is no science and possibly no concrete evidence of TQM success. Therefore, the potential application of fuzzy logic to the comparison of organisation's, TQM deployment advancement will rectify the anomaly. The other significant contribution is in identifying and transferring the matrix used in the service sector to quantifying the impact of deploying TQM on the organisation and business performance.

The Total Quality Management Performance Index can be used as a benchmark for internal and industry comparison. The results of the effect of the ten deployment constructs on organisation performance, are consistent with those in the literature. For example, the Executive Commitment construct scored highly when compared to the other constructs. This is in line with the Senior Management Commitment being the most important factor. The short fall in the deployment construct or thus called "the unused capabilities" enables the deployment constructs to be levelled. The study also demonstrates that Organisations claiming to be TQM could be no different from those stating not to. The proposed classification based on the advancement indices is of practical importance, as it provides a more robust and clear picture of the state of the organisation in terms of implementing the TQM constructs. As evident from the various definitions propagated by the Quality Managers, there is no formal definition of what constitutes TQM, therefore, one organisation could concentrate of the customer focus construct and pay less attention to benchmarking. Constructional practitioners will be able to use this model to evaluate their TQM implementation so as to target improvement areas. The application of the relative advancement index will prove particularly useful as benchmarks for comparison with other TQM deploying organisations. The Commitment and Advancement indices generated by the TQ-SMART Model serves as an assessment and monitoring mechanism for TQM deployment organisations at the same time as an assessment mechanism for non-TQM deploying organisations wishing to identify their existing levels of quality initiatives. Quality Manager's can use this model as well as Senior Management, to assess their strengths and weaknesses on the deployment constructs necessary for the effective implementation of TQM.

A composite measure (BOPI) was developed based on economic and human resources dimensions. Traditional measures of the bottom line such as sales, profit and resource utilisation, while still is use, have declined in importance. Whereas studies (US GAO 1991) of twenty finalists of the Malcolm Baldrige National Quality Award showed that measured improvements in employee relations, operating procedures, customer satisfaction and financial performance can be achieved in companies that practice the principles of TQM, this study has equally shown that to be the case.

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Chapter Eight

Discussion of the Findings

CHAPTER EIGHT: DISCUSSION OF THE FINDINGS

8.1 Introduction

This chapter aims to give a brief review of the summaries drawn from the preceding Chapters and provide a discussion of the findings. The positive contribution to managerial practice by this study is highlighted and discussed research problems.

This Chapter is structured as follows; first, the potential applications and managerial implications of TQ-SMART Model are discussed. Eight specific areas of application are identified with the findings from pervious chapters brought together with specific illustrative examples, second the inadequacies of existing models are explored with particular emphasis on the contribution of TQ-SMART to Aim and Objectives of Study, shortcomings of other models and the interface between TQM and Assessment/Monitoring brought to the fore. The selection of the EFQM Excellence Model for comparison and the deployment constructs of the TQ-SMART are explained. Finally the analysis and implications of the study are drawn.

8.2 Applications and Managerial Implications of TQ-SMART

The current study makes a further positive contribution to managerial practice in at least eight ways. One of the major shortcomings of existing quality models have been their focusing level, but not strategic level.

This approach according to Leonard and McAdam (2002), limits the potential of TQM within organisations. As argued by Reed et al (1996), TQM is a business-level strategy with components of process and content that both demand attention.

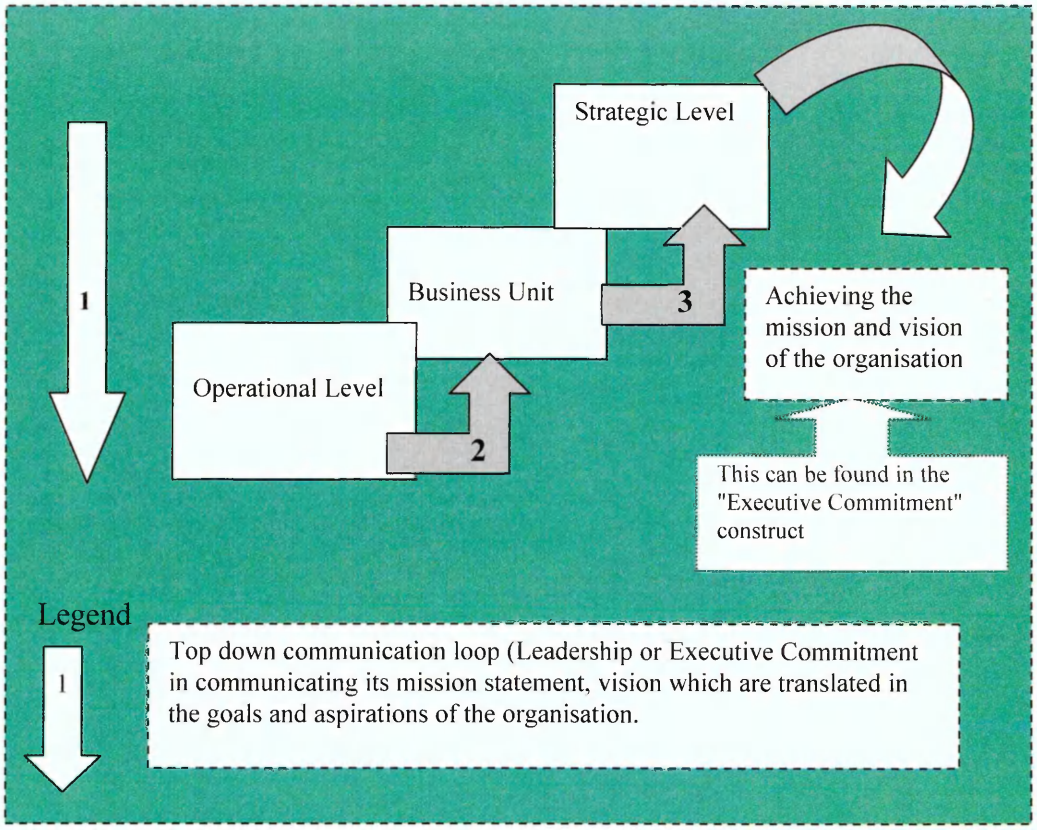

Figure 8.1: TQ-SMART at Different Strategic Levels

Depending on the nature of business, the business unit level would translate into the "how" to do it? For TQM Implementation to be successful, then it has to be at all levels. Chapter five explored this aspect in more detail. Communication is very important in the TQM philosophy, and a top-down approach is preferred. The results obtained from the matrix in comparing the TQM Implementation constructs and the organisation and business measures can be used as the 'down – up', as indicated by the arrow marked "1," to enable management to make decisions at all levels. Sousa and Voss (2002) pointed out a new direction for studies aimed at identifying important contingency variable, that distinguish between different types of organisational contexts and producing guidelines on which practices to emphasize in each of them. For example, are individual Quality Management Practices context dependent? In doing so extends the work of Sousa and Voss (2002) and Benson et al (1991). It confirms Taylor and Wright's (2003) assertion that TQM was likely to achieve more, if it was treated as a strategic business rather than merely an operational one.

The TQ-SMART Model has various implications for the UK Constructional related SMEs. These are depicted in the form of Figure 8.2. A brief explanation of each implication is summarised in this sub-section. Figure 8.2 is a response to Sousa and Voss (2002) who posed the following fundamental question; how to implement QM in a real business setting? They identified the pressing need to structure the current chaotic wealth of implementation advice, and produce more solid and useful advice to Managers (Sousa and Voss, 2002:109). The identification of the potential application in a simplified format contributes towards that goal.

8.2.1 Industry and Organisation Level Application

The TQ-SMART instrument can be effectively used by decision makers to measure the levels of TQM implementation by UK Construction related SMEs. This is possible, as the critical weight factors or factor loadings established, highlights the importance of each of the constructs and their associated activities. Therefore, the conceptual framework conveys a message of how limited Quality Management resources should be allocated (Flynn and Saladin, 2001). Additionally, according to Tan and Wisner (2004), knowledge of the interactions among the ten deployment constructs, can be a valuable diagnostic tool in addressing the effectiveness of each initiative alone to further enhance competitive success.

8.2.1.1 Industry

The TQ-SMART would assist organisations in understanding the linkages between practices and performance and help provide theoretical explanations as to why certain practices may work well in one context but not another.

8.2.1.2 Organisation Level

The model can be used to evaluate how different quality improvements are linked to Customer Satisfaction, Employee Satisfaction, Operating Indicators, Market Performance and Financial Performance. As Mohrman et al (1995) observe, the most popular external effectiveness measure is market share, which according to Juran (1991) is the fundamental test of a TQM effort.

8.2.2 Business-Level Strategy

In order to formulate a business-level strategy based on TQM, this entails both components of process and content demand attention. In this TQ-SMART model, the process part refers to the "TQM deployment constructs" and the content part as the "TQM outcomes". According to Reed et al (1996) Managers need to note that maintaining a focus on the content of TQM is as important as becoming immersed in its process. Performance benefits are achieved from a strategy that is dependant on both its content and the process of implementation and control.

8.2.3 Triple Role Application of the Total Quality Management Performance Index (TQMPI) Matrix

Given the business level described in section 8.2.2, the following sub section presents the triple role application of Total Quality Management-Performance Index (TQM-PI) Matrix as illustrated in Chapter Seven. The three level approaches are adopted as Quality Managers may have varying needs in terms of assessing the implementation of TQM.

8.2.3.1 - Level One: Measure or Total Quality Index (Simple)

The TQ-SMART factors form the basis of a TQ-SMART **Measure** or **Index**. For example, an overall score for each factor could be calculated as shown in

Chapter Seven. A simple sum of scores might be adequate. Such aggregation would have many practical benefits of using an existing TQM based system. A Total Quality Index (TQI) with respect to each of the ten factors can be computed for each UK construction related SMEs. The TQI for particular SMEs with respect to a particular factor is the average value (mean of the organisations TQM) of that factor score per item. These values have further potential for examining the inter-relationships between the constructs in the second-order factor analysis when employing structural equation modelling. The results of the TQI were computed in Chapter 7. The TQM values (TQI) for all the factors will give an overall picture of the level of TQM achieved by the organisation.

8.2.3.1-2 - Level One (b): Aggregation of TQI Factors: Yardstick Level

Managers within UK construction related SMEs can use these indices as a yardstick on which improvement efforts can be focussed.

8.2.3.2 Level Two: Measurement (Robust)

The Total Quality Management Performance-Index (TQM-PI) would allow SME's to measure how well they are performing the TQM practices, thus gauging the levels of competitive advantage and the Business and Market Performance Indicators. The Index would calculate an index score between 10 and 100, which for easy of clarity could also be visualised in the form of a radial advancement chart by computing the score to degrees. i.e. between 36^0 and 360^0 degrees.

8.2.3.3 - Level Three: Direct and Indirect Effects (Complex)

Using the Structural Equation Modelling to identify the contributory effects of each of the Ten Deployment constructs, towards organisation performance, enables the identification of direct and indirect effects on various levels of performance, an area found wanting when using correlation, or a series of multiple regression analysis. The direct and indirect contributory effects are obtained from the structural analysis results of the SEM. These coefficients are used to determine **Unit Contributions** of the ten deployment constructs towards Market, Financial and Organisational Performance. (Customer and Employee Satisfaction). Though the results show indication of a relationship between the process and outcome, difficulties in detecting the direct effects of TQM on organisational performance are taken on board. These were articulated by the seminal writing of Hackman and Wageman (1995) as measurement problems, exogenous disturbances and temporal issues which are described in more detail in the limitation section.

8.2.4 Assessment

Assessment of TQM levels leading into the following classification of High, Medium and Low. This is equally applicable to the Organisation Performance levels. This would be indicative of the position on the "Road Map". The testing of the linkages between the TQM factors could help to provide a roadmap for UK Construction related SME's, seeking to progress towards Quality Management. This would be achieved by identifying the TQM implementation constructs, strongly associated with the Business and Organisational Performance. Therefore, through the assessment of TQM levels and how it impacts the various components of BOPI, UK Construction related SMEs would be able to improve their effectiveness and efficiency thus realising the goals set out by the Egan Reports (1998 and 2002).

8.2.5 Rating

Rating is the same as classification, based on the rating factor. This results in classifying organisations based on the level of TQM Implementation where **'H'** is High, **'M'** is Medium and **'L'** is Low. This would in turn generate the profile along the TQM factors which would be useful to Managers for demonstrating the benefits of an existing TQM program.

8.2.6 Longitudinal Evaluation

Longitudinal evaluation ($time_1$ and $time_2$) of competitor's usage of TQM. This would be of benefit particularly for longitudinal studies in long term business plans.

8.2.7 Planning and Organisation

The TQ-SMART can be used to provide guidelines to UK Construction related SMEs for planning and organising their Quality Management initiatives. This research also tests the reliability and validity of the instrument developed by Powell (1995), which effectively is similar to the Action phase in the benchmarking process as identified in Chapter 5. This phase is characterised by implementation of plans, monitoring performance, reviewing benchmarks and replacing as needed. Given the importance of SMEs in contributing to the economy and in terms of employability, the analysis presented in this study provides clear sign posts on the "Road Map" to UK Construction related SMEs aspiring to become world class organisations. The study demonstrated that the ten deployment constructs were correlated, the Quality Managers, Decision Makers or Practitioners can analyse how their action plans impact other practices.

8.2.8 Benchmarking

The TQM scales can be used as a means of internal or external benchmarking.

8.2.8.1 - Internal Benchmarking

This can be used for the different types of benchmarking addressed in the study, the first being internal between the Strategic Business Units (SBUs) or Internal Benchmarking. Effectively the TQ-SMART is contributing to the second phase in the benchmarking process, namely that of Analysis by identifying gaps between company practice and industry-best practices.

8.2.8.2 Competitive Benchmarking

Figure 8.2 demonstrates and summarises how the TQ-SMART should be applied, the outputs potentially applicable to the UK Construction related SMEs and the field of Operations Management environment. The eight outer circles represent the potential areas of application and arranged in the same order as presented.

8.2.9 Identification of Areas of Improvement

This model can be used by Quality Managers as well as Senior Management to assess their strengths and weaknesses on the deployment constructs necessary for the effective implementation of TQM. The other significant contribution is in identifying the unused capabilities enabling the deployment constructs to be levelled. Constructional practitioners will be able to use this model to evaluate their TQM implementation so as to target improvement areas. This could be achieved through the findings of the inter-correlations between the factors in Chapter Six. Apart from Ahire et al (1996a), none of the earlier instruments provided the inter correlations between the factors or constructs used in their studies. Through the provisions of the relationship, this provides the evidence of treating the constructs as building blocks of TQM philosophy. (Won, 2000). Another area found wanting in terms of Quality Management research is the lack of interaction between Quality Management practices and with other sets of best practice. Chapter Six provides adequate evidence of the contribution made by this study in that area. From a managerial perspective, the TQM Advancement Radar (TQ-SMART) can be used at two different levels, which are industry and organisation to assess an organisation's level of TQM. The assessment results can be used on the industry level as a benchmark with competitors and other organisations that have achieved the "chartered" status. By identifying the strengths and weakness relating to the implementation of TQM, UK Construction related SMEs can better allocate their internal resources and provide better services to their customers. As evidenced by the findings of the Qualitative Analysis, usage of assessment mechanism helps identify the areas for improvement, as was the case for Organisation A which utilised the EFQM Excellence Model.

This research validates the proposals of Sousa and Voss (2002) who call for the integration of the content and process elements of the QM practices. The commitment and advancement indices generated by the TQ-SMART Model serves as an assessment and monitoring mechanism for TQM deployment organisations and at the same time as an assessment mechanism for non-TQM deploying organisations wishing to identify their existing levels of quality initiatives. The summary of the finding is that TQM deploying organisations were found to have a medium level of TQM implementation, whereas non-TQM deploying organisations were found to have a low level of TQM implementation. These findings are consistent with previous research by Quazi et al (1998), Flynn et al (1995) and Rao et al (1997) who found medium levels of TQM in the organisations they studied.

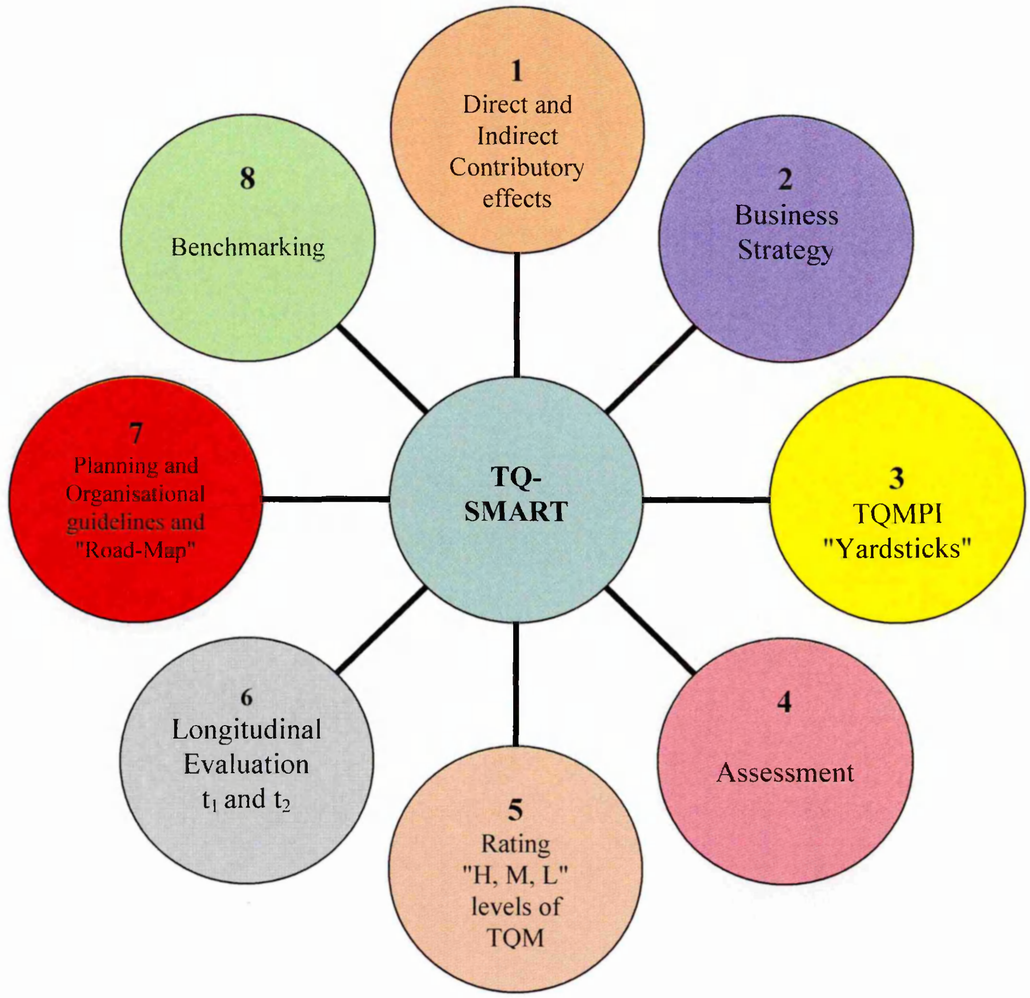

Figure 8.2: Application of TQ-SMART

8.3 Inadequacies of Existing Models

According to research by Yusof and Aspinwall (2000), numerous implementation frameworks found were not suitable and were not systematically developed for SME's. The frameworks could be classified into three types; Consultant, Academic and Award which are mostly based on descriptive and prescriptive models.

Biazzo and Bernardi (2004) identified three types of assessment logic as conformity, consistency and causation). This can be inferred as the question of what TQM "really is" has not interested the academia to a large extent (Hellsten and Klefsjo, 2000). The study contributes to the TQM literature by validating the direct and indirect relations among the TQM practices on organisation performance. Furthermore, the by product of this study is a refined version of the questionnaire constructed by Powell (1995) that can be used to measure and monitor the levels of TQM deployment among the UK Construction-related SMEs. This study contributes to the development of TQM theory by investigating the relationships between ten Quality Management practices and their effects on business and organisation performance.

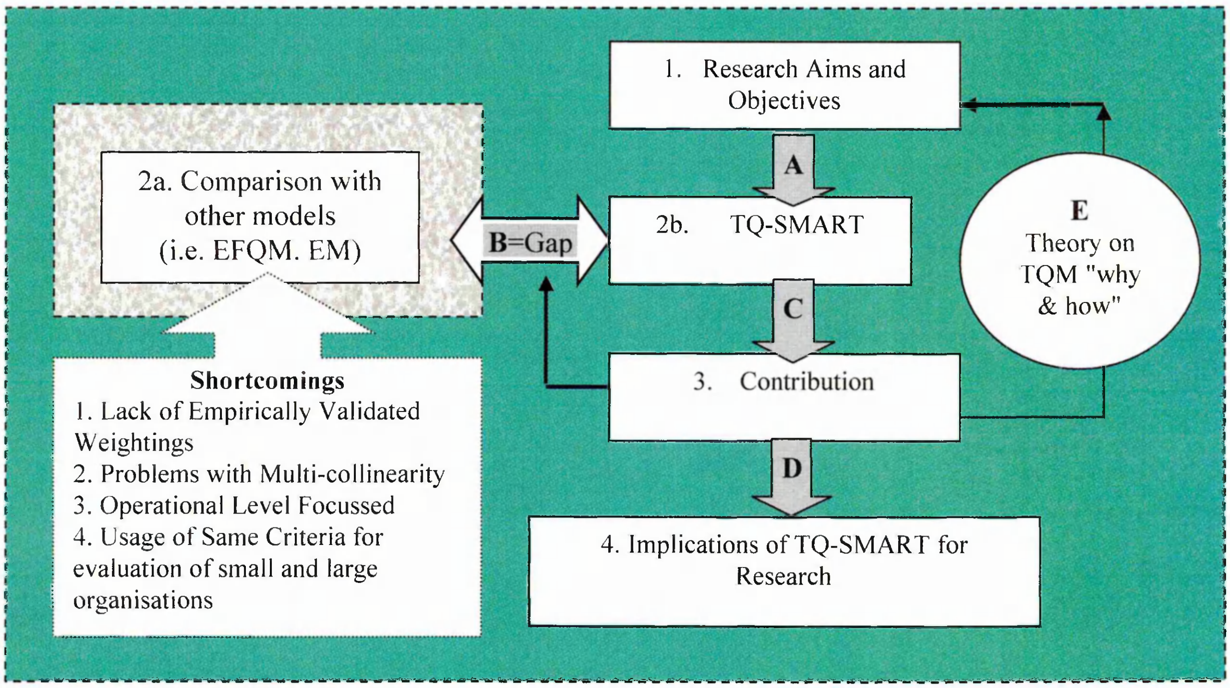

Figure 8.3: Contribution and Application of TQ-SMART in relation to other Models or Frameworks

8.3.1 Contribution of TQ-SMART to Aim and Objectives of Study

The TQ-SMART model has important implications for the management of the UK Construction-Related SMEs. In order to ascertain the contribution of the TQ-SMART Model to the research Aim and Objectives and the failings (if any) of other models that might be used, the linkages among the TQ-SMART and its implications for research is illustrated in the form of a flow chart shown in Figure 8.3. This Figure summarises the identification of the research gap and failings of other models and how the TQ-SMART contributes to the aims and objectives of the study. The first objectives of this research as outlined in Chapters One, Two and re-stated in this Chapter, was the identification of the major constructs of TQM and refinement of the scale for measuring the constructs. This is indicated as Path **A** in Figure 8.3, that is the process of translating the aim and objectives of the study and can be equated to the description phase or the 'what' part in the theory development process as illustrated in Chapter Nine, Figure 9.5. This involved a literature review and comparisons of other measurement instruments such as the one by Saraph et al, 1989; Ahire et al, 1996a; Black and Porter, 1996; Flynn et al, 1994.

The second objective of reviewing and evaluating the validated instruments to measuring Quality Management is also literature review based as well as the justification and rationale for the selected instrument. The formulation of TQ-SMART is also illustrated as a theoretical framework in Chapter Two.

The third objective of determining the differences in the Quality Management implementation was partly addressed in the case study and the quantitative analysis. As TQ-SMART is composed of ten independent variables, namely the TQM practices and the dependent variables in the form of the 15 business and organisation performance indicators, an examination of the differences was achieved through the discriminating functions which split the sample based on contextual factors such as TQM Maturity, Organisation size and whether implementing TQM or not. The groupings based on the discriminating functions were listed in Chapter Six, Tables 6.1, 6.2 and 6.13, which presented the summary of the discriminating functions. Based on the levels of TQM the "how" question was ascertained, and the case studies provided insights into the "whys", such as behavioural factors, structure, cultural and management issues. This was covered in great depth in both the qualitative, quantitative and triangulation approaches in Chapter Six.

Objective Four was achieved through the examination of the direct links TQM and Business and Organisation Performance indicators indicated by the Path **F** and **G,** and indirect links of **A→F, B→F, C→F,** and **D→F** as shown in Chapter Two, Figure 2.3.

Objective five was the identification of linkages between the attainment of a sustainable competitive advantage and the implementation of TQM, which are summed up in Chapter Nine, Figure 9.2, as the benefits of TQM would have to satisfy the conditions necessary for competitive advantage. Chapter Four provided the theoretical foundation for competitive advantage. Any shortcoming identified in the literature is designated by the arrow marked "**B**" linking the TQ-SMART and the Comparison in Figure 8.3 as the gap. Four specific shortcomings were identified from the literature, and the following sub section presents a critique of the same, and how TQ-SMART compensates for them.

8.3.2 Shortcomings of Other Models and Contribution of TQ-SMART

- **Lack of Empirically Validated Weightings**

The current weightings of the existing awards are never a true reflection of the relative importance of the categories. Furthermore, these existing models have focussed on large organisations mostly descriptive and prescriptive. Where the models are tailored for SME's, no focus on how to work out the used capabilities. The TQ-SMART model on the other hand is more robust and easy to apply. It appeals to both TQM and non-TQM organisations. Furthermore, the relation between award models and TQM is often quite diffused. The number of core values also differs between the award models and accordingly also the core values themselves (Hellsten and Klefsjo, 2000).

Given that the award model has influenced the practical implementation of TQM and their award criteria (i.e. Malcolm Baldrige National Quality Award in the USA, EFQM Excellence Model in Europe, Deming Prize in Japan, Austria Quality Award in Austria and more recently the South African Construction Excellence Model, SACEM), it is hardly surprising that confusion has arisen.

Another criticism of existing quality models is mainly to emphasise the operational level improvement attributed to TQM, while lacking representation of TQM at the strategic formulation level (Leonard and McAdam, 2002). Accordingly, it becomes necessary that the relationship between constructs and weighing scheme be tested and validated.

- **Problems with Multi-Collinearity**

Chapter Seven highlighted how TQ-SMART is intended to contribute further to building a theory on TQM. This is achieved by empirically validating TQ-SMART through the usage of Structural Equation Modelling (SEM) to assess the actual factor loadings (λi) and their associated measurement errors. This eliminates the problems of Multi-Collinearity between the enablers and results part of the EFQM Excellence Model. According to Kline (1998), multicollinearity occurs because what appears to be a separate variable, actually measure to the same thing.

As observed by Dahlgaard and Nilsson (2003), the Quality Management practices used in organisations are strongly correlated with one another; as such the relationship between the enablers and results of the EFQM Excellence model is obscured due to multi-collinearity problems. On the other hand, usage of structural equation modelling as demonstrated in Chapter Six, Figure 6.12 can employ tests such as checking the factor correlation matrix for coefficients with values greater than 0.8 which demonstrates the absence of multi-collinearity among variables.

- **Operational Level Focussed**

Leonard and McAdam (2002) observed that most of the existing models are operational level focussed. There is a need for models to be used at the strategic level in terms of planning and longitudinal planning.

- **Usage of Same Criteria to Evaluate Small and Large Organisations**

The EFQM Excellence Model has since started developing a model targeted for small-sized organisations.

8.3.3 Interface between TQM and Assessment / Monitoring

From literature review on TQM and Assessment/Monitoring mechanisms, it was established that despite the existence of models incorporating the principles of continuous improvement via the PDCA cycle (Plan, Do Check and Act) are necessary for TQM principles to flourish. However, the existing models were found to be prescriptive and descriptive. The present work explicitly discusses the interface between them and successfully links the aspect to monitoring and assessment to the success in the implementation of TQM principles. Both the 'Results' and 'Approaches' elements related to the Plan stage of Deming's control cycle, see Figure 8.4. Matching of Plan, Do, Check and Act Cycle with TQ-SMART. 'Monitoring' and 'Improvement' cover the 'check' and 'act' components of Deming's Cycle, whereas the 'Plan' and 'Do' are covered by the' Deploy' and 'Assessment'.

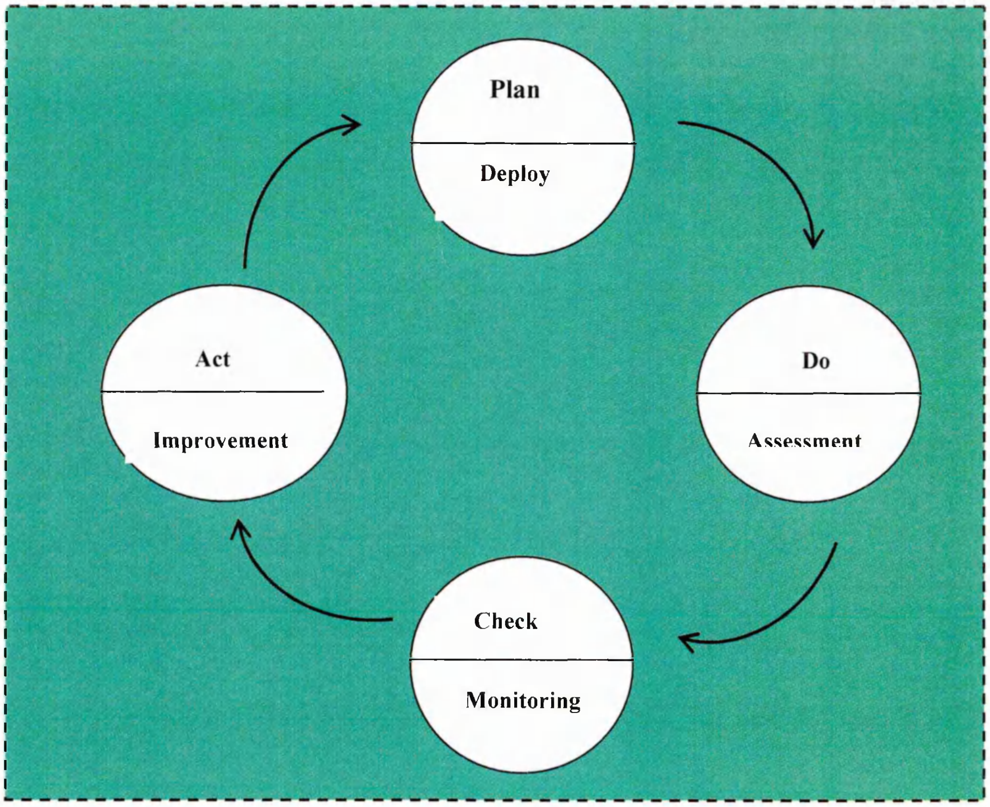

Figure 8.4: Matching of Plan, Do, Check and Act Cycle with TQ-SMART

8.3.4 Selection of the EFQM Excellence Model for Comparison

Usage of the EFQM Excellence Model is widely reported by various researchers (Azhashemi and Ho, 1999; Waterhouse and McCabe, 1999; McCabe and Robertson, 2000; Eskildsen et al, 2001; Dale et al, 2000; Samuelsson and Nilsson, 2002; Li and Yang, 2003; Watson and Chileshe, 2003a, and Watson and Chileshe, 2003b). Furthermore, several authors as citied by Biazzo and Bernardi (2004) have identified the EFQM Excellence Model and Malcolm Baldrige National Quality Award (MBNQA Model) as having the greatest conceptual value and the most importance in respect of their impact on self assessment practices. Adebanjo (2001) asserts that business excellence and quality complement each other, and should co-exist. The EFQM excellence model is the most widely used among organisations in Europe and can be used for a number of activities, where organisations assess themselves in order to identify where to focus improvement activity. For the purpose of this thesis, the EFQM is used "as a defector model of what is TQM and what is not". However, caution is exercised because the EFQM Excellence Model has not been empirically validated. Therefore, it has only been used as a comparison rather than because of its components as TQM Constructs. Flynn and Saladin's (2001) work on the Malcolm Baldrige National Quality Award (MBNQA) is a clear example on the dangers of taking such a route. Chapter Seven provided a comparison of the TQ-SMART and the EFQM.EM; in particular the TQ-SMART was juxtaposed on the EFQM.EM original model in order to highlight any similarities and differences. The fundamental differences between the awards based, such as EFQM and the survey approach to self-assessments used in this study are demonstrated.

8.4 Deployment Constructs of the TQ-SMART

A TQ-SMART model was then developed consisting of 34 independent variables (items). The 34 items were selected from the twelve-implementation constructs developed by Powell (1995), for the manufacturing industry. The 34 items of the TQ- SMART Model loaded on a single TQM factor. Content validity is supported by comparing the ten implementation constructs with the models from the literature. For example, the TQM practices identified by Black and Porter (1996), Ahire et al (1996a), Flynn et al (1994) and Saraph et al (1989). Each item in the TQ-SMART model was measured by using a five-point Likert type scale. The construct validation process included the reliability analysis, which was used to check the internal consistency. Construct validity pertains to the degree to which the measure of a construct sufficiently measures the intended concept. The reliability assessment adopted in this research is the Cronbach's Alphas (α.) Coefficient. This is generally accepted as one of the most popular methods for assessing reliability, (O'Leary-Kelly and Vokurka 1998). This study considers the different components of construct validity - unidimensionality, reliability, and convergent and discriminate validity. The internal consistency of the TQ-SMART model had a coefficient cronbach alpha of 0.934. Therefore, the 34 items of the TQ-SMART model were accepted as having good interrelationship between them, indicating that the TQ-SMART model was reliable.

8.5 Goodness of Fit of the TQ-SMART Model

This involves the examination of residuals: the differences between the actual (observed) and fitted values. The values obtained indicate(s) a goodness of fit. Various methods exist for determining the Goodness of Fit of any model. Notable among them are adjusted Goodness-of-Fit Index (AGFI), Bentler-Bonnet Index (B-BBI) also known as the Normed Fit Index, further explanation of which was provided in Chapter Seven. Goodness of Fit is defined by Field (2002) as the degree to which a statistical model represents the data collected. For example this can fall into three categories namely: Good fit, Moderate and Poor fit. Therefore the primary task in this model testing and model validating procedure was to determine the goodness of fit. In order to assess their unidimensionality and internal consistency, the ten scales were subjected to ten limited information factor analyses (Anderson and Grebing, 1998). The value obtained for the model was $(\chi^2 / df) = 2.57$ which is less than 3.00 indicating a good fit. Criterion validity was achieved by the correlations of the deployment constructs with the organisation performance measures. Accuracy of the goodness of fit, probably is the most important criterion. The accuracy uses evaluation of the degree to which the models provide a satisfactory description of the data.

8.6 Validation of the Implementation and Deployment Constructs of TQ-SMART

To examine the content validity of the deployment factors of the model, critical incidents were obtained from the three organisations (one TQM and Two non-TQM). Through the three incidents, it emerged that the application of all the deployment factors and constructs are necessary for organisations to achieve TQM. Executive Commitment was the essential component; however, organisations could either be Supplier Focus, Customer Focus or Human Resources Focussed, with mild application of the "hard" issues such as training, benchmarking and statistical process control activities. As McCaffer and Edum-Fotwe (1999) posits, issues that have driven research in Construction Management can be categorised into hard and soft factors, and research has shown that for TQM, there is an over reliance of soft factors such as Executive Commitment as opposed to the hard factors such as the usage of SPC. The findings of this study confirm that most of the TQM deploying organisations scored highly on the soft factors. Furthermore, these findings are consistent with those of Taylor and Wright (2003) who found the number of customers a firm dealt with did not affect the degree of success from TQM. The validation of the measurement model was conducted using responses from the wave of the surveys received. The test found that the measurement model replicates across independent samples of the same population, which would address the issue of non-response bias.

8.7 Analysis and Implication of the Study

The emerging picture is that constructional related SME's can align their TQM application into one of the following areas;

- Customer Oriented TQM
- Supplier Oriented TQM
- HRM Oriented TQM
- Process Oriented

Similarly, Forza and Filippini (1998) identified the following five concepts which constitute TQM levers as;

- Orientation towards quality
- TQM links with customers
- TQM links with suppliers
- Process Control
- Human Resources

Montes et al (2003) classified the elements considered among academics and practitioners as to which elements implemented in the organisation when TQM is set up into five large blocks. These are:

- Managerial leadership and commitment
- Human Resources Management
- The relationship with customers and suppliers
- The internal culture of the organisation
- The Process Management

Escrig-Tena (2004) deduced four dimensions that represent a minimum common denominator of TQM principles and practices as follows:

- Customer Orientation (CO)
- Continuous Improvement (CI)
- Focus on People (FP)
- Global vision of the organisation (GV)

These four dimensions were deemed to be interrelated and mutually support each other.

The findings of this study can equally be oriented to the above five concepts. The following sub sections now demonstrates how the five concepts as identified by Forza and Filippin (1998), and the five large blocks (Montes et al, 2003) and the four dimensions as advocated by Escrig-Tena (2004) are addressed in this study. Furthermore, the five concepts, large blocks and four dimensions all match with four major principles for successful implementation of TQM, established by the well-known pioneers of TQM such as Deming, Juran, Crosby and Ishikawa. The four principles are:

- Top Management Commitment
- Employee Involvement
- Supplier Participation and Quality Program

According to Lee (2004), the third and fourth requirements are heavily related to the relationships with customers and suppliers. Accordingly, in their relationships, the SMEs may be at a disadvantage to large organisations because they do not have as many resources or as much influence. Having classified the broad areas of where SMEs can align their TQM applications, the following sub section now presents the findings of the study by matching the five concepts which constitute TQM levers, building blocks and four dimensions.

1. Orientation towards Quality

The following constructs as used in this study addresses the issue of orientation towards quality. These are; Executive Commitment (EC), Zero Defects (ZD) and Adopting the Quality Philosophy (AP). There is clear evidence that these are the most important factors for the implementation of TQM as evidenced by the high scores achieved for both types of organisations. This is consistent with the management theory on Leadership and the teachings of the Quality Gurus like Deming (1986), Crosby (1979) and Juran (1989, 1991) who believe in such philosophies like “Quality is Free”, and “Do it Right the First Time". Deming approaches the problem of Quality Management from a statistician's perspective "Improving quality in manufacturing through the usage of SPC". Both statements attributable PIC, Juran proposed three basic processes; quality control, quality improvement and quality planning.

2. TQM Links with Customers or Customer Focus

The TQM links with customers can be matched with the customer focus construct as used in this study. The application and importance of "customer focus" was recognised by both TQM and non-TQM organisations in this study. This is evident by the ranking achieved (Rank 2) for TQM deploying and (Rank 3) for non-TQM. This finding is consistent with literature. For example Tsang and Antony (2001) ranked customer focus 'first' out of the 11 factors used in their study of UK Service organisations. The fact that the study was conducted within the service organisations, drew similar results with this research conducted within Construction highlights the importance of Customer Focus regardless of the industry.

3. TQM Links with Suppliers or Supplier Focus

The application of supply chain management within the industry is still slowly being implemented. In particular the focus is more towards customers than suppliers. The findings are consistent with literature on service management which notes that supplier development and management is not as critically important for service organisations as it is for manufacturing organisations, (Tsang and Antony; 2001) though creating long-term relationships can lead to increasing the competitiveness. The findings of this study from both the qualitative and quantitative approaches provided mixed findings. However, the statistical analysis found only 50% of the respondents reported benefits of increased supplier relationships; the case studies were all in agreement. As pointed out by Hackman and Wageman (1995), at least 50% of TQM organizations collaborate with their suppliers in some way to increase the quality of component parts.

4. Process Control

One of the concepts identified in the precepts of TQM in Chapter One (Figure 1.3) was that of Continuous Improvement. According to Sun et al (2004), this is one of the principles of TQM. They further state that in TQM, it is that all work is a process, and problem-solving processes are a continuous cycle of opening one's mind to a wide range of possible solutions. As demonstrated earlier in this thesis, process control or process management constitutes the core elements or hard factors of TQM and the element representing them are those of Benchmarking, Measurement and Zero Defects

- **Benchmarking**

Constructional related SMEs have not embraced this concept entirely. While acknowledging that it is suited for manufacturing organisations, it is recommended that they adopt at least one type of benchmarking, (be it generic) where they can learn from other industries. McCabe and Robertson (2000) found benchmarking as a concept which construction organisations could use in order to achieve radical changes resulting in significant improvements.

- **Measurement**

It is evident that there is a lack of implementation of the measurement construct, in particular, the practice of SPC and its underlying tools and techniques regardless of TQM implementation or not. There is also a lack of training managers and employees in the usage and understanding of SPC aspects, despite the concerns raised by various authors such as Oakland (1993) and Dale (1994) who have argued for SPC training and education which has a prerequisite for a successful TQM implementation, this area has been found wanting.

5. Human Resources

The human resources as used in this study is similar to Human Resources Management, and includes such constructs as 'Training and Education', Employee Empowerment', Employee Involvement as used by Sureshchandar et al (2001) in their study of the service industry in India. An effective HRM system can lead to a sustained competitive advantage through the creation of knowledge stocks at individual levels, which is human capital (Ordonez de Pablos, 2004:475). UK Construction-related SMEs must put more emphasis on human resources management as it plays an important role in sustaining competitive advantage through the socialising of employees (Escrig-Tena, 2004). Smith and Whittaker (1998) suggest that where SMEs do not have the capacity to employ HR and training specialists; therefore they need specialist advice which they can buy in. As observed by Cassell et al (2002), there is a lack of attention within the HRM practices within SMEs despite having a sample of 100, only 7% were from Construction, where as the majority were from Manufacturing (Engineering). As outlined in Chapter One, Construction as an Industry usually lags in terms of Management Research.

- **Training**

This is one area of concern between the SME's. Despite the advocated benefits of training as illustrated in the Egan (1998 and 2002) reports, constructional related organisations have been found to be slow in embracing this concept. One way forward is as suggested by Love et al (2002), Organisations must integrate learning within day-to-day work processes, in such a way that they not only share knowledge and continuously improve, but also, operate efficiently in response to their changing environment. Despite the advantages that SMEs have in terms of small work force which would make it easier for training and education of workforce (Ahmed and Hassan, 2003). Furthermore, as supported by Tannock et al (2002), the majority of people who do not hold any formal business qualifications operate a large proportion of SMEs. Though this was a perspective from the Thai manufacturing SMEs, the findings of this study showed that the training constructs in both TQM (mean = 2.65) and non-TQM organisations (mean = 2.55), on the variable levels, the item "training management in quality principles" was the least ranked by both types of organisations as evidenced by their RAI, TQM (TR_{rai} = 0.57, rank = 23rd) and non-TQM (TR_{rai}= 0.57, Rank = 22nd). Yusof and Aspinwall (2000) argue that being *ad hoc* and small in scale can actually hinder the improvement effort, whereas they still face a shortage of learned workers (Nwankwo, 2000). Training should be considered as primarily a vehicle for implementing and reinforcing quality practices. (Lemak and Reed, 2000). The training construct used in this study focussed on management training in quality principles, employee training in quality principles, problem-solving skills and training in teamwork. This according to Lemak and Reed (2000) is the usage of training for a myriad of other purposes. The training issues are not only applicable to SMEs, but large firms as well. McCabe (2004) argues that training should go beyond the norm of 'on the job' supplemented by educational courses, but through further development of people.

- **Open Organisation**

There is evidence of a strong culture environment among the Non-TQM organisations based on the mean scores. For non-TQM this was ranked second, as compared to the TQM deploying organisations which achieved the 5th rank.

- **Employee Empowerment**

The involvement of employees in designing and planning, an active employee suggestion system including autonomy in decision-making can advance and help the implementation of TQM. These "hard" factors such as usage of graphs and charts to measure and monitor quality would help employees progress their Quality Initiatives and Zero Defects.

8.8 Summary

Chapter Eight provided a discussion of the findings. The findings of the sub section relating to the application of TQ-SMART at different organisation levels are of particular importance to Managers of UK Construction-Related SMEs. The following Chapter concludes the thesis by providing the conclusions and recommendations.

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Chapter Nine

Conclusions & Recommendations

CHAPTER NINE: CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

This chapter aims to give a brief review of the research problems. The methodology summarises the major research findings and identifies the inadequacies of existing models. Present the application of the proposed model at the organisational and industry level and provide the managerial implications as well as a critical analysis and implications of the study.

Limitations of the study in terms of construct and external validity, sample restrictions are presented. The second purpose of this Chapter is to summarise the key conclusions with reference to the specific research objectives identified in Chapters One and Two and also reproduced in this Chapter in sub section 8.4. This chapter will be concluded by a summary of the contribution which has been made to current knowledge together with a number of recommendations for further research. The contribution to knowledge through the application and theory development of Quality Management is highlighted through the following; discovery, mapping, relationship building and theory validation purposes.

9.2 Research Problem

An extensive literature review indicated that little research had been conducted in the development of diagnostic tools, enabling organisations to customise their TQM implementation efforts (Ghobadian and Gallear, 2001). One of the objectives of this research was to develop a TQM generic model focussing on the assessment and monitoring aspects of TQM initiatives. Therefore, the research problem focuses on finding the extent of TQM deployment between both UK Construction-related SMEs, TQM and non TQM organisations. The research explores further, how advanced organisations are in terms of observing the TQM constructs and principles established from the literature review as being necessary for TQM implementation.

9.3 Research Methodology

The study has adopted the triangulation approach, which is a combination of both the qualitative and quantitative approaches. This was to achieve a complimentarily between the two approaches and provide deeper insight into the research question. This involved four different stages, namely; exploratory, descriptive, empirical and analytical research. The quantitative data is seen to provide descriptive patterns. The stages are explained as follows:

Exploratory – this stage involved an extensive literature review on the TQM and management writing. This aimed to establish the critical success factors necessary for the implementation of TQM, identification of advocated advantages associated with the implementation, measuring the success of TQM akin to the assessment of performance and the assessment of the competitive environment. Another objective was to review the existing models of implementation and identification of their inadequacies in terms of assessment and monitoring.

Descriptive refers to studies that are designed to provide a "snap shot" of the current state of events related to an operations management phenomenon, in this case, TQM. This stage led to the empirical, in which a questionnaire was developed and conducted among the Quality Managers of Small and Medium sized UK Constructional related organisations. It aimed to establish critical success factors and the rate of deployment of TQM principles. Both TQM and Non-TQM organisations were included in the sample. Further in-depth interviews and case studies were conducted in three organisations to further explore the application of TQM and Quality initiatives within their organisations. Both TQM and non-TQM Organisations used the method of frequency to examine the deployment of TQM constructs. Generally, these studies do not conduct formal tests of hypotheses other than a test of differences between groups for descriptive purposes.

Confirmatory (or theory testing) survey research - The data collection carried out in the descriptive stage was used with the specific aim of testing the adequacy of the TQM concepts developed in relation to the phenomenon, and the hypothesised linkages among the TQM concepts. Structural Equations Modelling (SEM) approach was employed using the AMOS software to translate these identified relationships into structural equations. The confirmatory stage of the study could be equated to the second step in the development of empirical theory, which was enhanced in the depiction of relationships in diagram form thus providing a visual aid for the interpretation and development of theory.

The empirical research involved subjecting the TQ-SMART to structural analysis. Based on Structural Equation Modelling using the AMOS Software, the structural analysis produced "factor loadings" that represented the strength of causal connection between the models independent and dependent variables (constructs). The factor loadings were used to determine the unit contributions of each construct towards business and organisation performance. In addition to testing the validity and reliability of the TQ-SMART through Confirmatory Factor Analysis (CFA), the structural equation modelling (SEM) was utilised to verify the construct validity of scales and to test relationships among variables and unobservable variables. SEM was used to determine the relative influence of each of the ten deployments constructs on the quality manager's perception of the overall Business and Organisational performance.

Relational - Refers to studies that are designed to empirically examine relationships among two or more constructs or variables in either an exploratory or a confirmatory manner. Studies that fall into this category specify propositions or hypothesis a priori to give subsequent empirical analysis. Chapter Two provided the hypothesised relationships in form of the theoretical conceptual framework. Examples of such studies are by Saraph et al (1989) that defined and operationalised eight critical factors underlying quality management.

9.4 Research Objectives

Prior to the presentation of the major research findings and the conclusions, it is initially appropriate to re-state the six research objectives as previously presented in Chapters One and Two:

(i) To identify the major constructs of Total Quality Management (TQM) and refine the scales for measuring the constructs.

(ii) To review and evaluate validated instruments used to measure Quality Management within the Manufacturing and Services Industries.

(iii) To determine if they are any differences in Quality Management implementation and quality outcomes across UK Construction related SMEs, and if so, how and why they differ.

(iv) To investigate the relationships among TQM practices and to identify the direct and indirect effects of TQM practices on the various dimensions of performance.

(v) To identify the linkages between attainment of a sustainable competitive Advantage and implementation of TQM.

(vi) To develop an operational framework of TQ-SMART that is theoretically grounded. Draw conclusions and empirically validate the model developed.

9.5 Major Research Findings

Too often many small and medium sized organisations decide not to adopt the Quality Management principles while inherently exhibiting some of the quality initiatives. As specified by Parkin and Parkin (1996), although many SME's (in the UK) like and agree with the ideas of TQM, they are not willing, or sufficiently competent enough to implement them effectively. This proposed model is designed as a monitoring tool for organisations which currently implement TQM. It is also an assessment mechanism of non-TQM organisations that wish to identify the levels of quality initiatives, prior to making a decision on whether to formally adopt TQM implementation.

The major objective of this research was to concentrate on the "Content" aspect of the Implementation Issues i.e. "**what** to do"?. Another objective was to develop a reliable and valid measure of TQM advancement level within the UK Constructional related SME's. As stated by Lemak and Reed (2000) and Reed et al (1996), there has been almost exclusive focus on the "process" or "how to" issues in TQM.

Though various assessment models exist, and literature has examined issues such as organisations needing to identify the unused capabilities, there are lack of formal methods of working out the unused capabilities or conducting empirical studies undertaken to test the validity of the measures. Of the earlier instrument, only Ahire et al (1996a) examined the causal relationship among the TQM factors.

9.5.1 Organisational Size and Level of Total Quality Management

The TQ-SMART Model takes into account the size of the organisation in determining which of the Implementation constructs needed further consideration. Ahire and Golhar (1996) found that size does not have an effect on the implementation of TQM, however, no cut off point has been suggested, as to the minimum number of employees required before an organisation can embark on a formal TQM implementation program. This research posits that there are differences in the weights attached to the implementation constructs. The SME's organisations should be further classified into the macro, micro, small/medium and an adjustment factor applied to the Implementation Constructs. Due to the number of organisations in the sample, only the small-sized and medium sized organisations were considered. On the contrary, Mann and Kehoe (1995) found small organisation to have a lower difficulty of implementing TQM as opposed to Larger Organisations.

9.5.2 Transferability and Applicability of Instruments within the Construction SME's

The major contribution of this research, is the transferability and applicability of the implementation construct from manufacturing and service to the specific construction settings. It is unique in the sense that a non-construction model has been utilised and validated, therefore, confirming the external validity. The study also contributes to TQM research by applying the constructs used in a manufacturing setting to the construction environment. Another area of contribution to the body of TQM knowledge is that the TQ-SMART will assist organisations to customise their TQM implementation efforts. This area has been found wanting according to Ghobadian and Gallear (2001). Another important aspect is the contribution to Flynn and Saladin (2001) work on the validation of the relationships between the constructs and weighting schemes. As these excellence models and self assessment models are usually tailor made for large organisations, the findings of this study in terms of the constructs that are less practised by SME's, lends weight to the revised TQM Constructs for SME's.

One obvious omission is the construct and principle of adopting the philosophy whose practice of entering the EFQM Excellence Model award is clearly less favoured among the UK Construction Related SME's, whether Implementing TQM or not, though the non-TQM regard it as the 'de-facto' model.

9.5.3 Classification of Organisations based on TQM Levels

This study further validates and supports the findings by Ahire et al (1996b) in the classification of organisations based on the extent to which they embrace the TQM philosophy. The study also demonstrates that UK Construction organisations claiming to be deploying TQM could be no different from those stating not. The proposed classification based on the advancement indices, is of practical importance as it provides a more robust and clear picture of the state of the organisation in terms of implementing the TQM constructs. As recently observed by Martinez-Lorente and Martinez-Costa (2004), enquiring if Managers are applying TQM within their companies, or not, has two problems; some companies that declare that they follow a TQM policy may be far from real TQM companies; and some companies that do not follow a TQM policy officially may be real TQM companies in practice.

Even though the study in question was conducted in the Spanish industrial companies, the problem raised by the study is universal; hence the classification proposed in this study and explained in the following sub section is meaningful and contributes to the classification of organisations. As evident from the various definitions propagated by the Quality Managers, there is no formal definition of what constitutes TQM. Therefore, one organisation could concentrate on customer focus construct and pay less attention to benchmarking. In short, SME's should tailor the Quality Management Methodology to exploit its unique strengths, and focus on its particular weaknesses.

One of the major limitations on TQM research has been the exclusion of non-TQM organisations in the sample. This study redressed this imbalance by including non-TQM deploying organisations. Through a comparison of the various elements of quality initiatives employed or implemented in TQM and non-TQM deploying organisations' it has been possible to classify or identify the alignment of organisations based on hard aspects of TQM deployment constructs such as statistical applications. This study also lends strong support to previous research on TQM Implementation issues. It acknowledges the importance of classifying organisations, not on a Yes/No response to whether organisations are implementing TQM, but a meaningful spiral approach of continuously assessing their current status in terms of commitment and advancement of quality initiatives. This in turn provides the answer to the second type of assessment necessary for the measurement and assessment of TQM activities and outcomes as stated in the seminal work of Hackman and Wageman (1995). Chapter one outlined the necessary types of the assessment required in form of a flow chart. This study extends the work of Martinez-Lorente and Martinez-Costa (2004).

9.5.4 Relative Importance of the Constructs of Total Quality Management

This study presents a simple and yet robust method of assessment and monitoring of organisations quality related initiatives. It acknowledges that the degree of importance attached to the ten implementation constructs may vary across organisations, therefore requiring them to adjust the implementation mode according to their focus. This is clearly demonstrated through the application of Critical Weight Factors (CWF) which differed by organisation size or maturity. Furthermore contrary to the assertion that TQM implementation varies by maturity, this study found this not to be the case for the following constructs, namely executive commitment, training and supplier focus, instead there was a marked "degree of decline". Therefore the theory of maturity with time, the organisation is expected to learn more in terms of deploying the TQM constructs was discounted on the following constructs namely Training, Supplier Focus and Executive Commitment. As asserted by

Thiagarajan and Zairi (1997b), the contribution to the understanding of the relative importance of individual elements can only be achieved by covering the theory, concepts and application of Total Quality Management within UK Construction-Related SMEs.

9.5.5 Confirmation of the Factor-Importance-Structure (FIS)

The mapping purpose which is the product of the empirical generalisation process step identifies the factors that are important, whereas the relationship building provides structure. Thus in this sub section, the main purpose will be to demonstrate how this study moved from the discovery stage to that of description and the remaining stages where appropriate. It must be pointed out that various authors (Behara and Gunderson, 2001; Dale et al, 2000; Handfield and Melynk, 1998; Filippini, 1997) have alluded to the fact that Quality Management research is still in its embryonic stage (i.e. the discovery stage), therefore any movement beyond that can be equalled to the contribution of knowledge in the TQM theory and development. This movement on the contribution to knowledge is illustrated in Figure 9.5.

9.5.6 Potential Application of Benchmarking

The model can be used as a benchmark (Industry Mean) for organisations to compare themselves against the best. Given the growing importance of SME's within the industry and their high contribution to the overall GDP of the economy, this study provides clear, visible landmarks for those constructional organisations aspiring to achieve "Chartered" status by identifying those TQM constructs strongly associated with the achievement of high performance measures. However, they must accept the holistic approach rather than the piece meal tendencies shown by SMEs. Other potential applications of the study are illustrated in Chapter 8, Figure 8.2.

9.5.7 Relationship Between TQM and Business and Organisational Performance

The study also confirms that higher levels of customer satisfaction (i.e. overall satisfaction, few customer complaints and greater customer retention) and organisation and business performance are linked to the deployment of TQM. This is evident from the TQMPI and the results from the structural equation modelling in which customer satisfaction had the highest (stronger) factor loadings.

Although the relationship is relatively strong between TQM and overall organisational and business performance, that between TQM and Market share, Sales per Employee, Return on Assets, Internal and External Efficiency is not very strong in the UK Construction Industry. This seems to suggest that the overall business performance which is the composite measure of the primary and secondary measures is a better measure of performance for the UK Construction-related SMEs.

One of the interesting findings of this study was that, contrary to literature (with the exceptions of Powell, 1995, Hendricks and Singhal, 2001), Adopting the Quality Philosophy, Supplier Focus and Training did not contribute to any one of the four business and organisational performance indicators or their fifteen associated variables. As expected, Customer Focus had the strongest correlation and significant links with the overall Business and Organisational Performance Indicator. This finding is consistent with that of Anderson and Sohal (1999) who investigated the relationship between Quality Management practices and performance in small businesses.

9.5.8 Impact of EFQM Excellence Models on Construction-Related SMEs

Further, there is no evidence to suggest that entering an EFQM Excellence Model Award is necessary for the successful implementation of TQM.

Therefore, Constructional related SME's can channel their organisational energies on more pressing matters.

The findings do not indicate whether entering an EFQM EM award is necessary for successful implementation of TQM although previous research by Waterhouse and McCabe (1999) found that the usage of the Business Excellence Model demonstrated which organisations have achieved demonstrable success in business excellence. However, findings from the case studies presented a different rationale for adopting the EFQM Excellence Model, it was viewed as a replacement for TQM.

The results of this part of the study can also be compared to that of Hewitt (1997) which stated that small firms lack interest in using Quality Award Models in self-assessing their Quality Management. Similarly, Wilkes and Dale (1998) found that SMEs are generally aware of the existence of the EFQM EM model, but do not fully understand how they can derive benefits from self-assessment against it's criteria. Furthermore, the existing EFQM Excellence models provide only prescriptive and indicative roadmaps for organisations to follow but fail to provide a complete coverage of TQM concepts, holistic measures of business excellence and the validated linkages between the TQM practices and business and organisational performance.

9.5.9 Levels of TQM within Construction-Related SMEs

The findings further revealed a medium level of TQM implementation among the self acclaimed TQM deploying organisations, and a low level (overall indicator of 2.50) for non-TQM deploying organisation. A further comparison was made between the application of hard and soft aspects of TQM in Appendix D, (Table D15, page 23) and Chapter Six, and through the application of SEM. Both types of organisations scored more on 'soft factors' compared to 'hard factors'.

These findings are consistent with Powell (1995), Flynn et al (1994) who reported similar results. For TQM deploying organisations, the top four constructs were executive commitment, customer focus, zero defects and adopting the philosophy. There were indications of high correlation among the TQM constructs and evidence or indication of the extent to which they contribute in finding the right "structural mix". This cross-sectional data shows that TQM deploying organisations have medium levels of TQM and that it leads to improved efficiency and effectiveness, however the improvements over time need monitoring. This can be achieved by using longitudinal case study approach in a number of SMEs, to reveal the pattern of improvement over time. complex as TQM, involving the view point of multiple actors over time. Taylor and Wright (2003) have used this approach though the limitation section in the first Chapter provided further evidence of the caution that should be exercised.

9.5.10 Antecedents and Consequences to Total Quality Management within Construction-Related SMEs

The following were identified as antecedents and consequences as illustrated in Figure 9.2 where antecedents are organisation factors that can enhance or impede the implementation of TQM. The following category is used for the classification of the antecedents: behavioural factors, structure, cultural constraints and management issues. The consequences which form part of the TQM outcomes were based on the Business and Organisational Performance Indicators. The study took into account the analysis of Time-lag between the implementation and benefits of the improvements. In essence, the model shown in Figure 9.2 sums up the findings of this thesis

Qualitative and Quantitative Approaches

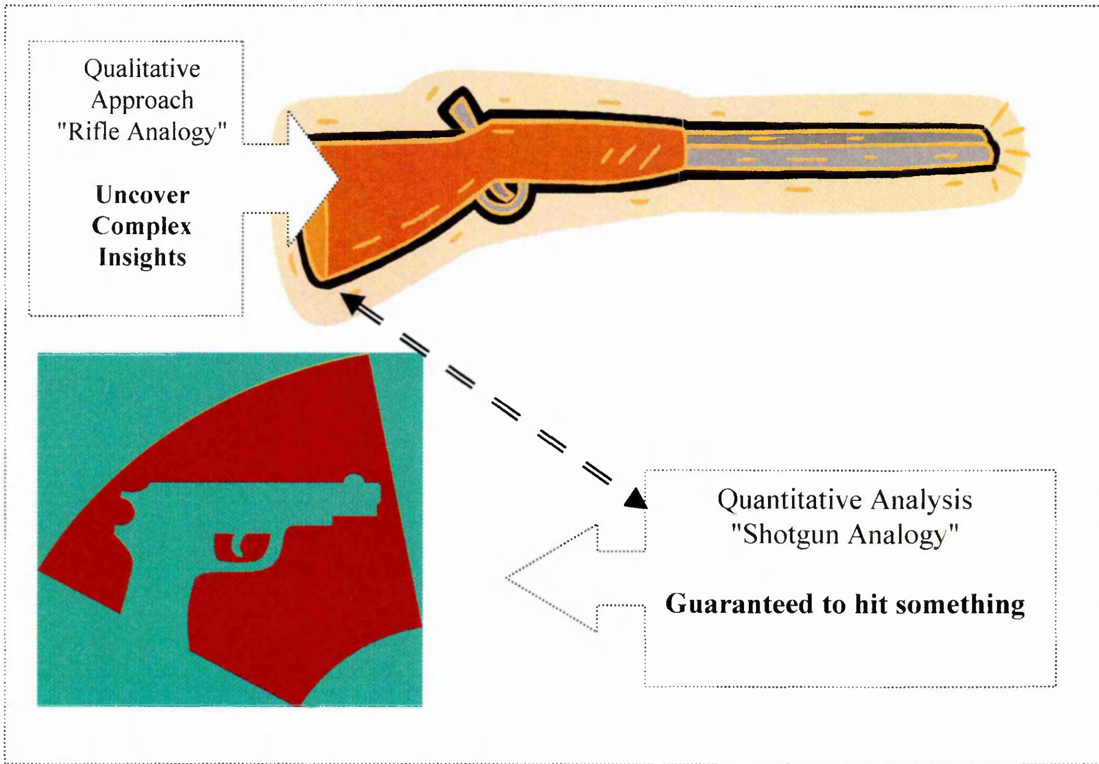

Figure 9.1: Matching the Qualitative and Quantitative Approaches to the "Rifle and Shotgun Analogy"

The above figure provides the justification of using the triangulation approach in this study. Whereas the quantitative approach through its over reliance on statistical analysis is bound to find something, either through descriptive statistics or confirmatory factor analysis, as similar to the shot gun, its guaranteed to hit something, because of its proximity but that might not reveal much. On the other hand, usage of qualitative approaches such as case studies are similar to the rifle as it uncovers complex insights.

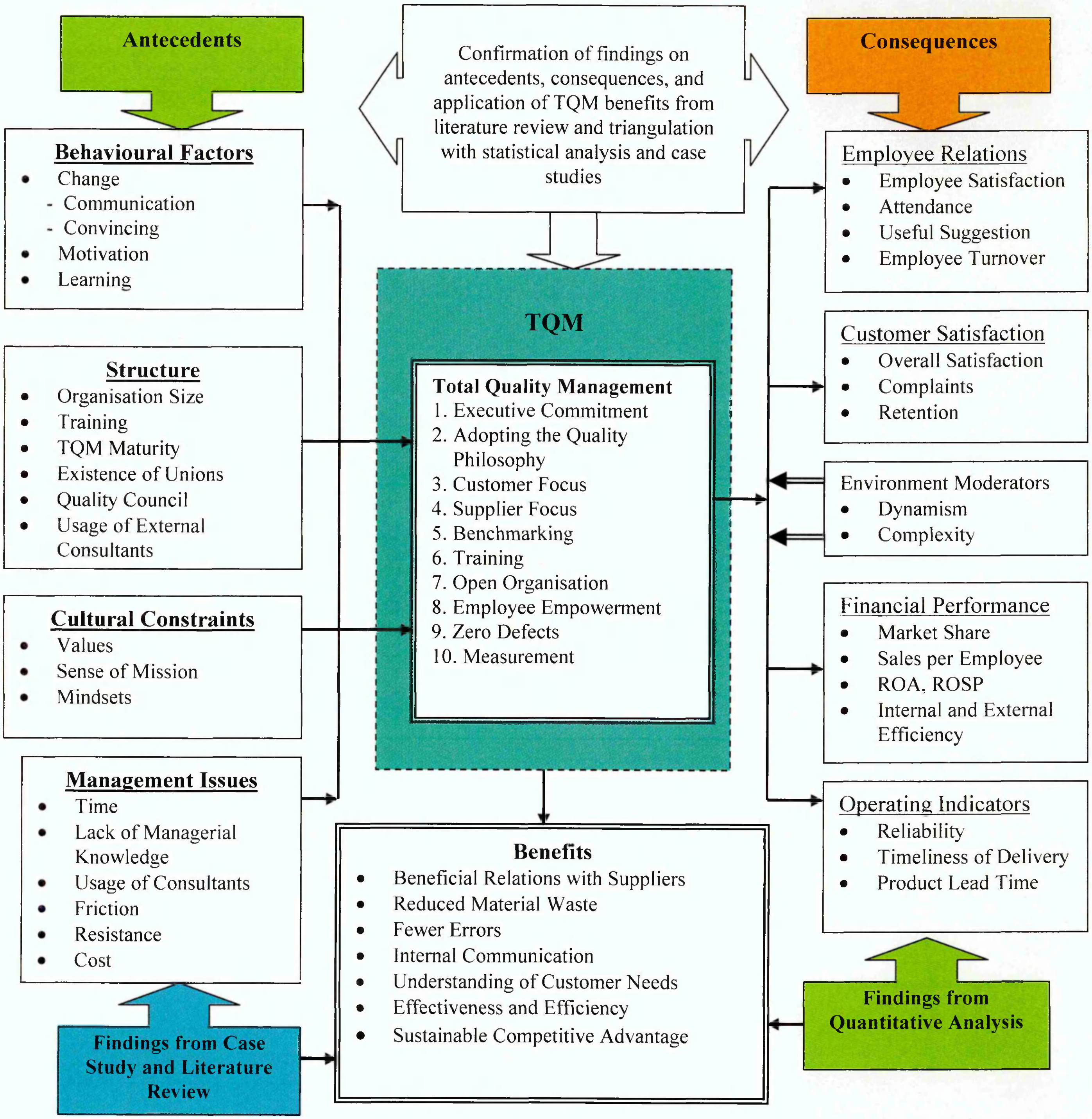

Figure 9.2: Benefits, Antecedents and Consequences of Total Quality Management

As observed by Friedman et al (2002), SMEs are driven predominantly by sever time, expertise and material constraints.

9.5.11 Confirmation of Factors Impeding the Application of TQM and Change Initiatives

As asserted by Mann and Kehoe (1995), investigating the factors impeding the application of TQM would lead to information which should assist in determining which implementation approach to use and how quickly it should be implemented. Furthermore, the identification of such factors would encourage the organisations consideration when developing an appropriate implementation.

However, although Mann and Kehoe's (1995) study did not indicate the nature of the organisations by industrial classification that participated in the study, it did provide the "quality critical organizational characteristics" which was defined as a characteristic that influences the effectiveness of a quality activity (Mann and Kehoe, 1995: 12). For this study, these factors that might impede or enhance the implementation of quality related initiatives within the Construction-Related SMEs are termed as antecedents, and are shown in Figure 9.2. These identified from case studies and the quantitative approach can broadly be classified in the following categories:

- Behaviour Factors
- Structure
- Cultural Constraints
- Management Issues
- Industrial Relations (Presence of Unions)
- Financial
- Training

These are discussed as:

- **Behaviour Factors**

Where usage of external consultants would overcome issues related to friction and resistance. The behaviour factors of communication pertain to the lack of information from Senior Management about the change initiatives. The findings of this research are consistent with those of Taylor and Wright (2003), who found that a Manager's understanding of TQM as an antecedent to TQM success, and those of Walsh et al (2002) who recommended keeping the following factor in mind when implementing TQM as Planning, Education and Training, Motivation and Commitment, Information, Time, Cost and Change Management. As asserted by Cheng et al (2001), there is the need for guiding employees to ensure the effective implementation of change.

Figure 6.76 in Chapter Six identified the following factors as necessary for the successful implementation of any quality related initiative, be it TQM or Business Process, Reengineering as Learning and change related factors as follows:

Learning Related Factors

- Promoting
- Training

Change Related Factors

- Communicating
- Convincing

Cheng et al (2001) in citing Dervitsiotis (1998) observed that the learning factors of promoting and training involved attracting everyone to a bright new future. Whereas the change related factors of communicating and convincing were concerned with the awareness of threats and weaknesses of the status quo, which was a recurring problems with two of the organisations in the case study. These findings confirm those of Mann and Kehoe (1995), who found that Management board's attitude towards change and Employee's attitudes towards change when negative would lead to a high, expected difficulty in implementing TQM. The positive aspect of communication were expounded by Thiagarajan and Zairi (1997a) who viewed effective communication as a means of maintaining enthusiasm for quality initiatives within an organisation. The case findings indicated that two of the three organisations studied were found lacking in that aspect. Therefore, there should be effective communication of planned changes to the employees. Alternatively the Management could employ external consultants to shepherd the exercise.

- **Structure**

The structure as an antecedent is defined according to Kuei et al (1995) as the degree of constraint on employee behaviour by rules, regulations and formal procedures.

- **Industrial Relations**

The findings from the quantitative approach did not find any correlation between the implementation of TQM and the presence of Unions. Table 6.10 in Chapter Six revealed, approximately 87% of the total respondents had no union present whereas for TQM deploying, only 5% of the respondents (1) had the union present. However, as stated in Chapter Six, this finding should be treated with caution, as the impact of unions vary according to the type of industry. However, Mann and Kehoe (1995) argue that organisations with poor industrial relations are likely to find it more difficult in implementing TQM.

9.5.12 Impact of Environmental Competitive Factors on TQM Implementation

This study extends Porter's (1980) analysis which initially was meant for larger organisations, this confirms the Reed et al (1996) assertion on time lag. It contributes to the knowledge gap on the impact of environmental competitive factors in UK Construction-related SMEs. Ahire and Golhar (1996) in citing Cole (1993) acknowledge that TQM success depends on organisational context including the firm's size, the nature of its products and industry characteristics. By determining the links between the two terms of reference of the environment, namely the segment involving the customers, competitors and the second aspect of the critical characteristics of the environment such as environmental dynamism and environmental munificence as defined by Reed et al (1996), Li and Ye (1999), and linking them to the orientation (process or customer) and the integration of TQM would influence the overall organisation and business performance. The findings in Chapter Six are based on the orientation-uncertainty matrix, have important theoretical and practical implications. The understanding of the direct relationship between TQM and Business and Organisation Performance is further enhanced significantly by taking into consideration the impact of the key contextual factors, such as the degree of environmental change or dynamism.

9.5.13 Empirical Analysis of Orientation-Uncertainty Matrix

This study developed a simple matrix for the assessment of the continua, which enables the UK Construction-Related SMEs to ascertain the best fit in terms of pursuing a "control" or "learning" approach as illustrated in Chapter Six. The findings indicate that the TQM deploying UK Construction-related SMEs were neither at the end of both continua; instead they exhibited both the Customer and Process orientation. This extends the work of Reed et al (1996).

9.5.14 Impact of TQM Maturity on TQM Implementation.

While TQM Maturity did not influence the strength of path relations, it did affect the level of execution and the degree of implementation of the executive commitment, supplier focus and training constructs. The findings indicate that there are minor significant variations in the deployment of TQM based on the duration of the program, but there was a marked "degree of decline" in the following constructs of Training, Executive Commitment and supplier Focus. On the contrary, these findings contradict the work of Ahire (1996) who found that TQM Maturity did affect the rigour of implementation.

9.5.15 Application of TQM within UK Construction-Related SMEs.

The design of this study through the Quantitative Analysis (Questionnaire) and Qualitative Approach (Case Study) was to learn how theoretical TQM was implemented within the UK Construction-Related SMEs, to ascertain how the critical factors affected the SMEs, and the benefits to be gained from implementing TQM. The basic underlying assumption of this study is a hypothesised framework as presented in Chapter 2 (Figure 2.3) and in this Chapter, Figure 9.2, which shows the relationships between key factors, benefits, antecedents, consequences and the TQM implementation.

9.5.16 Contribution to the TQM / ISO 9000 Certification Debate

This study contributes to the debate as articulated by Sun et al (2004) as to whether ISO 9000 is the stepping-stone to TQM (Quazi and Padibjo, 1997, Quazi et al, 1998; Parr, 1999) or whether ISO 9000 standard and certification is the foundation on which TQM is to be built (Stephen, 1994). The findings are varied, as revealed by the case studies; those organisations implementing TQM progressed from ISO 9000 whereas non-TQM deploying organisations viewed the standards as the de-facto TQM. As stated by Martinez-Lorente and Martinez-Costa (2004), ISO 9000 this does not satisfy a large number of TQM requirements.

The study also extends the work of Sila and Ebrahimpour (2002) who suggest that further research examines a comparison of implementation approaches by companies to ISO 9000 and TQM (TQM only, ISO 9000 only, TQM first and ISO 9000 second, ISO 9000 first and TQM second, and both ISO 9000 and TQM at the same time). Through case studies and Quality Manager definitions of TQM, a lot of insight has been gained in understanding the differences. The usage of ISO 9000 can contribute as "systems and procedures" and as vehicles for learning (McCabe, 2004). It also confirms the findings of Taylor and Wright (2003) who highlight the understanding of TQM and its relationship to ISO 9000 as an antecedent.

9.5.17 Emergence of Quality Related Initiatives - Six Sigma, Organisation Learning and BPR

Adebanjo (2001) affirms that business excellence and quality complement each other and should co-exist.

9.6 Matching the Criteria of Contribution to Knowledge

The ultimate test of any PhD is how it contributes to knowledge. In order to demonstrate the process undertaken towards contribution, it must be based on the following three pillars of knowledge namely, "observation, induction and deduction". In this study, in achieving the inductive and deductive nature, two steps of the research process were utilised, the positivist and phenomenological approaches as two distinct methodologies. One of the criteria of a PhD thesis is the need to demonstrate a disciplined attack on a determinate problem using appropriate methodology, as such, there is a need for awareness on the basis of techniques used and the strengths and limitations of their application to the issue in hand must be demonstrated. Chapter Two provided the detailed methodology in striving to achieve the stated criteria.

Chapter Six forms the bulk of the thesis as the statistical methods to be used were detailed in great depth. It can be argued that the PhD thesis is an assessment document, therefore the evidence for the statistical analysis together with its description of the process was outlined and explained in great detail. Furthermore it is suggested that examples of analysis helps serve the "awareness of the basis of techniques", Chapter Seven provided the numerical examples for the application of the Performance Index, and the demonstration of the Total Quality Management Index. Chapter Seven also provided the examples for the calculation of the Business and Organisational Performance Index (BOPI). The whole process was illustrated through a flow chart (Figure 7.18) highlighting the steps to be undertaken. In addition to the Scholarly contribution to knowledge, the PhD thesis needs to indicate the clear relationships with existing research. The three stated criteria which are necessary, are captured and illustrated in the form of a diagram showing the inter-connectivity.

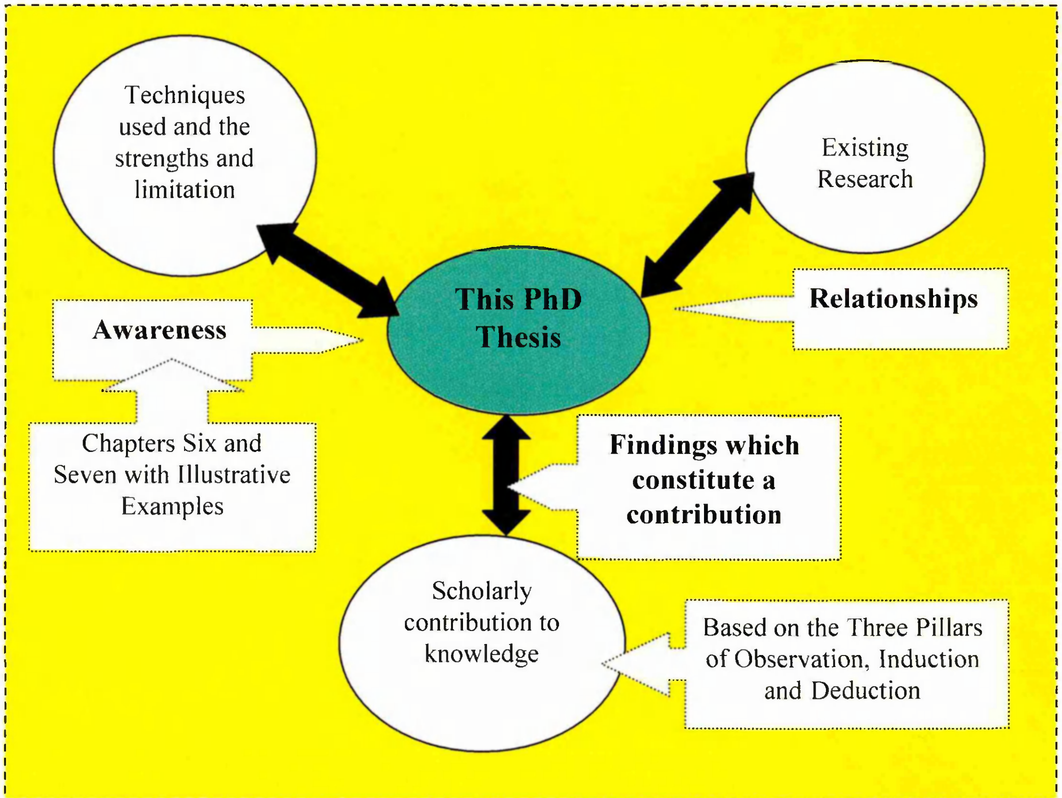

Figure 9.3: Criteria for PhD Thesis

The merits and demerits of the two distinct methodologies are clearly explained in Chapter Two. Furthermore, as stated by Handfield and Melnyk (1998), the scientific knowledge must provide one of the following five objectives:

- **A method** of organizing and categorising 'things' (a typology)
- **Predictions** of future events
- **Explanations** of past events
- **A sense of understanding** about causes events, and in some cases,
- The potential for **control** of events

9.6.1 Induction as a Pillar of Knowledge

The inductive approach whose focus is theory building can be illustrated in the following Figure 9.4, as elaborated by Vignali and Zundel (2003); induction contains the extrapolation from the data insights into human behaviour.

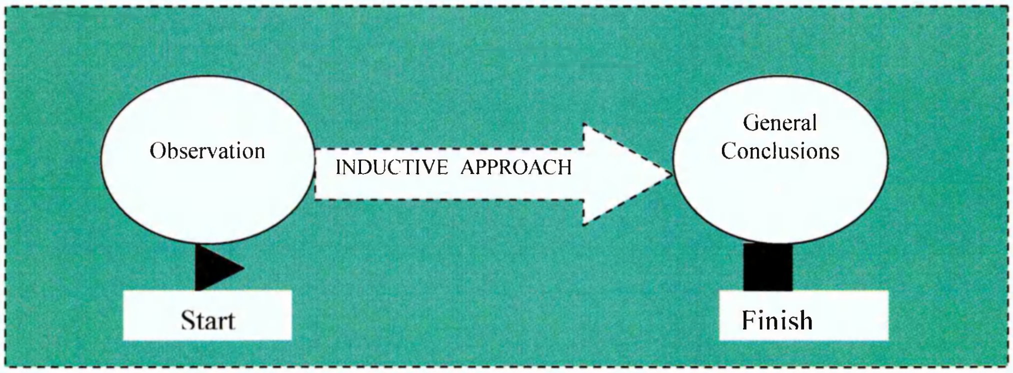

Figure 9.4 - Induction as a Pillar of Knowledge
(Author's Interpretation)

This process is also referred to as grounded theory; because it is grounded it has its base in specific observation of social life (Vignali and Zundel, 2003:207).

This called for reasoning from particular experiences to general truths and the case study methodology was particularly useful in demonstrating the pillar of knowledge, namely induction. Through the cross case analysis, new insights were gained, particularly concerning the little differences between TQM and non-TQM Organisations. Evidence also emerged of TQM giving way to different initiatives such as Business Reengineering, Six Sigma and EFQM Excellence Model.

One of the assumptions that underlie the positivist paradigm, is that knowledge is only of significance, if it is based on observations of external reality. Based on the assumptions of the French mathematician and philosopher Auguste Comte (1798-1857), citied in Vignali and Zundel (2003), one of the implications of the said assumption is that of cross-sectional analysis. Accordingly, making comparisons of variations between the TQM and non-TQM deploying organisations across the samples helped identify regularities in human and social behaviour. Though the sample was not large enough to generalise, it was indicative enough.

The approach draws heavily on the framework used by Filippini (1997) where the theory development process is utilised and the work is further guided by matching the research strategy with theory building activities as demonstrated by Handfield and Melnyk (1998). This showed the various steps in the theory building process model as observation, empirical generalisation, turning empirical generalization into theories, hypothesis generation and testing, and finally logical deduction.

In order to ascertain the specific contribution, the components of theory are defined as the "whats", "hows", and "whys". These can be described as follows:

- the "whys" are concerned with the identification and definition of the concepts,
- "hows" deal with the network of relations between concepts and finally
- "whys" offer an explanation of the credibility of the theory.

Forza and Filippini (1998) used a similar approach in their study of TQM impact on quality conformance and customer satisfaction. Meredith (1998: pp.445) offers an explanation of the steps in the theory development process as the issues of identification (*what*), explanation (*how*), and understanding (*why*). These three components are illustrated in Figure 9.5 and this study adopts the same approach in the development of empirical theory, by following the "what, how and why" in building the TQ-SMART. This sub section demonstrates how each of the components were achieved through the aim and objectives of this research. The three levels of development shown in Figure 9.5 are defined briefly as follows:

1. **Description Phase** - The conceptual "building blocks": This allowed the elements that are of interest to be characterised. Exploratory research based on the descriptive research as outlined in Chapter Six, were useful in this phase. Ordonez dePablos, (2004) observed in citing Hulland (1999) that the conceptual level is important as a prelude to the commencement of the causal modelling process. Filippini (1997) argues further that the description phase allows the elements that are of interest, to be characterised. As demonstrated by Llewelyn (2003), the concepts in the first stage theorise through explicating practice, they create meaning and significance through linking the subjective and objective realms of experience.

2. **Explanation Phase** - Empirical Level: This entails the construction of a framework which defines and justifies the relationship between the variable. According to Filippini (1997), this phase is often neglected in Operations Management studies where a complex phenomenon has been simplified and solved with an algorithmic model, thus ignoring important aspects of the real world. The inference being that the moderating effects are not taken into account. To avoid the identified pitfalls, three methods were considered for the analysis of the moderating effects. These are splitting the sample, hierarchical moderated regressions and structural equation modelling. Chapter Six provided a detailed explanation of each of the three methods and this study used them to ascertain the moderating effects.

3. **Explanation and Justification of Theory** - Theory Testing: This permitted the modification and development both of the concepts and the models.

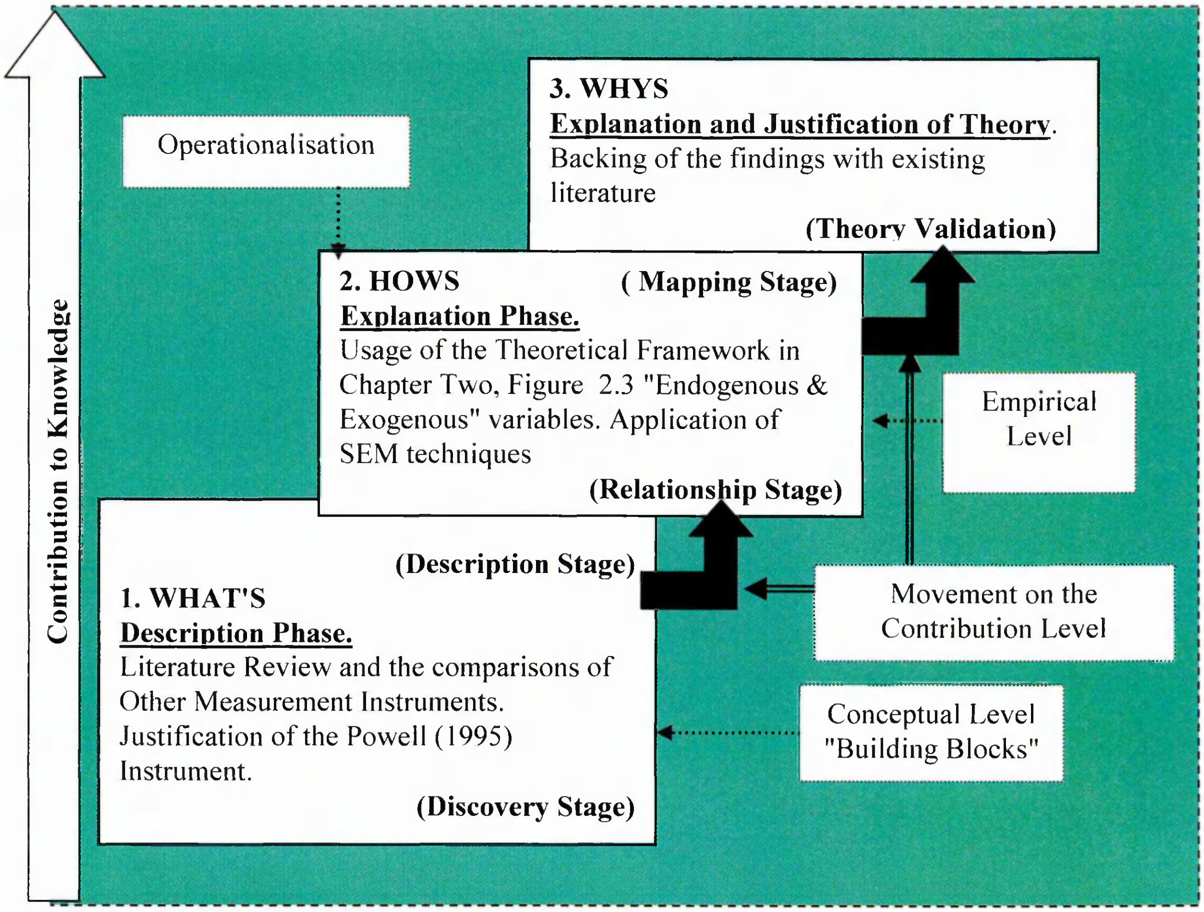

Figure 9.5: Author's interpretation of the Steps in the Development of Empirical Theory

The following is a discussion of the components which is dealt with through the three phases or steps;

9.6.2 Observation as a Pillar of Knowledge

Phase 1 can be equated to the conceptual level which is the process step of observation, and whose purpose is "discovery". Typical questions at this stage were; what is going on?, Is it interesting enough to research?, In order to achieve and complete the description phase, the first and second objectives of the study were, "to identify the major constructs of Total Quality Management (TQM) and refine the scales for measuring the constructs" and "to review and evaluate validated instruments used to measure Quality Management within the Manufacturing and Services Industries". This was elaborated upon in Chapters One and Five which set the background to the existing quality measurement instruments.

Literature review was the key data collection method in the comparisons of the measurement instruments. Phase 1 can also be described as defining the concepts of TQM or "building blocks". Chapter Four presented the critical success factors as propagated by various authors and backed by the Quality gurus such as Crosby, Juran and Deming from the theoretical perspective. Through the descriptive statistics presented in Chapter Six regarding the TQM deployment constructs, discovery of data relating to the application of TQM within SMEs was achieved. Such descriptive statistics such as the mean, standard deviation and median indicated in the Data Analysis Map shown in Chapter Six (Figure 6.1). However, this could not be used to compare the levels of different categories, but did provide the opportunity to rank the data and therefore, was adequate for this purpose. As argued by Forza (2002:155), descriptive survey is aimed at understanding the relevance of a certain phenomena, in this case being TQM and describing the distribution of the phenomena in a population, being the Construction Industry. The attributes of the UK Constructional related SMEs in generalizing observations were considered for possible effects of organisation size. Handfield and Melynk (1998) recommend such effects in setting boundary assumptions on the observation. This led to the classification of the sample into small-sized and medium sized.

Rather than focus on the first step in the development of theory, the **Discovery Stage** had to expand boundaries as stated by Handfield and Melnyk, (1998). TQM and non- TQM organisations were found to be different in terms of observing the TQM deploying constructs. This underlies the UK Construction-Related SME's, they should not only select certain quality practices in pursuit of their quality initiatives and ignore others, thus must adopt a holistic approach. While this is considered as the second step of the observation in the process step, its ultimate purpose is that of '**Description**' which seeks to explore the territory. Furthermore, it provides a portrait of new events or problems. The other main concern is explaining what is happening in those situations identified in the discovery phase.

9.6.3 Deduction as a Pillar of Knowledge

This sub section describes the second step which involves the "hows" and can also be represented in diagram form, thus providing a visual aid for the interpretation and development of the theory (Forza and Filippini, 1998)

Deduction as illustrated in Figure 9.6 has the purpose of explanatory theory testing. This describes the movement from the model to a solution in either symbolic or numerical form. Such procedures are supplied by mathematics.

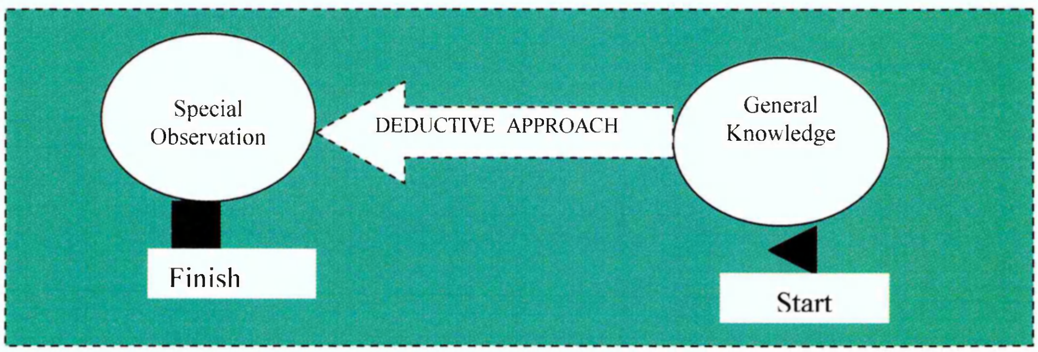

Figure 9.6: Deduction as a Pillar of Knowledge
(Phase) **Step 2**

Typical questions at this stage were;

- What is there?
- What are the key issues?
- What is happening?

The move from the discovery stage to that of description is demonstrated through the third objectives of this study, which was "to determine if there are any differences in quality management implementation and quality outcomes across UK Construction related SMEs.if so, how and why they differ".

Issues considered were the contextual factors shown in the research framework in Chapter Two (Figure 2.3) such as organisation size, union density and TQM maturity. Firstly this would in turn demonstrate whether Organisation Size impedes the implementation of TQM, secondly whether the differences in Quality Management could be attributed to the maturity of the TQM or any quality initiative and thirdly, whether union density affected the overall TQM implementation process.

The approach undertaken is described in detail in Chapter Six and involved splitting the sample on the moderate variables and correlating the independent and dependent variables across the sub-samples. Other methods used were the Hierarchical Moderated Regression Analysis (HRMA) and the Structural Equation Modelling (SEM), which was discussed in Chapters Six and Seven. It is acknowledged that science proceeds through a process of hypothesising fundamental laws and then deducing what kind of observations will demonstrate or falsify these hypothesis (Vignali and Zundel, 2003)

Another rationale of SEM usage is that, since science typically views theory validation as coming from predictive verification (Deductive Approach), of expected theoretically results based on empirical evidence, the SEM causal models used throughout the study provided an explanatory description of casual relationships among the TQM, Business and Organisation Performance constructs, plus a manipulation capabilities for diagnosing the key changes necessary for system improvements, and for predicting the impacts of potential change actions (Anderson and Vastag, 2003). By identifying the causal explanations among the TQM deployment and Business and Organisational Performance Indicators (BOPI), addresses the implication of "causality" which in turn helps towards achieving the goal of science.

In terms of demonstrating how the research contributes to the application or development of TQM within SME's, the TQ-SMART model proposed was developed by defining the constructs which shape it. This is the first step in the development of empirical theory and these definitions are provided for in Chapters Four and Five (critical success factors). The output of the second phase was two major types of descriptions, taxonomies and typologies. Taxonomies dealt with the categorical analysis of data (what are the phenomena?). This led to the classification of the UK TQM deploying organisations into high, medium and low depending on the levels of TQM identified. For example, based on TQM maturity, organisations were classified into 'less experienced' and 'experienced'. A cross tabulation between the different classifications was then conducted to ascertain whether the impact of Age and Organisation Size were the same.

Typologies described the most important aspect of the phenomena or activity, under consideration this was achieved by linking the hypotheses, depending on whether organisation size was associated with implementing TQM effectively. Reference was made to previous studies which found an association between 'organisation size' and 'inertia' where typically inertia is defined as inadequate or slow adoption to change or resistance to fundamental changes in conducting business.

The second stage as shown in Figure 9.5 includes the "hows", which in fact is the translation of the definitions into a system of measure equations (Forza and Fillippin, 1998). This was further dealt with using the AMOS software in which these relationships were translated into structural equations. This formed the basis of the structural equation modelling which involved parameter estimation and model testing, and the results were reported in Chapters Six and Seven. By applying the extension to the basic measurement model to include modelling systematic shared variance among indicators, evidence about the extent of bias that could not be obtained using traditional approaches such as partial correlation and multiple regressions was obtained.

Objective 4 was used to address this stage, which sought "to investigate the relationships among TQM practices and to identify the direct and indirect effects of TQM practices on the various dimensions of performance". However, the objective could be regarded as being at the conceptual level.

At the empirical level, the following hypothesis as stated in Chapter Two was tested; "There is a direct positive link between the proportion of TQM implementation in UK Construction related SME's and Organisational Performance". In this hypothesis the "proportion of TQM implementation" is empirical and numerically based measure of how advanced the implementation of TQM or the levels of commitment to TQM by the organisations. (Forza, 2002). Chapters Six and Seven show the graphical representation of the basic latent diagram for the model. The bulk of the SEM approach analysis is presented and discussed in Chapters Six and Seven.

A comprehensive instrument framework with specific focus on the construction sector, and in particular the SME's has also been developed from the refined Powell (1995) instrument and validated based on the data collected from Quality Managers and Chief Executive Officers (CEO) of UK Construction related SMEs. This model also portrayed various relationships between the different constructs.

The proposed model contains fourteen dimensions composed of ten for the process element and four for the outcome related; executive commitment, adopting the quality philosophy, customer focus, supplier focus, benchmarking, training, open organisation, employee empowerment, zero defects, and measurement. The four performance dimensions are employee satisfaction, customer satisfaction, operating indicators and financial indicators.

9.6.4 Step 3: Justification for the Theory on TQM

Filippini (1997) defines the third step, or phase, as that of theory testing which permits the modification and development both of concepts and of the model.

Many theories in operations management research are either deductive or mathematically deduced. It is generally accepted that the only valid result of scientific theory is adequate explanation. The bottom line is that Figure 8.4 should finish at the third step, otherwise absence of the third stage in the process can be likened to "war stories". The second stage would push TQM in a new direction.

9.6.4.1 TQM Theory

The Theory on TQM denoted as Path E in Chapter Eight, Figure 8.3 should meet and satisfy the following criteria:

- It must specify the variables (E_1 through E_{34} in Chapter Six, Figure 6.56) it considers relationships, must offer criteria for defining the boundaries, and must add to existing body of knowledge about a phenomenon.

These areas have been found wanting. This thesis contributes further to knowledge, by bridging the gap between the "rationalist" school based on the principles of scientific management, the theory of bureaucracy and the human "human relations" school (based on the role of organization as a social system, emphasizing psychological and social needs). Furthermore, the theory should demonstrate the following traits (Handfield and Melnyk, 1998):

- 'Not wrong', causality, falsifiability, and parsimony or according to Wacker (1998) have the necessary components of theory;

"Not wrong": Care was taken to ensure that the research methodology used in this study was appropriate. This involved matching the research problem with the appropriate data analysis mechanism as outlined in Chapter Six. The variance and covariance matrix is provided in Appendix G, where the data involved Structural Equation Modelling (SEM).

Sufficient data is provided throughout the thesis and appendices to ensure that the 'correctness" of such indicators as degrees of freedom (df) or the *p*-statistics or standard errors can be accepted. "Parsimony" introduces its own set of challenges. This is demonstrated through the thesis by using the few variables as a result of refining the measurement instrument, and yet, being able to explain the vents or outcome of interest. This supplementary criteria lies at the following assumption that the fewer the better. According to the Wacker (1998) theory there should be four basic criteria:

1. Conceptual definitions - terms of variables of the ten deployment constructs and four scales of Business and Organisation Performance indicators as provided for in Chapter 2.

2. Domain limitation - where the theory applies, this case being the UK Construction-related SMEs.

3. A set of relationships of variables as illustrated in the structural equation modelling in Figure 6.50, for the TQM deployment constructs and Figure 7.2 for the Business and Organisation Performance Indicators.

4. Specific predictions (factual claims) - This can be equated to TQ-SMART and its associated Business and Organisation Performance Indicators, and must be based on three pillars of knowledge namely, "observation, induction and deduction".

This section has demonstrated the application of the three pillars of knowledge to the study. Equally, the implications of the positivism paradigm of Independence, value freedom, causality, hypothetical-deductive, operationalisation, reductionism, generalisation and cross-sectional analysis are demonstrated throughout the research.

By finding support for a direct relationship between organisation size and the implementation of TQM, the study is contributing to the debates about the effects of organisation size on TQM to the somewhat mixed findings. Furthermore, the lessons to be learnt by SMEs are that as they move from the micro/small status to the medium status, they need to re-align their organisation strategy.

9.7 Contribution to Knowledge

The findings of the research can be categorised into six groups, namely:

1. the confirmation in the UK Construction Industry of results previously obtained in other industries such as Manufacturing and Service Industries,

2. application of the revised, good scale, previously utilised within the manufacturing and service environment within a construction specific setting. This area according to Sila and Ebrahimpour (2002) has been found inadequate, as studies dealing with implementation of TQM have targeted manufacturing companies to a greater extent.

3. verification of the constructs being more applicable through case studies.

The findings within the first part relate to the classification of organisations based on the extent to which they embrace the TQM philosophy; the high levels of TQM implementation against non-TQM organisations and the confirmation of a positive relationship between implementation of TQM and organisation performance (Flynn et al 1994; Powell, 1995; Rao et al, 1997; Ahire et al, 1996b; Quazi et al, 1998; Das et al, 2000; Ahire and Dreyfus, 2000).

4. The study contributes to the TQM literature by validating the direct and indirect relations among TQM practices and the effects of these practices on organisation and business performance, as argued by Lemak et al (1997), academics need to take a leading role in the empirical investigation of the value of TQM. This provides further sufficient evidence that UK Construction related SMEs can achieve high organisation performance by executing the ten TQM construct to their full extent as argued by Ahire and Golhar (1996). It validates the model proposed by Montes et al (2003) in which TQM content must fit with business strategy and both must fit with the requirements of the environment.

5. The framework also makes a distinct contribution to supporting theory development by having broader perspectives through the usage of multiplicity of variables that clearly intervene in operations. This is achieved by integration with other disciplines such as organisation behaviour, human resources management and services marketing.

6. Provide support for the time lag analysis by extending the seminal work of Reed et al (1996), and contributing to the knowledge of the organisation size impact on TQM implementation.

The significant findings within the second and third categories are:

1. The revised scale and generation of the TQ-SMART;

- Establishing that empirical differences in weights should be applied to the implementation constructs when assessing the levels of TQM, in particular for SMEs. This calls for an adjustment factor to be applied, hence confirming with empirical evidence what has been deduced from theory but not empirically tested as advocated by Flynn and Saladin (2001).

- The concept of entering the EFQM Excellence Model award is clearly less favourable among the SME's, but the literature supports that it is the process of deployment that is important.

2. Modelling

Redeveloping on the existing scales, and validation of the TQM advancement radial chart (TQ-SMART Model) that can be used by quality and senior managers within UK construction related SMEs at both the industry and organisation level. The industry level application would serve as a benchmark with competitors and other organisations, whereas the organisation level would be to assess the levels of TQM and identify the areas requiring improvement.

3. Organisational Size and Level of TQM Implementation

Whilst this study does not advocate the change of organisational size as an instrument of becoming more TQM oriented, it is worthwhile for a Manager to know the variation in TQM implementation levels as a function of size in the UK Construction Industry, in particular among the small and medium sized organisations.

The influence of organisation size on TQM implementation has been investigated before. However, support for organisation size in making an indirect contribution to the implementation of TQM is somewhat mixed in both manufacturing and service industries. While some studies (Brah et al, 2002; Powell, 1995; Goldschmidt and Chung, 2001) find support for a correlation between organisation size and TQM, in contrast several earlier and recent studies (Ahire and Golhar, 1996; Taylor and Wright, 2003; Yeung et al, 2003) have failed to find support for a direct relationship. In addition, most of the studies are conducted in large organisations. In this study, the medium sized organisations were put in a different category from the small-sized organisations. An analysis of the levels of TQM implementation showed that the medium-sized organisations were not significantly different from the small ones. While the mean of the level of TQM implementation in Medium organisations is higher than that of small-sized organisations, the difference is not significant. For instance, the small-sized scored the Customer Focus as the second most important mean. This is in agreement with earlier studies by Ahire and Golhar, 1996; and a recent study by Gustafsson et al (2003) which concluded that small organisations to be more customer oriented.

The findings in this study are significant because none of the previous studies isolated and investigated the position of small and medium sized organisations within the construction-related environment. The study is also unique as it allowed the control variable of environmental factors in determining the impact of TQM on business and organisational performance. Furthermore, organisation size does not impede the implementation of TQM.

4. Time Lag Analysis and TQM Benefits

The detailed findings are explained in sub section 9.7.3

5. Evaluation of TQM Implementation

This study has evaluated the implementation of TQM within UK Construction related SMEs through three distinct, different types of assessment as recommended by Hackman and Wageman (1995). First involved the empirical demonstration that TQM has in fact being implemented through the operationalisation of constructs found in literature and grounded in the principles of TQM as advocated by the Quality gurus and current Excellence Models.

9.7.1 Contribution to Theory Building Efforts

One of the purposes of this study was to contribute to the Quality Management, theory building efforts in services, particularly construction. This was achieved in the following ways:

This study contributes to the existing body of knowledge on TQM by answering some of the questions left unanswered both on the conceptual and empirical lines by various researchers. Filippini (1997) identifies these as:

- the components of total quality and their measurements. (SEM)
- relations between these

Chapter six demonstrates the causal relationships between the ten TQM deployment constructs through the factor loadings.

- the impact of different practices on performance

The impact and relationship between the TQM and BOPI and the development of the composite measure based on the economic and human dimensions. Through the regression analysis, it is possible to judge the extent to which variation, in one set of variables, might help explain variance in a variable of interest. According to Johnston et al (2004), the powers of Partial Least Square method can help in refining theory by showing which assumed predictors have substantive links to outcomes. Chapter Six indicates that none of the ten TQM deployments have substantive links to the business and organisation performance indicators.

- and conditions under which various interventions can be applied and their effects. (Filippini, 1997:622)

A discussion of how each of the highlighted "unanswered questions" is presented as follows:

These issues are all captured in this study, as illustrated by the research framework shown in Chapter Two (Fig 2.3) and the associated objectives. One of the objectives of this study was to help remedy the deficiency in theory for TQM in general, and TQM in construction industry, in particular the SMEs. Using Lemak and Reed's (2000) approach to Thompson's typology, the conceptual framework generated in Chapter Two makes a theoretical contribution and raises questions about how TQM should be used and implemented in construction industry, particularly among the SMEs

9.7.1.1 Contribution to Theory Building Efforts (2)

This study has moved from anecdotes, consultant based awards to a testable model and specific research hypotheses, linking the theoretical concepts of TQM to empirical indicants. As observed by Curkovic (2003), it is critical that researchers link theoretical concepts to empirical indicants. Tan and Wisner (2004) articulate the argument further when they compared previous studies as identified in this study (Anderson et al, 1995; Flynn et al, 1995; Black and Porter, 1996, and Ahire et al, 1996a) which despite identifying various practices, little attention was paid to whether these practices shared common variance-covariance characteristics that defined an individual construct. This study contributes to that body of knowledge by demonstrating the inter relations among the factors as used by Powell (1995) and refined in this study. Usage of Structural Equation Modelling technique enabled the objective to be achieved.

In this study, the concept of TQM has been linked to its indicants as manifested through the 34 variables. It has contributed to TQM-theory building by identifying the constructs associated with TQM, refining the scales for measuring these constructs, and empirically validating the scales. As stated in Chapter Six, support for organisation size in making an indirect contribution to the implementation of TQM is somewhat mixed in both manufacturing and services, and less studied in the Construction Industry.

Therefore, this study makes a contribution to the body of knowledge on the impact of organisational size on TQM within constructional related SMEs. It further contributes to the debate about the effects of Organisation Size and TQM Maturity on TQM Implementation. It also extends the work of Goldschmidt and Chung (2001) by empirically testing the theoretical framework for the relationship between organisation size, employee job satisfaction and customer satisfaction. The conceptual model developed in this study sheds more light on the subject of organisation size and customer satisfaction. The study also extends the work of Handfield and Melynk, 1998 who observe that there remains considerable work to be done in establishing the critical success factors within organisations that lead to improved performance. Through the usage of SEM, and simple correlation analysis, Chapter Six provides evidence of the relationships between the TQM practices and associated Business and Organisation Performance indicators.

9.7.2 Maintaining the Convergent and Discriminant Validity of QM

One area found wanting in TQM research, that is the difficulty at arriving at a theory which highlights the various concepts of TQM by measuring them and then correlating theses concepts to quality performance. The TQ-SMART achieves this through the application of Advanced Structural Equation Modelling techniques as advocated by Williams et al (2003). This research contributes to TQM knowledge by maintaining the convergent and discriminant validity of Quality Management. This extends the work of Hackman and Wageman (1995) that raised the following question; "Is there such a thing as TQM"?. In assessing the distinctiveness of TQM, the two comparison groups were considered, TQM and non-TQM deploying UK Constructional related SMEs, however, as foreseen by Hackman and Wageman (1995), despite passing the discriminant validity test, TQM is close to failing the test when one considers emerging initiatives as identified in this study, by organisations which claim not to be TQM yet, address some principles of TQM. The case studies also provide evidence of different initiatives such as' Business Improvement Teams', 'Business Re-Engineering'

9.7.3. Contribution to Time-Lag Analysis

Sousa and Voss (2002) identified one important factor in the practice performance model that requires further research, as that of time lag, between the implementation of Quality Management practices and performance. This study contributes to knowledge by extending the work of Sousa and Voss (2002) and contributing to TQM content. This study further extends the work of early studies Westphal et al, (1997), Reed et al (1996), and recent studies such as Hendricks and Singhal (2001), Taylor and Wright (2003). In particular, Taylor and Wright as they reported, only the degree of success as very successful, quite successful or unsuccessful. No analysis on the actual extent of implementing the deployment constructs was ever reported. The findings of this research are that there are no significant differences in the deployment of TQM constructs between the less experienced and experienced. However, there is a "degree of decline" in certain TQM constructs such as Executive Commitment, Training and Supplier Focus.

Reed et al (1996) presented valid reasons why some of the gains from TQM are far from instantaneous. According to their studies, this was due to the continua of either orientation or uncertainty being undimensional where for the purpose of this research, UK Construction-Related SMEs could either be Customer Oriented or Process Oriented or exist in either high or low uncertainness. They provided a framework and 10 factors that need to be addressed in order to address the issue of time lags. It also contributes to the body of knowledge of time lag studies by testing part of the model as shown in Chapter Six and addressing some of those factors. The following is a summary of matching some of the factors.

1. Reed et al (1996) proposed that for the model of orientation, TQM, uncertainty and performance, the following constructs of uncertainty, firm orientation, market advantage, product design efficiency, process efficiency, product reliability and financial would require operationalisation. Chapter Two provides the operationalisation of uncertainty and the "competitive factor" instrument was designed to ascertain the extent of the competitive factors using Porter's (1980) Model, and the modified Lau (1996) Chapter Three provides the implications of the Latham and Egan Reports and this was the basis of testing the compatibility of the TQM content, whose components of market advantage, product design, process efficiency and product reliability were articulated in Chapters Three and Four. The final, financial construct is captured in the "Measuring the Success of TQM and Performance" instrument in which the financial performance is operationalised by the following five measures; Market share, sales per employee, return on assets, internal and external efficiency and return on sales profitability. This sub section has demonstrated how their constructs and their associated direct and proxy measures are accounted for.

9.7.4. Contribution to Impact of TQM on Performance Related Variables.

Furthermore, the research contributes and extends the works of Taylor and Wright (2003) who proposed exploring the trends in the five performance variables, namely Customer Satisfaction, Employee Satisfaction, Process Management, Sales and Financial Performance, by including the variables apart from process management in the TQ-SMART Performance element of the model. The structural analysis through the Structural Equation Modelling have helped in refining theory by showing which assumed TQM deployment constructs as predictors, have substantive links to the Business and Organisation performance outcomes.

9.7.5 Testing of Instruments

Testing the existing instrument to measure Quality Management practice or dimensions, typically developed using samples of large companies in well developed industry such as construction, but in a less well studied context such as SMEs. Furthermore, the study extends the work of Sousa and Voss (2002). Additionally, this is the only research that has focussed exclusively on construction, and in particular SMEs. The empirical validation of the TQ-SMART measuring instrument for the TQM strives to enrich the subject of theory building in view of the scarcity of empirical research works in constructional related literature. This contributes towards producing contingency knowledge.

9.7.6. Contribution of Core and Infrastructure Elements.

This research extends the work of Flynn et al, 1995; Anderson et al, 1995; Dow et al, 1999; Samson and Terziovski, 1999 and Wilson and Collier, 2000; by allowing for the separation of direct effects of infrastructure practices on performance from indirect effects of these through the core practices. The main contribution made, is related to two aspects; the development of a theoretical justification of the influence TQM has on business and organisational performance and the existence of a factorial structure that differentiates the soft and hard factors in the assessment of a TQM initiative. Taking into account contextual factors such as environmental uncertainty, organisation size and TQM maturity, in investigating the relationship between TQM and BOPI has contributed towards the debate of the differences in findings of previous studies (Sila and Ebrahimpour, 2002). The current study suggests a number of implications and recommendations for future research.

9.8 Limitation of Study

While the study makes several contributions to Total Quality Management theory and practice, several limitations should be noted. The limitations of the study relate to the validity of the statistical assumptions, the measurement model, the structural model, usage of self-report data, and the sample. The limitations will also focus on two major threats to the inferences made from the measures and observations. According to Messick (1988), these are constructed under representation and construct irrelevary variance. Construct under representation occurs when the measure fails to include important dimensions or facts of the construct.

Construct-irrelevary variance can be described under its three sources:

- The measure is too broad and contains excess reliable variance associated with other distinct constructs;

- Reliable variance that is due to the manner in which the measure is obtained (i.e., method of variance); and

- Unreliable or error variance that is often quantified by some index (or coefficient) of reliability.

These findings can be regarded as indicative of the sample population.

The instrument has been validated by collecting data from Quality Managers of SME Construction related organisations in a developed country, like the UK. Due to this, there is a possibility of a bias playing role in the outcome of the study. Therefore, the study could be duplicated in other economies, particularily the less developed ones.

9.8.1 Usage of Self-report data

Usage of Self-report data and indicators of the constructs are sensitive and difficult for respondent. As stated by Larson and Sinha (1995), asking managers to report their perceptions on customer and employee satisfaction items, is a related shortcoming. One alternative would be to survey the customers and employees directly, however, it was beyond the scope of this study. As observed by Cassell et al (2002), survey based on the self-reported, views of a single representative of a company may not provide reliable estimates of use and effectiveness of TQM. However, there is consistency within the results from the quantitative and qualitative parts of the study. Additionally the results do appear to be consistent with previous research that has examined the implementation issues associated with TQM within SMEs.

9.8.2 Snap shot nature of Studies

Cross section studies such as this one, only capture the perceptions of management professionals at a certain point in time. One of the limitations of a cross section study of a concept as complex as TQM, involving the view point of multiple actors over time. This is further elaborated in the population validity, however, it does provide valuable insights. This led to the observation of the performance measures not being longitudinal and therefore, lacked a complete understanding of the time required for improvement from inception. Despite this limitation, some form of time lag analysis was undertaken to gauge the overall picture.

9.8.3 Cross Section Performance Data

Observation of the performance measures were not longitudinal and lacked a complete understanding of the time required for improvement from inception.

9.8.4 Construct Validity

The main thrust of construct validity was to establish the degree to which the TQ-SMART, as a research instrument was able to measure the deployment and implementation constructs under investigation. One major problem with the research process is that of ensuring the measurement of constructs is free of error. According to O'Leary-Kelly and Vorurka (1998), this omission leads to ignoring the main corrupting elements embedded in measurement error and informant bias. The analysis of confirmatory approach in this study was based on the data from a single sample with limited size. However, with the application of Structural Equation Modelling, the size constraints limitation is overcome, as the results of the CFA were validated by testing the following hypothesis:

H_{13}: The ten constructs of TQM as measured by their respective items are significantly different from each other.

9.8.5 External Validity

External validity refers to the degree to which the results of a study are valid and whether they can be generalised, beyond the immediate study sample and set into other samples. From the positivist research, the equivalence of external validity is transferability. This study is transferable as these findings present, fits the contexts beyond the immediate study situation, in this case constructional or service related environment to the manufacturing setting as shown by the results of Ahire et al (1996a) set in the manufacturing environment constructs. The results demonstrated that some "formal" TQM firms could in reality be no different from non-TQM firms. Another method for ensuring construct validity was through factor analysis and convergent and discriminant validity. One limitation acknowledged, is that in order to improve the external validity of the instrument, additional studies would be needed with increased sample sizes, no attempt is made to generalise the results beyond an exploratory assessment of the dimensionality of TQ-SMART within the Construction environment, and however the results are indicative.

9.8.6 Essential Time Dimension

Another major limitation citied by the same authors is that of the "essential time dimension" which was found to be missing in providing the models with a static or historic view of TQM in an organisation.

9.8.7 Sample Restriction

There are several limitations related to the sample. First the sample consisted of organisation in one industry operations. One industry operating in the United Kingdom. Consequently, the findings may not generalize to other industries or to industries, organisations operating in other countries.

9.8.7.1 Population Validity

Population validity refers to whether the sample is representative and whether the results are significant. Although the sample of this study (63) was limited, the findings represent a snapshot of the reality of TQM achievement by declared TQM and non-TQM organisations. However, the use of quantitative approaches normally require a large number of cases representing the population of interest, in order to determine the statistical significance of results. Therefore, while the results cannot be generalised at this stage, further research should confirm the findings of this study. Moreover, the sample organisations could only be regarded as representative of small to medium sized constructional related organisations. The drawback of this "snapshot" is unfortunately a static evaluation which does not consider the complex dynamics of TQM. However, even though it represents a snapshot of the industry at a point in time, it presents more of a picture, albeit far from complete, than what is available in the literature (Thiagaragan et al 2001). The limited sample further leads to having a weak relationship between intervention-induced process improvements and organisational outcomes.

9.9 Recommendation for Future Research

The current study suggests a number of implications and recommendations for further research. These are discussed as follows;

9.9.1 Exploration of Product Quality

The study has primarily been conducted within the UK Construction Industry and focussed on the deployment of TQM related quality initiatives in both TQM and non-TQM Construction-Related Organisations. Future research would benefit from exploring the product quality to the application of TQM. Among other issues to be addressed under the cultural aspect will include developing people, training, changing the nature of the industry to be less adversarial and more aspiration, working in teams to get it right first time.

9.9.2 Extension of TQ-SMART to other SMEs and Large Organisations in the Manufacturing and Service Sectors

The TQ-SMART could also be extended to other organisations in the service and manufacturing environment, further testing of the model could be applied to large construction organisations.

9.9.3 Need for an Investigation of SPC tools applicable to Construction-Related SMEs

The application of SPC between constructional related SME's could be investigated in detail. In particular as there are over 100 methods of statistical control (Kanji and Asher, 1996), these could be narrowed down so that specific methods are inferred from the different types of business activities and common methods be highlighted e.g. pareto charts could be used by contractors (on site) and suppliers.

9.9.4 Need for Longitudinal Studies

This will address the issue of time lag effects, but by tracking TQM implementation results over time, as evidenced by recent studies such as Taylor and Wright (2003) that used the longitudinal approach over a 5-year period. However, though the time-delay between implementation and performance is significant, as pointed out by Taylor and Wright (2003), there are difficulties associated with attribution of performance improvement to TQM implementation practices and that this casuality may be impossible to prove categorically (Taylor and Wright, 2003:100).

Chapter One highlighted the limitation lacking in longitudinal data. This data used was cross section which presented a static view of TQM implementation. Future studies could replicate this one by adopting the longitudinal approach. Although casual modelling has been utilised in this research through Structural Equation Modelling, no definitive statements can be made about causal ordering. Furthermore, longitudinal studies are not a panacea for resolving the temporal issues as demonstrated by Hackman and Wageman (1995). They considered the documentation of changes in outcome measures to be of limited use. Particularly in disentangling the effects of a focussed intervention from those of other endogenous and exogenous changes. These are illustrated as "flashes" or as symbols for lightening in Chapter 1, Figure 1.2

the process steps within the Constructional SMEs. Pupius (2003) advocate that six sigma can be deployed in any size or type of organisation, in manufacturing, construction and service industries.

Although the implementation of TQM was viewed from the Quality Manager's perception, there is a need for focussing on the employee's perceptions in order to understand why some TQM deploying organisations report success or failure. As argued by Coyle-Shapiro and Morrow (2003), individuals vary considerably in their receptivity to organisation change. According to Wanberg and Banas (2000) citied in Coyle-Shapiro and Morrow (2003), they found that personal resilience which was composed of self-esteem, optimism, and perceived control was related to change acceptance. Their studies were based on cognitive adaptation and core self evaluation theories. This view is supported by Tsang and Antony (2001) who also advocated for focussing on different positions of the employees within the organisation in order to provide a wider perspective on the TQM philosophy. However, despite the majority of respondents being Quality Managers and Directors, in this study, they were selected on the basis of "key respondents" and for being the most knowledgeable in the issues that this research was trying to uncover.

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9.9.5 Impact of New Concepts such as Six-Sigma, Cultural of Innovation on SMEs

According to Banuelas and Antony (2003) Six sigma is considered as a business strategy that employs a well-structured continuous improvement methodology to tackle process variability and drive out waste from the business processes with the application of statistical tools and techniques in a rigorous manner. Various definitions of Six-Sigma are presented; DeMast (2004) defines Six Sigma programme as a complete programme for company-wide quality improvement, encompassing methods for analysing the customers demands and for selecting the problem having the highest priority. There is a need to investigate the full potential that UK Construction-related SMEs can obtain from the application of Six-Sigma. Moves towards this trend are emerging as evidenced by recent research by Kashiwagi et al (2004) demonstrates.

As Wessel and Burcher (2004) observe, Six sigma can be seen as the current stage of evolution in the field of QM with a core focus on profitability improvement and strategic value levelling, but still based in the fundamentals of traditional TQM. Therefore there is scope for UK Construction-related SMEs currently deploying TQM to embrace the concepts of six sigma by building on their existing TQM fundamental or levels.

Other writings on Six-sigma are by Senapati (2004) who compare and state that six-sigma is like any other process improvement initiative such as TQM and Statistical Engineering. Senapati outlines the process steps of Six-sigma as DMAIRC which is Define, Measure, Analyze, Improve, Reporting and Control. A cross comparison among quality improvement programs is also provided. Klefsjo et al (2001) contend that six-sigma is a methodology within the larger framework of total quality management through the blending of old and new techniques as the tools of six-sigma are familiar with those of TQM. Therefore, further studies could be conducted to explore the applicability of the process steps within the Constructional SMEs. Pupius (2003) advocate that six sigma can be deployed in any size or type of organisation, in manufacturing, construction and service industries.

Although the implementation of TQM was viewed from the Quality Manager's perception, there is a need for focussing on the employee's perceptions in order to understand why some TQM deploying organisations report success or failure. As argued by Coyle-Shapiro and Morrow (2003), individuals vary considerably in their receptivity to organisation change. According to Wanberg and Banas (2000) cited in Coyle-Shapiro and Morrow (2003), they found that personal resilience which was composed of self-esteem, optimism, and perceived control was related to change acceptance. Their studies were based on cognitive adaptation and core self evaluation theories. This view is supported by Tsang and Antony (2001) who also advocated for focussing on different positions of the employees within the organisation in order to provide a wider perspective on the TQM philosophy. However, despite the majority of respondents being Quality Managers and Directors, in this study, they were selected on the basis of "key respondents" and for being the most knowledgeable in the issues that this research was trying to uncover.

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Chapter Ten

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Appendices

Appendices

APPENDIX A: SAMPLE QUESTIONNAIRE

QUESTIONNAIRE ON THE APPLICATION OF TQM WITHIN SMALL & MEDIUM SIZED CONSTRUCTION ENTERPRISES

I am undertaking a research as part of a PhD. My area of research relates to the application of TQM within Construction-Related SME's. I would be most grateful if you could take 15 mins to complete this questionnaire by placing a tick in the appropriate box ☑.

If possible please try to answer all the questions. Your responses shall be treated with the strictest confidence. Please return this questionnaire by 30th August 2002
A summary of the conclusions will be posted to you upon completion of my research
Nicholas Chileshe, School of Environment & Development, Sheffield Hallam University, City Campus, Pond Street, Sheffield, S1 1WB.

SECTION 1: ORGANISATIONAL CHARACTERISTICS

Q1. Designation of respondent

Chief Executive Officer (CEO)	❒ 1	Managing Director	❒ 4
Quality Director	❒ 2	Quality Manager	❒ 5
Quality Co-ordinator	❒ 3	Other	❒ 6

Q2. Number of year's respondent has been employed by the Organisation................

Q3. Please indicate which of the following is your main business activity?

Main contractor	❒ 1	Supplier	❒ 3
Management	❒ 2	Consultancy	❒ 4

Q4. How many employees does your organisations have in the UK?

Under 10	❒ 1	100-249	❒ 4
11-49	❒ 2	250-499	❒ 5
50-99	❒ 3	> 499	❒ 6

Q5. Is your organisation currently Implementing TQM?

Yes	❒ 1	No	❒ 2

Q6. If 'Yes' to Q5, State the number of years TQM has been in place

0-3 ❒ 1 3-6 ❒ 2 6-10 ❒ 3 10 > ❒ 4

Q7. Please indicate the amount (£) of turnover achieved by the organisation in the last

financial year

£0-5m	❒ 1	£50-125m	❒ 4
£5-20m	❒ 2	£125-250m	❒ 5
£20-50m	❒ 3	Over £250m	❒ 6

Q8. Is your organisation unionised?

Yes ❒ 1 No ❒ 2 Partly ❒ 3

Q9. Has your organisation ever made a significant commitment to Total Quality Management or a similar Total Quality program? e.g. EFQM

Yes ❒ 1 No ❒ 2

Q10. How advanced is the implementation of the program in comparison with other Quality programs of other organisations you are familiar with.

Far More Advanced.	❒ 1
Somewhat more advanced.	❒ 2
About equally advanced.	❒ 3
Somewhat less advanced	❒ 4
Far less advanced	❒ 5
No significant involvement with a Quality program	❒ 6

Q10.1 Please provide your organisation's brief definition of total quality management (TQM) in the space provided

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SECTION 2: FACTORS FOR THE IMPLEMENTATION OF TQM

Respondents should indicate their implementation of the Quality features given below based on five-point Likert Scale (5= highly advance in implementation: 1= have not begun implementation but intend to).

Q11. : 10 Implementation constructs

I. Executive Commitment	**1**	**2**	**3**	**4**	**5**
1. A top executive decision to commit fully to a Quality program	❒	❒	❒	❒	❒
2. Top executives actively championing our Quality program	❒	❒	❒	❒	❒
3. Executives actively communicating a Quality commitment to employees	❒	❒	❒	❒	❒
II. Adopting the philosophy	**1**	**2**	**3**	**4**	**5**
1. Quality principles included in our mission and vision statement	❒	❒	❒	❒	❒
2. An overall theme based on our Quality program	❒	❒	❒	❒	❒
3. Entering a European Quality Foundation Model (EFQM) Award competition	❒	❒	❒	❒	❒
III. Closer to customers	**1**	**2**	**3**	**4**	**5**
1. Increasing the organisation's direct personal contacts with customer	❒	❒	❒	❒	❒
2. Actively seeking customer inputs to determine their requirements.	❒	❒	❒	❒	❒
3. Using customer requirements as the basis for Quality	❒	❒	❒	❒	❒
4. Involving customers in product or service design	❒	❒	❒	❒	❒
IV. Closer to supplier	**1**	**2**	**3**	**4**	**5**
1. Working more closely with suppliers	❒	❒	❒	❒	❒
2. Requiring suppliers to meet stricter Quality specifications	❒	❒	❒	❒	❒
3. Requiring suppliers to adopt a Quality program	❒	❒	❒	❒	❒
V. Benchmarking	**1**	**2**	**3**	**4**	**5**
1. An active competitive benchmarking program	❒	❒	❒	❒	❒
2. Researching best practices of other organisations	❒	❒	❒	❒	❒
3. Visiting other organisations to investigate best practices first hand	❒	❒	❒	❒	❒

VI. Training	**1**	**2**	**3**	**4**	**5**
1. Management training in Quality principles	❒	❒	❒	❒	❒
2. Employee training in Quality principles	❒	❒	❒	❒	❒
3. Employee training in problem-solving skills	❒	❒	❒	❒	❒
4. Employee training in teamwork	❒	❒	❒	❒	❒
VII. Open Organisation	**1**	**2**	**3**	**4**	**5**
1. A more open, trusting organisational culture	❒	❒	❒	❒	❒
2. Less bureaucracy	❒	❒	❒	❒	❒
3 Use of empowered work teams	❒	❒	❒	❒	❒
VIII. Employee empowerment	**1**	**2**	**3**	**4**	**5**
1. Increased employee involvement in design and planning	❒	❒	❒	❒	❒
2. A more active employee suggestion system	❒	❒	❒	❒	❒
3. Increased employee autonomy in decision making	❒	❒	❒	❒	❒
4. Increased employee interaction with customers and suppliers	❒	❒	❒	❒	❒
IX. Zero Defects	**1**	**2**	**3**	**4**	**5**
1. An announced goal of zero-defects	❒	❒	❒	❒	❒
2. A program for continuous reduction in defects	❒	❒	❒	❒	❒
3. A plan to drastically reduce rework	❒	❒	❒	❒	❒
X. Measurement	**1**	**2**	**3**	**4**	**5**
1. Measurement of Quality performance in all areas	❒	❒	❒	❒	❒
2. Valid charts and graphs to measure and monitor Quality	❒	❒	❒	❒	❒
3. Appropriate statistical methods to measure and monitor Quality	❒	❒	❒	❒	❒
4. Employee training in Statistical methods for measuring and improving Quality	❒	❒	❒	❒	❒

SECTION 3: IDENTIFICATION OF ADVOCATED ADVANTAGES ASSOCIATED WITH THE IMPLEMENTATION

From the following list of reasons advocated for organisations implementing TQM, please tick the appropriate box ☑.

Do you consider that the implementation of TQM has

Q12. provided your organisation with a sustainable competitive advantage?

Yes ❐ 1 No ❐ 2

Q13. Improved the effectiveness and efficiency of the organisation?

Yes ❐ 1 No ❐ 2

Q14. has resulted in improved understanding of customer needs?

Yes ❐ 1 No ❐ 2

Q15. has improved internal communication?

Yes ❐ 1 No ❐ 2

Q16. has resulted in fewer errors?

Yes ❐ 1 No ❐ 2

Q17. has reduced material waste?

Yes ❐ 1 No ❐ 2

Q18. has resulted in stronger more beneficial relationships with suppliers?

Yes ❐ 1 No ❐ 2

SECTION 4: MEASURING THE SUCCESS OF TQM & ASSESSMENT OF ORGANISATIONAL PERFORMANCE

To what extent has there been an improvement/increase in the following measurement indicators since the implementation of TQM? Appertaining to the following:

Please tick the appropriate box

Q19. Financial performance	Greatly	Hardly	Not at all
a) Market share			
b) Sales per employee (£)			
c) Return on assets			
d) Internal and external efficiency			
e) Return on sales profitability (£)			

Q20. Employee relations	Greatly	Hardly	Not at all
a) Employee satisfaction			
b) Attendance			
c) Number of useful suggestion received			
d) Employee turnover			
Q21. Customer Satisfaction	Greatly	Hardly	Not at all
a) Overall satisfaction			
b) Customer Complaints			
a) Customer retention			
Q22. Operating indicators	Greatly	Hardly	Not at all
a) Reliability			
b) Timeliness of delivery			
c) Product lead time			

SECTION 5: ASSESSMENT OF COMPETITIVE ENVIRONMENT

Q23. Please could you rate your organisation on the following competitive factors? using a scale of 1 to 5, where 5 is the most positive answer and 1 is the most negative answer (1= very low, 5= very high)

	COMPETITIVE FACTORS	1	2	3	4	5
Q23.1	The competitive position of your company in its respective industry?	❒	❒	❒	❒	❒
Q23.2	The bargaining power of your customers	❒	❒	❒	❒	❒
Q23.3	The possibility (or threat) of new or potential competition is :	❒	❒	❒	❒	❒
Q23.4	The ability of your organisation to reduce construction uncertainties is	❒	❒	❒	❒	❒
Q23.5	The ability of your organisation to redefine market uncertainties.	❒	❒	❒	❒	❒

END OF QUESTIONNAIRE
THANK YOU FOR RESPONDING

Would you be prepared for me to contact you with a view to discuss TQM issues in person?

Yes ❒ No ❒

Designation : --

Company : --

Address : --

Tel. /Fax : --

Signature : --

TABLE B1: Summary of Sample Data and Total Quality Management Index (TQMI)

ORG	EC	QP	CF	SF	BM	TR	OO	EM	ZD	ME	TQMI
1	4.33	2.33	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.57**
2	4.00	3.00	3.50	3.33	3.67	3.50	4.00	3.75	2.67	3.25	**3.47**
3	3.67	3.33	3.50	2.67	1.00	3.25	3.00	2.00	4.00	4.25	**3.07**
4	2.67	2.67	4.00	1.67	1.33	2.20	2.67	4.00	4.33	3.50	**2.90**
5	3.67	3.67	5.00	5.00	3.33	3.25	3.00	3.00	4.00	3.50	**3.74**
6	3.33	2.33	3.75	2.67	4.33	3.00	2.33	1.75	4.67	3.75	**3.19**
7	3.67	3.67	2.50	3.00	4.00	1.00	3.67	3.00	4.67	4.75	**3.39**
8	4.33	3.67	3.00	4.00	1.00	1.00	1.67	3.25	1.00	1.00	**2.39**
9	5.00	3.67	3.25	2.67	4.67	2.50	4.33	3.00	4.67	2.75	**3.65**
10	4.00	3.00	4.50	3.67	2.33	3.00	4.00	3.50	4.00	3.00	**3.50**
11	5.00	3.67	3.50	3.67	1.67	3.25	1.67	2.00	3.33	3.00	**3.08**
12	5.00	3.67	4.25	3.67	3.00	3.00	3.00	4.00	4.00	3.75	**3.73**
13	2.67	1.67	4.00	3.00	1.00	2.50	2.00	2.00	1.00	1.00	**2.08**
14	4.00	2.67	4.00	3.33	3.00	2.00	3.67	3.75	2.33	2.00	**3.08**
15	5.00	3.67	5.00	3.67	2.33	3.00	5.00	4.25	4.00	4.75	**4.07**
16	5.00	5.00	5.00	2.33	5.00	4.75	5.00	5.00	5.00	5.00	**4.71**
17	3.33	2.67	3.75	2.33	2.00	1.75	1.67	2.50	3.00	3.35	**2.64**
18	4.00	3.33	4.25	3.67	2.00	3.00	4.67	2.50	4.00	1.25	**3.27**
19	5.00	3.67	4.00	3.00	2.67	4.50	5.00	5.00	3.00	3.00	**3.88**
20	5.00	3.67	3.50	2.67	2.00	1.00	1.67	1.00	2.33	2.75	**2.56**
21	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	**3.00**
22	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	**3.00**
23	5.00	4.67	4.75	3.33	2.33	3.50	5.00	3.00	4.33	2.50	**3.84**
24	5.00	2.33	5.00	5.00	4.67	4.50	5.00	5.00	4.67	1.50	**4.27**
25	4.33	3.33	2.75	2.33	1.67	3.50	3.33	3.50	3.33	3.25	**3.13**
26	1.67	1.00	2.75	1.67	1.33	2.75	2.00	1.00	2.00	1.00	**1.72**
27	1.00	2.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.13**
28	3.33	3.00	3.00	4.00	2.67	2.00	2.33	2.50	3.00	2.00	**2.78**
29	2.33	2.33	4.00	3.67	2.33	2.75	3.33	3.50	5.00	1.00	**3.02**
30	3.00	2.67	3.75	4.00	2.33	1.00	2.00	3.50	2.67	4.50	**2.94**
31	3.67	3.67	4.75	2.67	2.33	2.00	5.00	4.25	5.00	3.50	**3.68**
32	5.00	5.00	1.00	1.00	3.00	2.75	1.67	3.25	1.00	4.00	**2.77**
33	2.67	3.67	3.25	2.00	2.33	3.00	2.00	1.75	3.00	1.50	**2.52**
34	2.00	2.00	3.25	1.67	1.00	3.75	3.00	2.00	3.00	1.25	**2.29**
35	3.00	3.00	3.00	3.33	3.00	3.75	3.00	3.00	3.00	3.00	**3.11**
36	3.00	3.00	3.00	3.67	3.00	2.00	3.00	3.00	3.00	3.00	**2.97**
37	3.33	3.00	3.00	2.67	3.00	1.00	3.00	3.00	3.00	3.00	**2.80**
38	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	**3.00**
39	3.33	3.00	3.00	2.33	3.00	3.00	3.00	3.00	3.00	3.00	**2.97**
40	3.67	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	**3.07**
41	2.33	2.00	3.25	2.67	2.00	3.00	3.00	2.75	2.00	2.00	**2.50**
42	2.67	3.33	2.50	3.00	5.00	4.00	4.33	3.25	4.00	4.50	**3.66**
43	1.00	1.67	2.50	2.00	1.00	1.00	2.67	3.00	2.67	1.00	**1.85**
44	5.00	3.67	5.00	3.67	3.67	2.75	2.67	4.75	4.33	4.25	**3.98**
45	4.33	3.67	4.00	3.67	3.00	4.00	4.67	3.25	4.00	2.25	**3.68**
46	1.67	1.33	3.00	1.33	1.00	1.00	1.00	1.00	1.00	1.00	**1.33**
47	1.00	1.00	5.00	4.33	1.00	4.00	5.00	5.00	5.00	1.00	**3.23**
48	3.33	3.33	3.50	4.00	2.00	2.75	3.67	3.25	4.00	2.75	**3.26**
49	5.00	3.67	4.50	4.00	1.67	4.00	5.00	3.75	2.00	3.75	**3.73**

ORG	EC	QP	CF	SF	BM	TR	OO	EM	ZD	ME	TQMI
50	5.00	3.33	3.75	4.33	3.33	3.00	2.67	1.75	2.67	3.25	**3.31**
51	5.00	3.67	3.25	3.00	2.00	5.00	4.00	2.75	3.67	2.25	**3.46**
52	1.00	1.00	1.75	2.33	1.00	1.75	1.67	2.25	3.00	1.50	**1.73**
53	4.00	2.67	2.50	1.67	2.33	2.75	2.33	2.00	2.00	1.75	**2.40**
54	1.00	1.00	1.00	1.00	1.00	1.50	3.00	4.00	3.67	1.00	**1.82**
55	4.00	3.00	4.00	4.00	4.00	3.50	3.67	3.75	3.00	3.75	**3.67**
56	3.33	3.67	3.75	4.33	4.00	4.00	3.00	2.25	4.33	3.75	**3.64**
57	2.00	2.67	3.00	2.33	1.00	1.75	2.33	3.50	1.67	2.25	**2.25**
58	1.33	1.00	5.00	3.00	3.00	3.50	5.00	5.00	4.33	1.50	**3.27**
59	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
60	1.67	1.67	4.50	2.67	2.67	3.75	3.33	4.00	4.67	3.00	**3.19**
61	5.00	3.67	5.00	3.00	5.00	3.50	3.00	3.00	3.33	4.00	**3.85**
62	2.00	1.67	2.25	2.33	1.67	2.00	4.33	3.00	3.00	1.25	**2.35**
63	3.00	2.33	3.75	3.67	2.00	4.00	4.00	3.50	3.67	2.50	**3.24**

APPENDIX C : CASE STUDY PROTOCOL QUESTIONNAIRE

1.0 INTRODUCTION

This questionnaire seeks to determine the implementation process your organisation undertook for the TQM programme. Information pack to the questions would be appreciated. This may be documentary sources in form of **policy documents**, the **profile documents** containing the **aims, overall company quality** goals and **objectives, mission statements**, **Organisations Charts** and any **flow diagrams** showing your organisation's **TQM Implementation approach.**

1.0 PREPARATION FOR THE TQM PROGRAMME

Question 1.1

What preparations, if any, did you undertake at the initial stage of producing TQM, Identify what you did exactly, and the time/personnel allocated to this initial stage? Did you adopt the method of steering? i.e. Board Steering TQM, Quality Steering Team or Quality Council?

Question 1.2

Different TQM approaches bring with them different benefits and problems, and the success of an approach can depend on many factors (probably the two most important are the organisation's 'starting position' and the level of commitment to the implementation). Did the organisation understand its strengths and weaknesses?

2.2 What progressed from the initial stage?

Question 1.3

What followed on from question 2, i.e. stage 3 of the process?

Question 1.4

What other comments can you make about your TQM Programme? i.e. what was the period of time between planning of TQM and when TQM became operational (Rate of TQM Implementation?)

2.0 OBSTACLES INHIBITING THE EFFECTIVE IMPLEMENTATION OF TQM

The primary objective is to determine major barriers to successful implementation of TQM

Question 2.1

List the stumbling block (barriers) which could have affected the process

Question 2.1.2

What measures did you undertake to resolve this?

3.0 IDENTIFICATION OF CRITICAL SUCCESS FACTORS

Question 3.1

Which factors contributed to the successful (if it was) implementation of TQM?

4. OTHER QUESTIONS: To act as guidelines to the information requested.

Question 4.1

What have been the benefits for your organisation, employees and clients from the introduction of TQM?

Question 4.2

Did your organisation take into consideration the following crucial factors when implementing TQM?

- Cost, Manpower and Clients

If yes, what exactly was considered?

Question 4.3

To which extent where the employees involved in he implementation process

Question 4.3

Is the EFQM Excellence Model applied in your organisation ?, and if so, how is it applied ?

Question 4. 4

Is quality training an integral part of all job instruction? Yes No

If Yes to Q 4.4,

Is training carried out by

Quality management..	Yes	No
Superiors..	Yes	No
Other operators..	Yes	No
Outsiders..	Yes	No

What % of your operators have attended special quality courses ------- %

OTHER INFORMATION REQUESTED:

- Assignment of Roles and Responsibilities
- Education and Training i.e. What courses Management Undertook
- Determining Customer requirements
- Recognition and reward schemes for employees

APPENDIX D – DESCRIPTIVE STATISTICS

Table D1: Factor Analysis for TQM Deploying Organisations - Communalities

Implementation Construct	Initial	Extraction	RAI	Rank
(1)	(2)	(3)	(4)	(5)
1. Executive Commitment			**0.82**	
Fully committed to a quality program	1.000	0.914	0.84	1
Championing a quality program	1.000	0.937	0.82	2
Communicating a quality commitment	1.000	0.781	0.80	6
2. Adopting the philosophy			**0.65**	
Quality principles in mission/vision stat.	1.000	0.908	0.81	4
An overall theme based on a Quality Programmes	1.000	0.856	0.80	5
Entering a EFQM Award competition	1.000	0.886	0.36	34
3. Customer Focus			**0.76**	
Direct personal contacts with customers	1.000	0.878	0.81	3
Customer inputs to requirements	1.000	0.914	0.77	7
Seeking Customer inputs	1.000	0.800	0.76	8
Customer involvement in design	1.000	0.815	0.67	13
4. Supplier Focus			**0.61**	
Working more closely with suppliers	1.000	0.852	0.66	15
Suppliers to meet stricter Quality specifications	1.000	0.859	0.66	14
Suppliers to adopt a Quality program	1.000	0.952	0.51	30
5. Benchmarking			**0.52**	
A competitive benchmarking program	1.000	0.951	0.53	27
Researching best practice of other orgs.	1.000	0.906	0.48	32
Visiting other organisations	1.000	0.936	0.53	29
6. Training			**0.53**	
Management in quality principles	1.000	0.930	0.57	23
Employees in quality principles	1.000	0.917	0.59	22
Employees in problem solving skills	1.000	0.933	0.42	33
Employees in team work	1.000	0.832	0.50	31
7. Open Organisation			**0.63**	
Open, trusting organisation culture	1.000	0.948	0.70	11
Less bureaucracy	1.000	0.917	0.64	18
Use of empowered work teams	1.000	0.931	0.55	26
8. Employee Empowerment			**0.61**	
In design and planning	1.000	0.883	0.65	17
Active employee suggestion system	1.000	0.848	0.56	24
Autonomy in decision making	1.000	0.853	0.59	21
Interaction with customers and suppliers	1.000	0.853	0.64	19
9. Zero Defects			**0.67**	
An announced goal of zero defect	1.000	0.803	0.61	20
A program for continuous reduction	1.000	0.860	0.73	10
A plan to drastically reduce rework	1.000	0.858	0.69	12
10. Measurement			**0.61**	
Of quality performance in all areas	1.000	0.878	0.73	9
Graphs & Charts to measure & monitor	1.000	0.804	0.65	16
Appropriate statistical methods	1.000	0.834	0.55	25
Employee training in statistical methods	1.000	0.859	0.53	28

Table D2 : TQM Organisations responses and ranking of the advancement in implementation of the quality features (n=20)

Implementation construct	% of respondents advancement scoring			Relative advancement index	Rank
	≥ 4	3	≤ 2		
(1)	(2)	(3)	(4)	(5)	(6)
1. Executive Commitment					
Fully committed to a quality program	80.0	10.0	10.0	0.84	1
Championing a quality program	70.0	25.0	5.0	0.82	2
Communicating a quality commitment	65.0	35.0	0.0	0.80	6
2. Adopting the philosophy					
Quality principles in mission/vision stat.	70.0	15.0	15.0	0.81	4
An overall theme based on a Quality Programs	70.0	25.0	5.0	0.80	5
Entering a EFQM Award competition	15.0	10.0	75.0	0.36	34
3. Customer Focus					
Direct personal contacts with customers	85.0	10.0	5.0	0.81	3
Customer inputs to requirements	70.0	20.0	10.0	0.77	7
Seeking Customer inputs	45.0	30.0	25.0	0.76	8
Customer involvement in design	45.0	30.0	25.0	0.67	13
4. Supplier Focus					
Working more closely with suppliers	45.0	35.0	20.0	0.66	15
Suppliers to meet stricter Quality specifications	50.0	30.0	20.0	0.66	14
Suppliers to adopt a Quality program	25.0	25.0	50.0	0.51	30
5. Benchmarking					
A competitive benchmarking program	30.0	15.0	55.0	0.53	27
Researching best practice of other organisations	30.0	15.0	60.0	0.48	32
Visiting other organisations	35.0	20.0	45.0	0.53	29
6. Training					
Management in quality principles	40.0	25.0	35.0	0.57	23
Employees in quality principles	45.0	15.0	40.0	0.59	22
Employees in problem solving skills	5.0	20.0	75.0	0.42	33
Employees in team work	20.0	25.0	55.0	0.50	31
7. Open Organisation					
Open, trusting organisation culture	45.0	35.0	20.0	0.70	11
Less bureaucracy	45.0	20.0	35.0	0.64	18
Use of empowered work teams	35.0	25.0	40.0	0.55	26
8. Employee Empowerment					
In design and planning	45.0	20.0	35.0	0.65	17
Active employee suggestion system	65.0	15.0	20.0	0.56	24
Autonomy in decision making	55.0	20.0	25.0	0.59	21
Interaction with customers and suppliers	35.0	45.0	20.0	0.64	19
9. Zero Defects					
An announced goal of zero defect	45.0	20.0	35.0	0.61	20
A program for continuous reduction	65.0	15.0	20.0	0.73	10
A plan to drastically reduce rework	55.0	20.0	25.0	0.69	12
10. Measurement					
Of quality performance in all areas	70.0	10.0	20.0	0.73	9
Graphs & Charts to measure & monitor	50.0	20.0	30.0	0.65	16
Appropriate statistical methods	35.0	20.0	45.0	0.55	25
Employee training in statistical methods	30.0	15.0	55.0	0.53	28

Table D3: Non-TQM Deploying Organisations responses and ranking of the advancement in implementation of the quality features (n=43)

Implementation construct	% of respondents advancement scoring			Relative advancement index	Rank
	≥ 4	3	≤ 2		
(1)	(2)	(3)	(4)	(5)	(6)
1. Executive Commitment				**0.584**	
Fully committed to a quality program	34.7	19.2	46.1	0.58	9
Championing a quality program	34.7	15.3	50.0	0.55	15
Communicating a quality commitment	46.1	7.8	46.1	0.62	4
2. Adopting the philosophy				**0.500**	
Quality principles in mission/vision statement	50.0	7.7	42.3	0.63	3
An overall theme based on a Quality Program	23.1	23.1	53.8	0.52	20
Entering a EFQM Award competition	11.5	7.7	80.8	0.35	31
3. Customer Focus				**0.612**	
Direct personal contacts with customers	46.1	26.9	27.0	0.64	2
Customer inputs to requirements	42.4	26.9	30.7	0.62	5
Seeking Customer inputs	46.1	23.1	30.8	0.65	1
Customer involvement in design	34.6	23.1	42.3	0.54	16
4. Supplier Focus				**0.500**	
Working more closely with suppliers	42.3	19.2	38.5	0.58	12
Suppliers to meet stricter Quality specifications	38.5	15.4	46.1	0.54	18
Suppliers to adopt a Quality program	15.4	11.5	73.1	0.38	30
5. Benchmarking				**0.424**	
A competitive benchmarking program	23.1	19.2	57.7	0.47	27
Researching best practice of other organisations	11.5	30.7	57.8	0.45	28
Visiting other organisations	7.6	19.2	73.2	0.35	33
6. Training				**0.510**	
Management in quality principles	30.7	15.3	54.0	0.51	22
Employees in quality principles	30.7	11.5	57.8	0.49	25
Employees in problem solving skills	26.9	15.3	57.8	0.50	24
Employees in team work	30.7	26.9	42.4	0.54	17
7. Open Organisation				**0.590**	
Open, trusting organisation culture	30.7	23.0	46.3	0.57	14
Less bureaucracy	30.7	30.7	38.6	0.59	7
Use of empowered work teams	38.5	23.0	38.5	0.60	6
8. Employee Empowerment				**0.457**	
In design and planning	26.9	26.9	46.2	0.50	23
Active employee suggestion system	11.5	7.7	80.8	0.23	34
Autonomy in decision making	19.2	34.6	46.2	0.52	19
Interaction with customers and suppliers	30.1	34.6	35.3	0.58	13
9. Zero Defects				**0.554**	
An announced goal of zero defect	38.6	15.3	46.1	0.58	10
A program for continuous reduction	30.7	30.7	38.6	0.58	11
A plan to drastically reduce rework	38.5	23.2	38.3	0.59	8
10. Measurement				**0.450**	
Of quality performance in all areas	30.7	23.1	46.2	0.50	21
Graphs & Charts to measure & monitor	19.2	15.4	65.4	0.42	29
Appropriate statistical methods	23.7	3.8	72.5	0.42	28
Employee training in statistical methods	11.5	7.6	80.9	0.35	32

Table D4 : TQM Deploying Organisations mean responses and standard deviations of the advancement in implementation of the quality features (n=20)

Implementation construct	mean	sd
(1)	(2)	(3)
1. Executive Commitment	**4.10**	
Fully committed to a quality program	4.20	1.005
Championing a quality program	4.10	0.967
Communicating a quality commitment	4.05	0.82
2. Adopting the philosophy	**3.27**	
Quality principles in mission/vision statement	4.20	1.05
An overall theme based on a Quality Program	4.1	0.92
Entering a EFQM Award competition	1.55	1.28
3. Customer Focus	**3.80**	
Direct personal contacts with customers	4.05	0.94
Customer inputs to requirements	3.85	1.09
Seeking Customer inputs	3.80	1.15
Customer involvement in design	3.35	1.42
4. Supplier Focus	**3.07**	
Working more closely with suppliers	3.30	1.03
Suppliers to meet stricter Quality specifications	3.30	1.13
Suppliers to adopt a Quality program	2.55	1.23
5. Benchmarking	**2.60**	
A competitive benchmarking program	2.65	1.31
Researching best practice of other organisations	2.40	1.39
Visiting other organisations	2.65	1.46
6. Training	**2.65**	
Management in quality principles	2.85	1.31
Employees in quality principles	2.95	1.47
Employees in problem solving skills	2.15	0.98
Employees in team work	2.50	1.27
7. Open Organisation	**3.17**	
Open, trusting organisation culture	3.50	1.23
Less bureaucracy	3.20	1.32
Use of empowered work teams	2.75	1.52
8. Employee Empowerment	**3.05**	
In design and planning	3.25	1.20
Active employee suggestion system	2.80	1.47
Autonomy in decision making	2.90	1.29
Interaction with customers and suppliers	3.20	1.28
9. Zero Defects	**3.43**	
An announced goal of zero defect	3.05	1.50
A program for continuous reduction	3.65	1.42
A plan to drastically reduce rework	3.45	1.54
10. Measurement	**3.05**	
Of quality performance in all areas	3.60	1.47
Graphs & Charts to measure & monitor	3.25	1.37
Appropriate statistical methods	2.75	1.48
Employee training in statistical methods	2.50	1.54

Table D5 : Non-TQM Deploying Organisations mean responses and standard deviations of the advancement in implementation of the quality features (n=43)

Implementation construct	Mean	sd
(1)	(2)	(3)
1. Executive Commitment	**2.92**	
Fully committed to a quality program	2.90	1.526
Championing a quality program	2.75	1.390
Communicating a quality commitment	3.10	1.308
2. Adopting the philosophy	**2.50**	
Quality principles in mission/vision statement	3.15	1.472
An overall theme based on a Quality Program	2.60	1.349
Entering a EFQM Award competition	1.75	1.150
3. Customer Focus	**3.06**	
Direct personal contacts with customers	3.20	1.267
Customer inputs to requirements	3.10	1.182
Seeking Customer inputs	3.23	1.257
Customer involvement in design	2.70	1.250
4. Supplier Focus	**2.50**	
Working more closely with suppliers	2.90	1.226
Suppliers to meet stricter Quality specifications	2.70	1.121
Suppliers to adopt a Quality program	1.90	1.148
5. Benchmarking	**2.12**	
A competitive benchmarking program	2.35	1.297
Researching best practice of other organisations	2.25	1.179
Visiting other organisations	1.75	1.201
6. Training	**2.55**	
Management in quality principles	2.55	1.179
Employees in quality principles	2.45	1.191
Employees in problem solving skills	2.50	1.197
Employees in team work		1.195
7. Open Organisation	**2.93**	
Open, trusting organisation culture	2.85	1.145
Less bureaucracy	2.95	1.166
Use of empowered work teams	3.00	1.279
8. Employee Empowerment	**2.23**	
In design and planning	2.50	1.271
Active employee suggestion system	1.15	1.184
Autonomy in decision making	2.60	1.144
Interaction with customers and suppliers	2.90	1.146
9. Zero Defects	**2.92**	
An announced goal of zero defect	2.90	1.361
A program for continuous reduction	2.90	1.211
A plan to drastically reduce rework	2.95	1.181
10. Measurement	**2.11**	
Of quality performance in all areas	2.50	1.151
Graphs & Charts to measure & monitor	2.10	1.275
Appropriate statistical methods	2.10	1.314
Employee training in statistical methods	1.75	1.226

Table D6 : One Sample Statistics- T-Test

Implementation Construct	t	df	Sig. (2-tailed)	Mean Difference
(1)	(2)	(3)	(4)	(5)
1. Executive Commitment				
Fully committed to a quality program	19.014	62	.000	3.4921
Championing a quality program	18.570	62	.000	3.2540
Communicating a quality commitment	21.180	62	.000	3.3651
2. Adopting the philosophy				
Quality principles in mission/vision statement.	20.193	62	.000	3.5873
An overall theme based on a Quality Program	18.865	62	.000	3.1905
Entering a EFQM Award competition	11.928	62	.000	1.7937
3. Customer Focus				
Direct personal contacts with customers	23.224	62	.000	3.5556
Customer inputs to requirements	23.368	62	.000	3.4603
Seeking Customer inputs	22.860	62	.000	3.5397
Customer involvement in design	19.355	62	.000	3.1746
4. Supplier Focus				
Working more closely with suppliers	21.793	62	.000	3.1905
Suppliers to meet stricter Quality specifications	21.449	62	.000	3.0476
Suppliers to adopt a Quality program	17.904	62	.000	2.6349
5. Benchmarking				
A competitive benchmarking program	15.590	62	.000	2.5397
Researching best practice of other organisations.	16.123	62	.000	2.5238
Visiting other organisations	14.754	62	.000	2.3968
6. Training				
Management in quality principles	18.824	62	.000	2.8730
Employees in quality principles	17.564	62	.000	2.8254
Employees in problem solving skills	17.473	62	.000	2.5556
Employees in team work	18.275	62	.000	2.8413
7. Open Organisation				
Open, trusting organisation culture	22.346	62	.000	3.3016
Less bureaucracy	20.762	62	.000	3.1587
Use of empowered work teams	17.379	62	.000	2.9683
8. Employee Empowerment				
In design and planning	18.745	62	.000	2.9683
Active employee suggestion system	18.199	62	.000	2.9206
Autonomy in decision making	19.997	62	.000	2.9841
Interaction with customers and suppliers	21.237	62	.000	3.1587
9. Zero Defects				
An announced goal of zero defect	17.326	62	.000	3.0476
A program for continuous reduction	19.999	62	.000	3.2698
A plan to drastically reduce rework	20.922	62	.000	3.3016
10. Measurement				
Of quality performance in all areas	19.258	62	.000	3.1270
Graphs & Charts to measure & monitor	15.609	62	.000	2.6667
Appropriate statistical methods	14.759	62	.000	2.5397
Employee training in statistical methods	13.435	62	.000	2.2540

Table D7: Barlett's Test of Sphericity, KMO (n=63)

VARIABLES	KMO[a]	Reproduced Correlation	Approximate Chi-Square	*df*
(1)	(2)	(3)	(4)	(5)
1. Executive Commitment	**0.686**		171.896	3
Fully committed to a quality program	0.847	0.831		
Championing a quality program	0.826	0.945		
Communicating a quality commitment	0.776	0.827		
2. Adopting the philosophy	**0.478**		50.149	3
Quality principles in mission/vision statement	0.822	0.745		
An overall theme based on a quality program	0.867	0.832		
Entering a EFQM Award competition	0.583	0.586		
3. Customer Focus	**0.801**		166.229	6
Direct personal contacts with customers	0.916	0.813		
Customer inputs to requirements	0.892	0.806		
Seeking customer inputs	0.749	0.691		
Customer involvement in design	0.764	0.608		
4. Supplier Focus	**0.645**		60.006	3
Working more closely with suppliers	0.800	0.662		
Suppliers to meet stricter quality specifications	0.692	0.722		
Suppliers to adopt a quality program	0.592	0.825		
5. Benchmarking	**0.709**		111.419	3
A competitive benchmarking program	0.848	0.793		
Researching best practice of other organisations	0.807	0.816		
Visiting other organisations	0.692	0.720		
6. Training	**0.673**		183.817	6
Management in quality principles	0.731	0.793		
Employees in quality principles	0.830	0.781		
Employees in problem solving skills	0.739	0.855		
Employees in team work	0.764	0.709		
7. Open Organisation	**0.767**		147.626	3
Open, trusting organisation culture	0.884	0.841		
Less bureaucracy	0.825	0.734		
Use of empowered work teams	0.795	0.823		
8. Employee Empowerment	**0.845**		179.487	6
In design and planning	0.790	0.732		
Active employee suggestion system	0.817	0.759		
Autonomy in decision making	0.748	0.870		
Interaction with customers and suppliers	0.784	0.825		
9. Zero Defects	**0.665**		89.565	3
An announced goal of zero defect	0.703	0.676		
A program for continuous reduction	0.811	0.822		
A plan to drastically reduce rework	0.784	0.724		
10. Measurement	**0.776**		172.554	6
Of quality performance in all areas	0.807	0.771		
Graphs & charts to measure & monitor	0.886	0.832		
Appropriate statistical methods	0.693	0.894		
Employee training in statistical methods	0.618	0.782		

Table D8 : Average Weights (Means Values), W_{ij} of Manifest variables for the TQ-SMART for n= 63 ALL Organisations

Implementation Construct	1	2	3	4	$\sum$Wi
1. Executive Commitment	3.49	3.25	3.36		**3.37**
2. Adopting the philosophy	3.59	3.19	1.79		**2.86**
3. Customer Focus	3.56	3.46	3.54	3.17	**3.43**
4. Supplier Focus	3.19	3.05	2.63		**2.96**
5. Benchmarking	2.54	2.52	2.40		**2.49**
6. Training	2.87	2.83	2.56	2.84	**2.77**
7. Open Organisation	3.30	3.16	2.97		**3.14**
8. Employee Empowerment	2.97	2.92	2.98	3.16	**3.00**
9. Zero Defects	3.05	3.27	3.30		**3.21**
10. Measurement	3.13	2.67	2.54	2.25	**2.65**
Overall TQM Index (Medium Level of TQM Implementation)					**2.988**

Table D9 : Relative Advancement Indices (RAI) of Manifest variables for the TQ-SMART for n= 63 ALL TQM Deploying Organisations

Implementation Construct	1	2	3	4	$\sum$Wi
1. Executive Commitment	0.70	0.65	0.67		**0.67**
2. Adopting the philosophy	0.72	0.64	0.36		**0.57**
3. Customer Focus	0.71	0.69	0.71	0.63	**0.67**
4. Supplier Focus	0.64	0.61	0.53		**0.59**
5. Benchmarking	0.51	0.50	0.48		**0.50**
6. Training	0.57	0.57	0.51	0.57	**0.55**
7. Open Organisation	0.66	0.63	0.60		**0.63**
8. Employee Empowerment	0.59	0.58	0.60	0.63	**0.60**
9. Zero Defects	0.61	0.65	0.66		**0.64**
10. Measurement	0.63	0.53	0.51	0.45	**0.53**
Overall TQM Index					**0.595**

Table D10 : Coefficient of Variation (CV) for the manifest variables for TQM-Deploying organisations (n= 20)

Implementation Construct	1	2	3	**4**	$\sum$CVi
1. Executive Commitment	23.82	23.60	20.38		**22.60**
2. Adopting the philosophy	25.14	22.94	82.32		**43.46**
3. Customer Focus	23.32	28.29	30.28	42.52	**31.10**
4. Supplier Focus	31.24	34.19	48.40		**37.94**
5. Benchmarking	49.39	57.98	55.12		**54.17**
6. Training	45.92	49.76	45.96	51.09	**49.15**
7. Open Organisation	35.29	41.30	55.18		**43.92**
8. Employee Empowerment	37.19	52.59	44.61	40.04	**43.61**
9. Zero Defects	49.29	39.02	42.51		**43.61**
10. Measurement	40.70	42.21	53.90	61.55	**49.59**

Table D11 : Coefficient of Variation (CV) for the manifest variables for the Non-TQM deploying organisations (n=43)

Implementation Construct	1	2	3	**4**	**$\sum$CVi**
1. Executive Commitment	48.26	48.59	42.94		**46.70**
2. Adopting the philosophy	44.59	47.96	60.30		**50.95**
3. Customer Focus	38.10	36.03	36.79	40.41	**37.83**
4. Supplier Focus	39.06	38.26	42.96		**40.09**
5. Benchmarking	52.15	45.71	52.72		**50.20**
6. Training	40.89	43.07	43.62	39.841	**41.18**
7. Open Organisation	35.69	37.16	41.68		**38.17**
8. Employee Empowerment	44.80	39.80	37.84	36.50	**39.74**
9. Zero Defects	44.67	39.20	36.03		**39.97**
10. Measurement	39.59	53.23	53.84	57.32	**51.00**

Table D12 : Coefficient of Variation (CV) for the manifest variables for the total sample (n= 63)

Implementation Construct	1	2	3	4	$\sum CVi$
1. Executive Commitment	41.74	42.74	37.47		**40.65**
2. Adopting the philosophy	39.31	42.07	66.53		**40.30**
3. Customer Focus	34.17	33.97	34.72	41.00	**35.97**
4. Supplier Focus	36.42	37.01	44.33		**39.25**
5. Benchmarking	50.91	49.23	53.79		**51.31**
6. Training	42.20	45.19	45.42	43.43	**44.06**
7. Open Organisation	35.52	38.23	45.66		**39.80**
8. Employee Empowerment	42.34	43.62	39.69	37.37	**40.75**
9. Zero Defects	39.69	45.81	37.31		**40.94**
10. Measurement	41.21	50.85	53.77	59.07	**51.23**

Table D13 : Average Weights (Mean Values), W_{ij} of the Latent Constructs of the TQ-SMART for the organisation used in the Validation Process

Implementation Construct	1	2	3	4	$\sum$ **Wi**
1. Executive Commitment	5	5	3		**4.33**
2. Adopting the philosophy	5	5	1		**3.67**
3. Customer Focus	5	4	1	4	**3.50**
4. Supplier Focus	4	4	4		**4.00**
5. Benchmarking	1	1	1		**1.00**
6. Training	1	1	3	1	**1.50**
7. Open Organisation	3	4	1		**2.67**
8. Employee Empowerment	4	4	2	3	**3.25**
9. Zero Defects	1	1	1		**1.00**
10. Measurement	1	1	1	1	**1.00**
Average					**25.92**
Overall Indicator (Low Level of Implementation)					**2.592**

Table D14: Latent Variables and Measurement Variables for the TQ-SMART Model for n= 20 TQM Deploying Organisations

Implementation Construct	R^2 Squared Multiple Correlation	Sample Question Manifest
1. Executive Commitment	0.7978	Fully committed to a quality program
2. Adopting the philosophy	0.3868	Quality principles in mission statement
3. Customer Focus	0.6465	Seeking Customer input
4. Supplier Focus	0.4411	Working closely with suppliers
5. Benchmarking	0.5998	A competitive benchmarking program
6. Training	0.7437	Employee in quality principles
7. Open Organisation	0.7383	Open trusting organisation culture
8. Employee Empowerment	0.6768	Autonomy in decision making
9.Zero Defects	0.5695	An announced goal of zero defects
10. Measurement	0.6745	Usage of appropriate statistical methods

Table D15: Classification of Constructs into Soft & Hard Aspects (Based on Powell 1995 and thuis Study)

Implementation Construct	This Study		Powell (1995)			
	Aspect		Aspect		Tangibles	
	Soft	Hard	Soft	Hard	I	Core
1. Executive Commitment	▲		▲		●	●
2. Adopting the philosophy	▲		▲		●	
3. Customer Focus		▲	▲		●	
4. Supplier Focus		▲	▲		●	
5. Benchmarking		▲		▲		●
6. Training	▲		▲		●	
7. Open Organisation	▲		▲		●	
8. Employee Empowerment	▲		▲		●	
9. Zero Defects		▲		▲		●
10. Measurement		▲		▲		●
Total	**5**	**5**	**7**	**3**	**6**	**4**

Table D16: Reliability Analysis - Scale (Split)

Factor (% variance explained) Variable	Corrected Item-Total Correlation	Square Multiple Correlation
1. Executive Commitment (%)		
Fully committed to a quality program	0.914	0.8786
Championing a quality program	0.937	0.9596
Communicating a quality commitment	0.781	0.9239
2. Customer Focus (%)		
Direct personal contacts with customers	0.878	0.8066
Customer inputs to requirements	0.914	0.8508
Seeking Customer inputs	0.800	0.6748
Customer involvement in design	0.815	0.8676
3. Supplier Focus (%)		
Working more closely with suppliers	0.852	0.7573
Suppliers to meet stricter Quality specifications	0.859	0.9011
Suppliers to adopt a Quality program	0.952	0.8686
4. Benchmarking (%)		
A competitive benchmarking program	0.951	0.8117
Researching best practice of other orgs.	0.906	0.8612
Visiting other organisations	0.936	0.8851
5. Training (%)		
Management in quality principles	0.930	0.9166
Employees in quality principles	0.917	0.8951
Employees in problem solving skills	0.933	0.9400
Employees in team work	0.832	0.9186
7. Open Organisation (%)		
Open, trusting organisation culture	0.948	0.9067
Less bureaucracy	0.917	0.9042
Use of empowered work teams	0.931	0.9118
8. Employee Empowerment (%)		
In design and planning	0.883	0.8544
Active employee suggestion system	0.848	0.8287
Autonomy in decision making	0.853	0.9244
Interaction with customers and suppliers	0.853	0.9045
9. Zero Defects (%)		
An announced goal of zero defect	0.803	0.7660
A program for continuous reduction	0.860	0.9309
A plan to drastically reduce rework	0.858	0.8718
10. Measurement (%)		
Of quality performance in all areas	0.878	0.8653
Graphs & Charts to measure & monitor	0.804	0.8829
Appropriate statistical methods	0.834	0.9243
Employee training in statistical methods	0.859	0.8399

Table D17: General Linear Model (Organisation Size = Small)
Between-Subject Factors[a]

		N
Executive Commitment	2.67	1
	3.67	1
	4.33	1
	5.00	3

Table D18: General Linear Model : Multivariate Tests [c, d]

1Effect	Value	Value	F	Hypothesis df	Error df	Sig
Intercept	Pillai's Trace	.861	3.100[a]	2.000	1.000	.373
	Wilk's Lambda	.139	3.100[a]	2.000	1.000	.373
	Hotelling's Trace	6.200	3.100[a]	2.000	1.000	.373
	Roy's Largets Root	6.200	3.100[a]	2.000	1.000	.373
FACTOR1	Pillai's Trace	1.000	.677	6.000	4.000	.688
	Wilk's Lambda	.250	.333[a]	6.000	2.000	.875
	Hotelling's Trace	2.000	.000	6.000	.000	.
	Roy's Largets Root	1.000	.667[b]	3.000	2.000	.646

a. Exact statistic
b. The statistic is an upper bound on F that yield a lower bound on the significance level.
c. Design: Intercept + FACTOR 1
d. Organisation Size = Small

Table D19: General Linear Model (Organisation Size = Medium)
Between-Subject Factors[a]

		N
Executive Commitment	2.67	1
	3.33	2
	3.67	2
	4.00	4
	4.33	1
	5.00	4

Table D20: General Linear Model : Multivariate Tests [c, d]

1Effect	Value	Value	F	Hypothesis df	Error df	Sig
Intercept	Pillai's Trace	.965	7.908[a]	7.000	2.000	.117
	Wilk's Lambda	.035	7.908[a]	7.000	2.000	.117
	Hotelling's Trace	27.679	7.908[a]	7.000	2.000	.117
	Roy's Largets Root	27.679	7.908[a]	7.000	2.000	.117
FACTOR1	Pillai's Trace	2.713	1.017	35.000	30.000	.485
	Wilk's Lambda	.003	.883[a]	35.000	10.843	.632
	Hotelling's Trace	20.973	.240	35.000	2.000	.976
	Roy's Largest Root	15.378	13.181[b]	7.000	6.000	.003

a. Exact statistic
b. The statistic is an upper bound on F that yield a lower bound on the significance level.
c. Design: Intercept + FACTOR 1
d. Organisation Size = Medium

Table D21: Tests of Between-Subjects Effects° (Organisation Size = Medium)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	MS	8.429	5	1.686	.793	.583
	SEP	6.857	5	1.371	.686	.648
	ROA	10.714	5	2.143	1.008	.471
	Int/Ext	9.429	5	1.886	.629	.684
	ROSP	4.714	5	.943	.503	.767
	Employee Satisfaction	4.429	5	.886	.337	.877
	Attendance	14.857	5	2.971	3.962	.042
	Useful Suggestions	4.714	5	.943	.444	.807
	Employee Turnover	10.429	5	2.086	1.112	.424
	Overall Satisfaction	7.857	5	1.571	.547	.738
	Customer Complaints	11.714	5	2.343	1.171	.400
	Customr Retention	14.714	5	2.943	1.121	.421
	Reliability	17.429	5	3.486	3.486	.057
	Timeliness of Deliver	19.429	5	3.886	2.220	.151
	Product Lead Time	17.429	5	3.486	3.486	.057
Intercept	MS	87.500	1	87.500	41.176	.000
	SEP	92.571	1	92.571	46.286	.000
	ROA	97.786	1	97.786	46.017	.000
	Int/Ext	126.000	1	126.000	42.000	.000
	ROSP	87.500	1	87.500	64.667	.000
	Employee Satisfaction	60.071	1	60.071	22.884	.001
	Attendance	41.143	1	41.143	54.857	.000
	Useful Suggestions	52.071	1	52.071	24.504	.001
	Employee Turnover	68.643	1	68.643	36.610	.000
	Overall Satisfaction	120.071	1	120.071	41.764	.000
	Customer Complaints	103.143	1	103.143	51.571	.000
	Customr Retention	108.643	1	108.643	41.388	.000
	Reliability	73.143	1	73.143	73.143	.000
	Timeliness of Deliver	73.143	1	73.143	41.796	.000
	Product Lead Time	73.143	1	73.143	73.143	.000
FACTOR1 (Executive Commitment)	MS	8.429	5	1.686	.793	.583
	SEP	6.857	5	1.371	.686	.648
	ROA	10.714	5	2.143	1.008	.471
	Int/Ext	9.429	5	1.886	.629	.684
	ROSP	4.714	5	.943	.503	.767
	Employee Satisfaction	4.429	5	.886	.337	.877
	Attendance	14.857	5	2.971	3.962	.042
	Useful Suggestions	4.714	5	.943	.444	.807
	Employee Turnover	10.429	5	2.086	1.112	.424
	Overall Satisfaction	7.857	5	1.571	.547	.738
	Customer Complaints	11.714	5	2.343	1.171	.400
	Customr Retention	14.714	5	2.943	1.121	.421
	Reliability	17.429	5	3.486	3.486	.057
	Timeliness of Deliver	19.429	5	3.886	2.220	.151
	Product Lead Time	17.429	5	3.486	3.486	.057

Table 22: Comparison of Tests of Between-Subjects Effects[0] by Organisation Size

Business and Organisation Performance Indicators	Medium Organisation		Small Organisation		Medium Organisation	
	Executive Commitment		Quality Philosophy			
	R Squared	Adjusted R Square	R Squared	Adjusted R Square	R Squared	Adjusted R Square
MS	.331	-.086	.500	-.250	.103	-.457
SEP	.300	-.138	.333	-.667	.236	-.242
ROA	.387	.003	.333	-.667	.235	-.243
Int/Ext	.282	-.167	.500	-.250	.322	-.102
ROSP	.239	-.236	.448	-.379	.229	-.253
Employee Satisfaction	.174	-.342	.500	-.250	.549	.267
Attendance	.712	.533	.765	.412	.297	-.143
Useful Suggestions	.217	-.272	.556	-.111	.104	-.457
Employee Turnover	.410	.041	.500	-.250	.103	-.457
Overall Satisfaction	.255	-.211	.500	-.250	.421	.059
Customer Complaints	.432	.062	.500	-.250	.163	-.360
Customr Retention	.412	.045	.500	-.250	.332	-.086
Reliability	.685	.489	.586	-.034	.313	-.116
Timeliness of Deliver	.581	.319	.200	-1.000	.525	.229
Product Lead Time	.685	.489	.500	-.250	.313	-.116

Table 23: Standardised Coefficients of Market Share

Model	Unstandardised Coefficents		Standardised Coefficients		
	B	Std. Error	Beta	t	Sig
1 (Constant)	3.502	2.164		1.618	.140
EC	.534	.713	.253	.750	.473
QP	.417	.814	.188	.512	.621
CF	-1.759e-02	.538	-.010	-.033	.975
SF	-.663	.474	-.310	-1.399	.195
BM	-.443	.334	-.343	-1.326	.217
TR	.213	.414	.141	.515	.619
OO	-.706	.445	-.552	-1.587	.147
EP	-.399	.446	-.283	-.893	.395
ZD	1.196	.493	.922	2.428	.038
ME	-.667	.421	-.505	-1.586	.147

Table D24 : Correlation Matrix

Implementation Construct	Item			
	(1)	(2)	(3)	(4)
Executive Commitment				
Fully committed to a quality program	**1.000**			
Championing a quality program	0.868	**1.000**		
Communicating a quality commitment to employees	0.743	0.875	**1.000**	
Adopting the philosophy				
Quality principles in mission/vision statement.	**1.000**			
An overall theme based on a quality program	0.741	**1.000**		
Entering a EFQM Award competition	-0.003	0.126	**1.000**	
Customer Focus				
Direct personal contacts with customers	**1.000**			
Customer inputs to requirements	0.846	**1.000**		
Seeking customer inputs	0.714	0.774	**1.000**	
Customer involvement in design	0.539	0.642	0.595	**1.000**
Supplier Focus				
Working more closely with suppliers	**1.000**			
Suppliers to meet stricter quality specifications	0.522	**1.000**		
Requiring suppliers to adopt a quality program	0.420	0.699	**1.000**	
Benchmarking				
A competitive benchmarking program	**1.000**			
Researching best practice of other organisations	0.357	**1.000**		
Visiting other organisations	0.267	0.725	**1.000**	
Training				
Management in quality principles	**1.000**			
Employees in quality principles	0.861	**1.000**		
Employees in problem solving skills	0.590	0.611	**1.000**	
Employees in team work	0.483	0.484	0.839	**1.000**
Open Organisation				
Open, trusting organisation culture	**1.000**			
Less bureaucracy	0.808	**1.000**		
Use of empowered work teams	0.818	0.931	**1.000**	
Employee Empowerment				
In design and planning	**1.000**			
Active employee suggestion system	0.694	**1.000**		
Autonomy in decision making	0.704	0.780	**1.000**	
Interaction with customers and suppliers	0.710	0.738	0.821	**1.000**
Zero Defects				
An announced goal of zero defect	**1.000**			
A program for continuous reduction	0.625	**1.000**		
A plan to drastically reduce rework	0.527	0.793	**1.000**	
Measurement				
Of quality performance in all areas	**1.000**			
Graphs & charts to measure & monitor	0.754	**1.000**		
Appropriate statistical methods	0.675	0.830	**1.000**	
Employee training in statistical methods	0.479	0.628	0.757	**1.000**

Method : Unweighted Least Squares, Rotation method : Oblimin with Kaiser Normalization

Table D25: Summary of ANOVA with Implementing TQM as the Dependent Variable - Non-Mechanist (Soft) 7 Construct Model

Model		Sum of Squares	df	Mean Square	F	Sig	Accept
1	Regression	1.719	3	.573	2.834	.046[a]	Yes
	Residual	11.931	59	.202			
	Total	13.651	62				
2	Regression	3.554	6	.495	2.598	.027[b]	Yes
	Residual	10.097	56	.191			
	Total	13.651	62				
3	Regression	3.706	10	.452	2.504	.018[c]	Yes
	Residual	9.945	52	.181			
	Total	13.651	62				

Appendix D1: The QQ-Plot of the Research Constructs

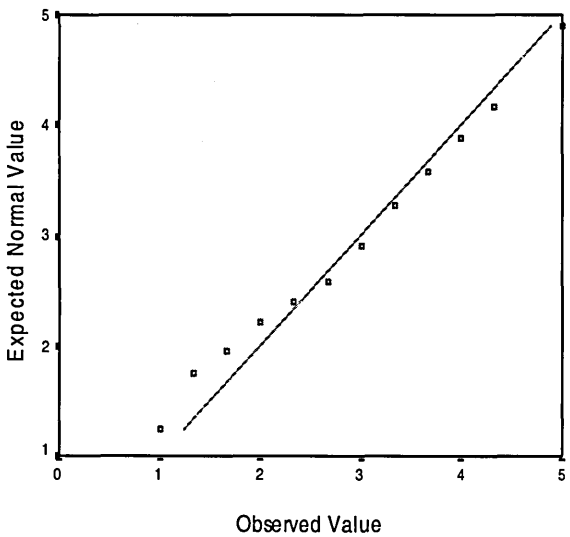

Figure D1 : Normal Q-Q Plot of Executive Committment

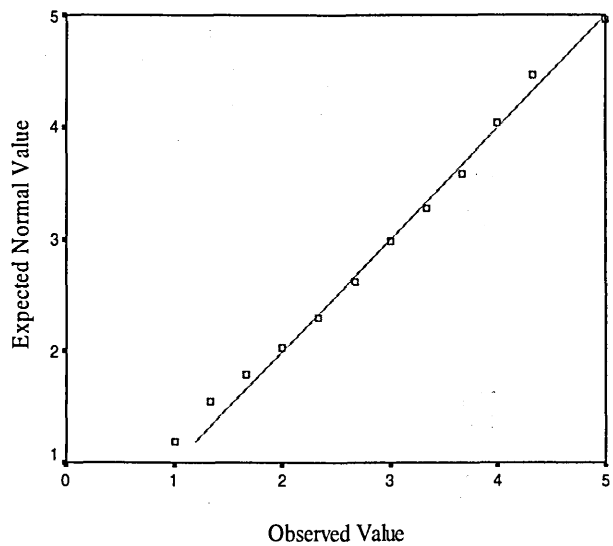

Figure D3 : Normal Q-Q Plot of Supplier Focus

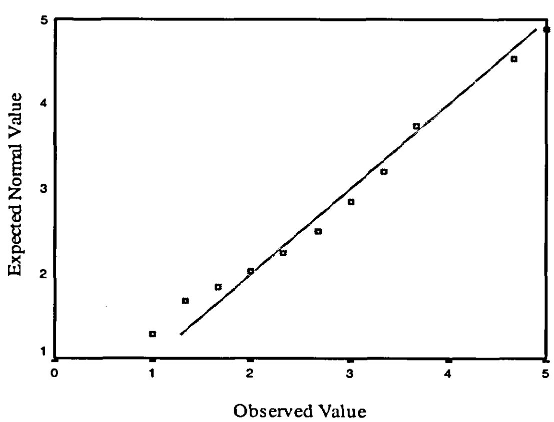

Figure D2 : Normal Q-Q plot of Adopting the Quality Philosophy

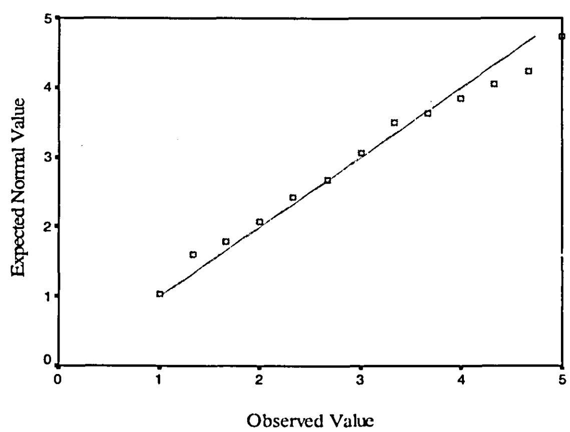

Figure D4 : Normal Q-Q Plot of Benchmarking

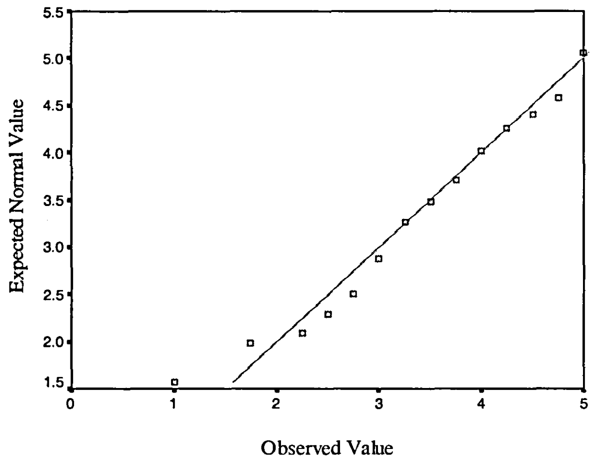

Figure D5 : Normal Q-Q Plot of Customer Focu

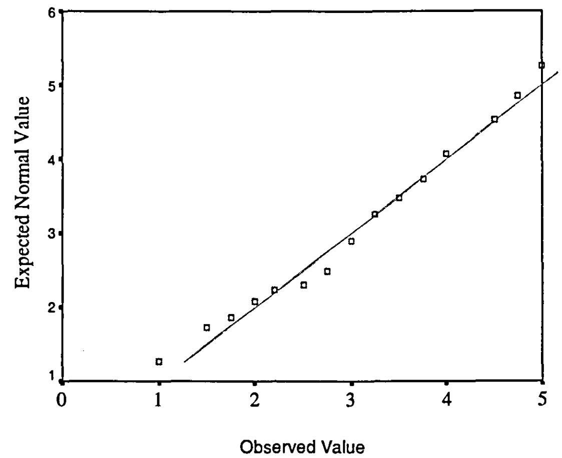

Figure D6 : Normal Q-Q plot of Training

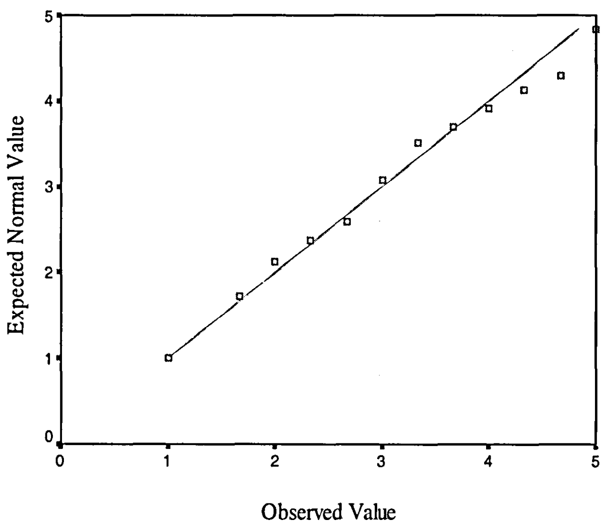

Figure D7 : Normal Q-Q Plot of Open Organisation

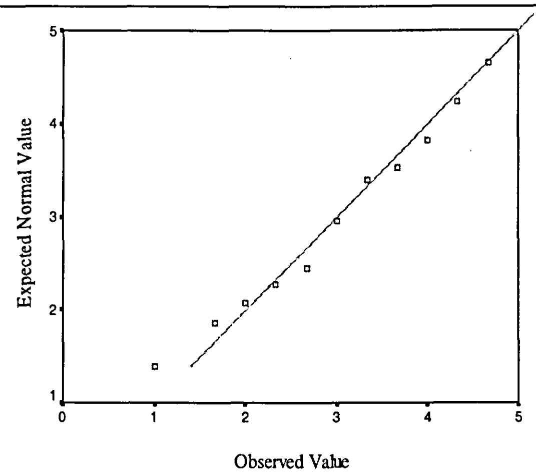

Figure D8 : Normal Q-Q Plot of Zero Defects

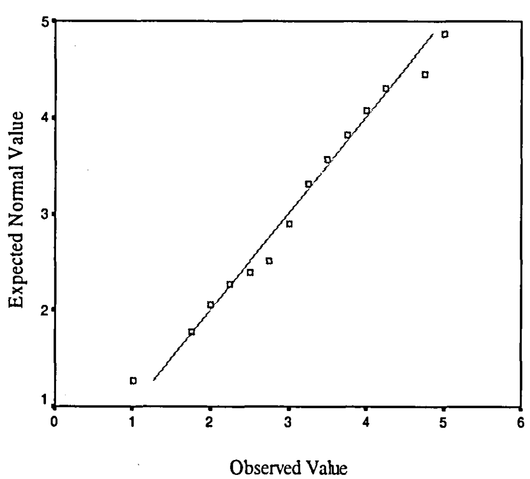

Figure D9 : Normal Q-Q Plot of Employee Empowerment

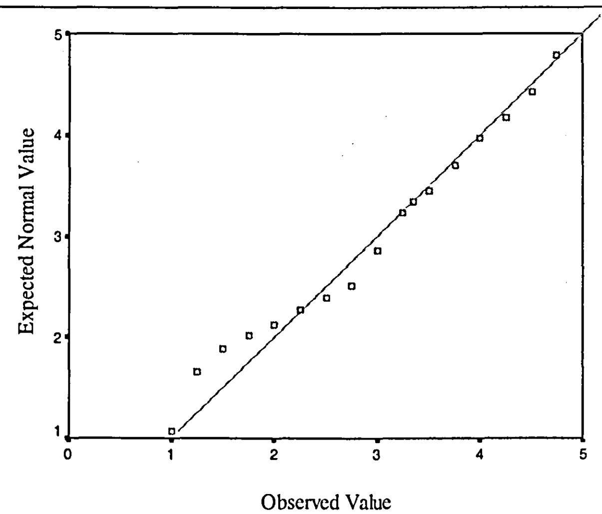

Figure D10: Normal Q-Q Plot of Measurement

APPENDIX E – BUSINESS AND ORGANISATION PERFORMANCE INDICATORS DESCRIPTIVE STATISTICS

Table E1: Total Scores for Item Scales (ALL Organisations n = 63)

Implementation Construct	**Items**				Total Score $\sum(\varphi)$
	1	2	3	4	
1	**2**	**3**	**4**	**5**	**6**
1. Executive Commitment	220	205	212		637
2. Adopting the philosophy	226	201	113		540
3. Customer Focus	224	218	223	200	865
4. Supplier Focus	201	192	166		559
5. Benchmarking	160	159	151		470
6. Training	181	178	161	179	699
7. Open Organisation	201	199	187		587
8. Employee Empowerment	187	184	188	199	758
9. Zero Defects	192	206	201		599
10. Measurement	197	168	160	142	667
Overall Score					6381

Table E2: Total Scores for Item Scales for TQM Deploying (n = 20)

Implementation Construct	**Items**				Total Score $\sum(\varphi)$
	1	2	3	4	
1	**2**	**3**	**4**	**5**	**6**
1. Executive Commitment	84	82	80		246
2. Adopting the philosophy	84	80	32		196
3. Customer Focus	81	78	76	68	303
4. Supplier Focus	66	66	52		184
5. Benchmarking	53	48	53		154
6. Training	57	59	43	50	209
7. Open Organisation	70	64	55		189
8. Employee Empowerment	65	56	58	64	243
9. Zero Defects	61	73	69		203
10. Measurement	72	65	55	50	242
Overall Score					2169

Table E3: Total Scores for Item Scales for non-TQM deploying (n = 43)

Implementation Construct	Items				Total Score $\sum(\varphi)$
	1	2	3	4	
1	**2**	**3**	**4**	**5**	**6**
1. Executive Commitment	136	123	131		390
2. Adopting the philosophy	142	121	82		345
3. Customer Focus	143	141	147	133	564
4. Supplier Focus	135	126	115		376
5. Benchmarking	107	111	98		316
6. Training	124	119	118	129	490
7. Open Organisation	138	135	132		189
8. Employee Empowerment	122	128	130	135	243
9. Zero Defects	131	133	141		405
10. Measurement	125	103	105	92	425
Overall Score					4212

Where $\varphi_{i\ co}$ is the total score of item (i) within component construct co

Table E4 : Relative Advancement of Scale Items, Total Score and Construct: $_{RAI}$ (ALL Organisations)

Implementation Construct	Relative Advancement Index of Scale Items				Total Score $\sum(\varphi)$	Construct RAI
	1	2	3	4		
1	**2**	**3**	**4**	**5**	**6**	**7**
1.Executive Commitment	0.698	0.651	0.673		637	0.674
2. Adopting the philosophy	0.717	0.638	0.358		540	0.572
3. Customer Focus	0.711	0.692	0.708	0.635	865	0.686
4. Supplier Focus	0.638	0.610	0.527		559	0.592
5. Benchmarking	0.508	0.505	0.479		470	0.498
6. Training	0.575	0.565	0.511	0.568	699	0.554
7.Open Organisation	0.660	0.632	0.594		587	0.628
8. Employee Empowerment	0.584	0.597	0.596	0.632	758	0.600
9. Zero Defects	0.609	0.653	0.660		599	0.642
10. Measurement	0.625	0.533	0.507	0.450	667	0.530
Overall Construct Relative Advance Index						**5.180**

Where $\varphi_{i\ co}$ is the total score of item (i) within component construct co

Table E5: Relative Advancement of Scale Items, Total Score and Construct RAI: TQM Deploying Organisations

Implementation Construct	Relative Advancement Index of Scale Items				Total Score	Construct RAI
	1	2	3	4	$\sum(\varphi)$	
1	**2**	**3**	**4**	**5**	**6**	**7**
1. Executive Commitment	0.840	0.820	0.810		246	0.820
2. Adopting the Philosophy	0.840	0.800	0.310		196	0.650
3. Customer Focus	0.810	0.770	0.760	0.670	303	0.760
4. Supplier Focus	0.660	0.660	0.510		184	0.610
5. Benchmarking	0.530	0.480	0.530		154	0.520
6. Training	0.570	0.590	0.430	0.500	209	0.530
7. Open Organisation	0.700	0.640	0.550		189	0.630
8. Employee Empowerment	0.650	0.560	0.580	0.640	243	0.610
9. Zero Defects	0.610	0.730	0.690		203	0.670
10. Measurement	0.720	0.650	0.550	0.500	242	0.610
Overall Construct Relative Advancement Index						**6.410**

Where $\varphi_{i\ co}$ is the total score of item (i) within component construct co

Table E6: Relative Advancement of Scale Items, Total Score and Construct RAI: non-TQM Deploying Organisations

Implementation Construct	Relative Advancement Index of Scale Items				Total Score	Construct RAI
	1	2	3	4	$\sum(\varphi)$	
1	**2**	**3**	**4**	**5**	**6**	**7**
1. Executive Commitment	0.580	0.550	0.620		390	0.584
2. Adopting the Philosophy	0.630	0.520	0.350		345	0.500
3. Customer Focus	0.640	0.620	0.650	0.540	564	0.612
4. Supplier Focus	0.470	0.450	0.350		376	0.500
5. Benchmarking	0.470	0.450	0.350		316	0.424
6. Training	0.510	0.490	0.500	0.540	490	0.510
7. Open Organisation	0.570	0.590	0.600		189	0.590
8. Employee Empowerment	0.500	0.230	0.520	0.580	243	0.457
9. Zero Defects	0.580	0.580	0.590		405	0.554
10. Measurement	0.500	0.420	0.420	0.350	425	**0.450**
Overall Construct Relative Advancement Index						**5.181**

Where $\varphi_{i\ co}$ is the total score of item (i) within component construct co

Table E7: Relative Advancement of Scale Items, Total Score and Construct: RAI (ALL Organisations)

Implementation Construct	Relative Advancement Index of Scale Items				Construct RAI	Centroid Construct Ǿ
	1	2	3	4		
1	**2**	**3**	**4**	**5**	**6**	**7**
1.Executive Commitment	0.698	0.651	0.673		0.674	0.1128
2. Adopting the philosophy	0.717	0.638	0.358		0.572	0.0957
3. Customer Focus	0.711	0.692	0.708	0.635	0.686	0.1148
4. Supplier Focus	0.638	0.610	0.527		0.592	0.0991
5. Benchmarking	0.508	0.505	0.479		0.498	0.0833
6. Training	0.575	0.565	0.511	0.568	0.554	0.0927
7.Open Organisation	0.660	0.632	0.594		0.628	0.1051
8. Employee Empowerment	0.584	0.597	0.596	0.632	0.600	0.1004
9. Zero Defects	0.609	0.653	0.660		0.642	0.1074
10. Measurement	0.625	0.533	0.507	0.450	0.530	0.0886
TOTAL					5.976	**1.000**

Where $\varphi_{i\ co}$ is the total score of item (i) within component construct co

Table E8: Relative Advancement of Scale Items, Total Score and Construct RAI: TQM Deploying Organisations

Implementation Construct	Relative Advancement Index of Scale Items				Construct RAI	Centroid Construct Ǿ
	1	2	3	4		
1	**2**	**3**	**4**	**5**	**6**	**7**
1. Executive Commitment	0.840	0.820	0.810		0.820	0.1279
2. Adopting the Philosophy	0.840	0.800	0.310		0.650	0.1014
3. Customer Focus	0.810	0.770	0.760	0.670	0.760	0.1186
4. Supplier Focus	0.660	0.660	0.510		0.610	0.0952
5. Benchmarking	0.530	0.480	0.530		0.520	0.0811
6. Training	0.570	0.590	0.430	0.500	0.530	0.0780
7. Open Organisation	0.700	0.640	0.550		0.630	0.0983
8. Employee Empowerment	0.650	0.560	0.580	0.640	0.610	0.0952
9. Zero Defects	0.610	0.730	0.690		0.670	0.1045
10. Measurement	0.720	0.650	0.550	0.500	0.610	0.0952
TOTAL					6.410	**1.000**

Where $\varphi_{i\ co}$ is the total score of item (i) within component construct co

Table E9: Relative Advancement of Scale Items, Total Score and Construct RAI: non-TQM Deploying Organisations

Implementation Construct	Relative Advancement Index of Scale Items				Construct RAI	Centroid Construct Ǿ
	1	2	3	4		
1	2	3	4	5	6	7
1. Executive Commitment	0.580	0.550	0.620		0.584	0.1127
2. Adopting the Philosophy	0.630	0.520	0.350		0.500	0.0965
3. Customer Focus	0.640	0.620	0.650	0.540	0.612	0.1181
4. Supplier Focus	0.470	0.450	0.350		0.500	0.0965
5. Benchmarking	0.470	0.450	0.350		0.424	00818
6. Training	0.510	0.490	0.500	0.540	0.510	0.0984
7. Open Organisation	0.570	0.590	0.600		0.590	0.1138
8. Employee Empowerment	0.500	0.230	0.520	0.580	0.457	0.0824
9. Zero Defects	0.580	0.580	0.590		0.554	0.1069
10. Measurement	0.500	0.420	0.420	0.350	0.450	0.0868
TOTAL					5.180	**1.000**

Where $\varphi_{i\ co}$ is the total score of item (i) within component construct co

Table E10: Mean Scores for Performance Indicators (n=20)

Performance Indicator	Frequency of Scoring			Mean	PI
	5 Greatly	3 Hardly	1 Not at All		
(1)	(2)	(3)	(4)	(5)	(6)
1.Financial Performance				**3.02**	**0.600**
Market Share	30.0	35.0	35.0	2.90	
Sales per employee (£)	20.0	50.0	30.0	2.80	
Return On Assets	25.0	45.0	30.0	2.90	
Internal and External Efficiency	50.0	25.0	25.0	3.50	
Return on Sales Profitability	25.0	50.0	25.0	3.00	
2. Employee Relations				**2.475**	**0.495**
Employee Satisfaction	20.0	45.0	35.0	2.70	
Attendance	10.0	35.0	55.0	2.10	
Number of Useful Suggestion Received	5.0	45.0	50.0	2.10	
Employee Turnover	10.0	55.0	35.0	3.00	
3. Customer Satisfaction				**3.00**	**0.600**
Overall Satisfaction	35.0	35.0	30.0	3.00	
Customer Complaints	35.0	35.0	30.0	3.00	
Customer Retention	35.0	35.0	30.0	3.00	
4. Operating Indicators				**2.57**	**0.514**
Reliability	25.0	40.0	35.0	3.00	
Timeliness of Delivery	15.0	40.0	45.0	2.40	
Product Lead Time	10.0	45.0	45.0	2.30	
Total Means of TQM Performance Indicators					**2.209**

Table E11: Reliability Analysis – Scale (alpha) of TQM Performance Measurement Indicator

Dependent Variable	Number of Items	alpha	Standardized item alpha
1	2	3	4
1. Financial Indicators	5	.9495	.9515
2. Employee Relations	4	.8388	..8389
3. Customer Satisfaction	3	.9261	.9260
4. Operating Indicators	3	.9106	.9138

Table E12: Four Dimensions of TQM Success and Organisational Performance

Factor (% variance explained) Variable	Factor Score	Cronbach's α	Standardized item alpha
1. Financial performance (%)		**.9495**	**.9515**
Market Share	.8186		
Sales Per Employee	.8456		
Return on Assets	.8049		
Internal and External Efficiency	.9055		
Return on Sales and Profitability	.8654		
2. Employee Relations (%)		**.8388**	**.8389**
Employee Satisfaction	.7943		
Attendance	.6919		
Number of Useful Suggestions Received	.6428		
Employee Turnover	.8310		
3. Customer Satisfaction (%)		**.9261**	**.9260**
Overall Satisfaction	.9467		
Customer Complaints	.8849		
Customer Retention	.8691		
4. Operating Indicators (%)		**.9106**	**.9138**
Reliability	.8774		
Timeliness of Delivery	.6981		
Product Lead Time	.6600		

Table E13: Summary of Reliability Analysis – Scale (Split) : Performance Measures

Factor (% variance explained) Variable	Corrected Item-Total Correlation	Squared Multiple Correlation	Standardized alpha
1. Financial performance (%)		**.9495**	**.9515**
Market Share	.8186		
Sales Per Employee	.8456		
Return on Assets	.8049		
Internal and External Efficiency	.9055		
Return on Sales and Profitability	.8654		
2. Employee Relations (%)		**.8388**	**.8389**
Employee Satisfaction	.7943		
Attendance	.6919		
Number of Useful Suggestions Received	.6428		
Employee Turnover	.8310		
3. Customer Satisfaction (%)		**.9261**	**.9260**
Overall Satisfaction	.9467		
Customer Complaints	.8849		
Customer Retention	.8691		
4. Operating Indicators (%)		**.9106**	**.9138**
Reliability	.8774		
Timeliness of Delivery	.6981		
Product Lead Time	.6600		

Table E14 : Four Dimensions of TQM Success and Organisational Performance

Factor (% variance explained) Variable (α)	Mean	Rank
1. Financial performance (%) (0.9495)	**3.02**	
Market Share	2.90	4
Sales Per Employee	2.80	5
Return on Assets	2.90	3
Internal and External Efficiency	3.50	1
Return on Sales and Profitability	3.00	2
2. Employee Relations (%) (0.8388)	**2.35**	
Employee Satisfaction	2.70	1
Attendance	2.10	4
Number of Useful Suggestions Received	2.10	3
Employee Turnover	2.50	2
3. Customer Satisfaction (%) (.9291)	**3.20**	
Overall Satisfaction	3.40	1
Customer Complaints	3.10	2
Customer Retention	3.10	2
4. Operating Indicators (%) (.9106)	**2.50**	
Reliability	2.80	1
Timeliness of Delivery	2.40	2
Product Lead Time	2.30	3

Table E15: Second-Order Factor Loadings of BOPI Constructs

Path	Factor Loading	Standardised Regression Weights	Squared Multiple Correlations
BOPI- F1	ϑ_{11}	1.000	1.000
BOPI - F2	ϑ_{21}	0.870	0.756
BOPI - F3	ϑ_{31}	0.692	0.478
BOPI - F4	ϑ_{41}	1.172	1.373

Table E16 : Correlation Matrix

Business and Organisation Performance Indicators (BOPI)	Item				
	1	2	3	4	5
1. Financial performance					
Market Share	**1.000**				
Sales Per Employee	.8788	**1.000**			
Return on Assets	.8356	.8592	**1.000**		
Internal and External Efficiency	.6932	.7322	.7538	**1.000**	
Return on Sales and Profitability	.7909	.8081	.7645	.8528	**1.000**
2. Employee Relations					
Employee Satisfaction	**1.000**				
Attendance	.599**	**1.000**			
Number of Useful Suggestions Received	.474	.535*	**1.000**		
Employee Turnover	.728**	.552*	.611**	**1.000**	
3. Customer Satisfaction					
Overall Satisfaction	**1.000**				
Customer Complaints	.809	**1.000**			
Customer Retention	.870	.654	**1.000**		
4. Operating Indicators					
Reliability	**1.000**				
Timeliness of Delivery	.7657	**1.000**			
Product Lead Time	.7268	.8459	**1.000**		

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table E17 : Summary of Intraclass Correlation Coefficient

Indicator	DF	Single Measure Interclass Correlation			Average Measure Intraclass Correlation		
		F	Lower	Upper	F	Lower	Upper
Financial Performance	19, 76	19.7888	.6514	.8966	19.788	.9033	.9775
Employee Relations	19, 57	6.2018	.3483	.7663	6.2018	.6813	.9292
Customer Satisfaction	19, 38	13.5364	.6440	.9110	13.5364	.8444	.9685
Operating Indicators	19, 38	11.1871	.5897	.8936	11.1871	.8117	.9618

Table E18: Summary of Item Means

DIMENSION	Item Means					
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Financial Performance	3.020	2.800	3.500	.700	1.2500	.0770
Employee Relations	2.350	2.100	2.700	.600	1.2857	.0900
Customer Satisfaction	3.200	3.100	3.400	.3000	1.0968	.0300
Operating Indicators	2.500	2.300	2.800	.5000	1.2174	.0700

Table E19: Summary of Item Variances

DIMENSION	Item Variances					
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Financial Performance	2.4189	2.0632	2.8947	.8316	1.4031	.1397
Employee Relations	1.800	1.4632	2.2211	.7579	1.5180	.1097
Customer Satisfaction	2.7439	2.7263	2.7789	.0526	1.0193	.0009
Operating Indicators	2.1439	1.8000	2.4842	.6842	1.3801	.1170

Table E20 : Summary of Inter-Item Covariances

DIMENSION	Inter- Item Covariances					
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Financial Performance	1.9105	1.6842	2.1053	.4211	1.2500	.0235
Employee Relations	1.0175	.6211	1.4000	.7789	2.2542	.0827
Customer Satisfaction	2.2140	1.8842	2.4842	.6000	1.3184	.0741
Operating Indicators	1.6561	1.5368	1.7684	.2316	1.1507	.0108

Table E21 : Summary of Inter-Item Correlations

DIMENSION	Inter- Item Correlations					
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Financial Performance	.7969	.6932	.8788	.1856	1.2677	.0035
Employee Relations	.5656	.3740	.6912	.3172	1.8479	.0168
Customer Satisfaction	.8066	.6911	.9025	.2114	1.3059	.0092
Operating Indicators	.7795	.7268	.8459	.1192	1.1640	.0030

Table E22: Summary of Reliability Analysis : Scale for Individual Dimensions

DIMENSION	Statistics for Scale			
	Mean	Variance	Std Dev	No of variables
Financial Performance	15.10	50.3053	7.0926	5
Employee Relations	9.400	19.4105	4.4057	4
Customer Satisfaction	9.600	21.5158	4.6385	3
Operating Indicators	7.500	16.3684	4.0458	3

Table E23: Summary of Intraclass Correlation Coefficient

Indicator	Single Measure Intraclass Correlation			Average Measure Intraclass Correlation		
	Sig	Test Value	Coefficient	Sig	Test Value	Coefficient
Financial Performance	0.000	0.0000	.7898*	.0000	0.0000	.9495**
Employee Relations	.0000	.0000	.5653*	.0000	.0000	.8388**
Customer Satisfaction	.0000	.0000	.8069*	.0000	.0000	.9261**
Operating Indicators	.00000	.0000	.7725*	.0000	.0000	.9106**

* Notice that the same estimator is used whether the interaction effect is present or not.
** This estimate is computed if the interaction effect is absent
All estimates based on 95% Confidences Interval of the Difference

Table E24 : Results of Regression Analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.886	5	.577	.495	.775[a]
	Residual	16.314	14	1.165		
	Total	19.200	19			
2	Regression	9.063	9	1.007	.993	.499[b]
	Residual	10.137	10	1.014		
	Total	19.200	19			
3	Regression	11.655	12	.971	.901	.584[c]
	Residual	7.545	7	1.078		
	Total	19.200	19			
4	Regression	13.200	14	.943	.786	.671[d]
	Residual	6.000	5	1.200		
	Total	19.200	19			

E25: Model Summary for the BOPI

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.388[a]	.150	-.153	1.07949
2	.687[b]	.472	-.003	1.00683
3	.779[c]	.607	-.067	1.03819
4	.829[d]	.688	-.187	1.09545

APPENDIX F: ANOVA OF TQM IMPLEMENTATION CONSTRUCTS, BOPI and COMPETITIVE FACTORS

Table F1: ANOVA for self-assessment of Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between People	1318.2278	62	21.2617	10.465	.0000
Within people	2428.32	2079	1.1680		
Total	3746.55	2141	1.7499		

Table F2: ANOVA for self-assessment of Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*P* value
Between Measures	350.71	33	10.6276	10.465	.0000
Residual	2077.61	2046	1.0155		

Table F3: ANOVA for the role of Executive Commitment in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	309.4074	62	4.9904		.0703
Within people	42.667	126	.3386	2.7124	
Total	352.0741	2141	1.8727		

Table F4: ANOVA for the role of Executive Commitment in the Advancement of TQM Implementation – Between Measures

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	1.7884	2	.8942	2.7124	.0703
Residual	40.8783	124	.3297		

Table F5: ANOVA for the role of Adopting a Quality Philosophy in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	173.8095	62	2.8034	46.3848	.0000
Within people	261.3333	162	2.0741		
Total	435.1429	188	2.3146		

Table F6: ANOVA for the role of Adopting a Quality Philosophy in the Advancement of TQM Implementation – Between Measures

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	111.8413	2	55.9206	46.3848	.0000
Residual	1449.4921	124	1.2056		

Table F7: ANOVA for the role of Customer Focus in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	285.6032	62	4.6065		.0080
Within people	96.2500	189	.5093	4.0609	
Total	381.8532	251			

Table F8: ANOVA for the role of Customer Focus in the Advancement of TQM Implementation – Between Residuals

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	5.9167	3	4.6065	4.0609	.0080
Residual	90.3333	186	.5093		

Table F9: ANOVA for the role of Supplier Focus in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	172.3280	62	2.7795		.0003
Within people	85.3333	126	.6772	8.6868	
Total	257.6614	188			

Table F10: ANOVA for the role of Supplier Focus in the Advancement of TQM Implementation (Between Measures)

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	10.4868	2	5.2434	8.6868	.0003
Residuals	74.8466	124	1.3705		

Table F11: ANOVA for the role of Employee Empowerment in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	298.9841	62	4.8223		
Within people	75.000	189	.3968	1.7402	.1603
Total	373.9841	251	1.4900		

Table F12: ANOVA for the role of Employee Empowerment in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	2.0476	3	.6825	1.7402	.1603
Residuals	72.9524	186	.3922		

Table F13: ANOVA for the role of Open Organisation in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	253.8095	62	4.0937		
Within people	39.3333	126	.3122	6.1011	.0030
Total	293.1429	188	1.5593		

Table F14: ANOVA for the role of Open Organisation in the Advancement of TQM Implementation (Between Measures)

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	3.5238	2	1.7619		
Residuals	35.8095	124	.2888		

Table F15: ANOVA for the role of Benchmarking in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between People	247.2169	62	3.9874	.8672	.4277
Within people	56.0000	126	.4444		
Total	303.2169	188	1.6129		

Table F16: ANOVA for the role of Benchmarking in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between People	.7725	2	.3862	.8672	.4277
Residuals	55.2275	124	.4454		

Table F17: ANOVA for the role of Training in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	270.8571	62	4.3687		.0573
Within people	103.2500	189	.5463	2.5478	
Total	374.1071	251	1.4905		

Table F18: ANOVA for the role of Training in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	4.0754	3	1.3585	2.5478	.0573
Residuals	99.1746	186	.5332		

Table F19: ANOVA for the role of Measurement in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	339.3175	62	5.4729		.0000
Within people	128.2500	189	.6787	15.0091	
Total	467.5675	251			

Table F20: ANOVA for the role of Measurement in the Advancement of TQM Implementation

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	24.9960	3	8.3320	15.0091	.0000
Residual	103.2540	186	.5551		

Table F21: Summary of ANOVA for the TQM Advancement

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between People	1318.2278	62	21.2617		
Within people	2428.32	2079	1.1680		
Between Measures	350.71	33	10.6276	10.465	.0000
Residual	2077.61	2046	1.0155		
Total	3746.55	2141	1.7499		
Grand Mean	2.9855				

Hotelling's T-Squared = 172.5988, F = 2.5308, Prob. = 0.0060, Degrees of Freedom, Numerator = 33, Denominator = 30

Table F22 Test for Goodness of Fit Model - Parallel

Chi-square	1525.9759
Degrees of Freedom	593
Log of determinant of unconstrained nmatrix	2428.32
Log of determinant of constrained nmatrix	-26.671594
Probalility	.0000
Residual	2077.61
Total	3746.55
Grand Mean	2.9855

Table F23: Parameter Estimates

Estimated common variance Error variance True variance	1.6109 1.0155 0.5955
Estimated common inter-item correlation	0.3696
Log of determinant of unconstrained nmatrix	2428.32
Log of determinant of constrained nmatrix	-26.671594
Estimated reliability of scale	.9522
Unbiased estimate of reliability	.9538

Table F24: ANOVA for ALL the TQM Measurement Indicators – Between People

Source of Variation	Sum of Sq. SS	Degree of Freedom DF	Mean Square MS	Chi-square	*p* value
Between People	451.2533	19	23.7502	5.0341	.0266
Within people	245.333	280	0.8762		
Total	696.5867	299	2.3297		

Table F25: ANOVA for ALL the TQM Measurement Indicators – Between Measures

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	51.3867	14	3.6705	5.0341	.0000
Residual	193.9467	266	.7291		
Nonadditivity	13.3022	1	13.3022	19.5140	.0000
Balance	180.644	265	.6817		

Table F26 : ANOVA for the Financial Performance Indicators – Between People

Source of Variation	Sum of Sq. SS	Degree of Freedom DF	Mean Square MS	Chi-square	*p* value
Between People	191.16	18	10.0611	5.0341	.0266
Within people	44.800	80	0.5600		
Total	235.96	99	2.3834		

Coefficient of Concordance W = .0261

Table F27: ANOVA for the Financial Performance Indicators – Between Measures

Source of Variation	Sum of Sq. SS	DF	Mean Square	Chi-square (F)	*p* value
Between Measures	6.160	4	1.5400	11.000	.0266
Residual	38.640	76	.5084	(3.0290)	
Nonadditivity	.1695	1	.1695	.3305	.5671
Balance	38.4705	75	.5129		

Table F28: ANOVA for the Employee Relations Indicators – Between Measures

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between Measures	5.40	3	1.800		
Residual	44.60	57	.782		
Nonadditivity	1.0946	1	1.0946	1.4089	.2402
Balance	43.50	56	.7769		

Table F29: ANOVA for the Employee Relations Indicators (Between People)

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between People	92.20	19	4.8526		
Within people	50.00	60	.8333	2.3004	.0869
Total	142.0	79			

Table F30: ANOVA for the Customer Satisfaction Indicators – For Measures & Residuals

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between Measures	5.400	3	1.800	2.3004	
Residual	44.60	57	.5298		.0869
Nonadditivity	1.0946	1	1.0946		
Balance	45.5054	56	.7769	1.4089	.2402
			1.8000		

Table F31: ANOVA for the Customer Satisfaction Indicators (Between People)

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between People	92.200	19	4.8526		
Within people	50.000	60	.8333	5.2500	.0869
Total	142.200	79	2.1186		

Table F32: ANOVA for the Operating Indicators (Between People)

Source of Variation	Sum of Sq. SS	DF	Mean Square	Q	P value
Between People	136.2667	19	7.1719		
Within people	21.333	40	.5333	1.1325	.3329
Total	157.60	59	2.6712		

Grand Mean 3.200

Table F33: ANOVA for the Operating Indicators – For Measures & Residuals

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between Measures	1.200	2	.6000	1.1325	.3329
Residuals	21.333	38	.5298		
Nonadditivity	.1764	1	.1764	.3270	.5709
Balance	19.9569	37	.5394		

Table F34: ANOVA for the Impact of TQM on Competitive Factors

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	*p* value
Between People	26916462	62	434136.48	4.8662	.0009
Within people	242.80	252	1.1680		
Total	26916704	314	85721.990		

Table F35: ANOVA for the Impact of TQM on Competitive Factors

Source of Variation	Sum of Sq. SS	DF	Mean Square	F	P value
Between Measures	17.6698	4	4.4175	4.8662	.0009
Residual	225.1302	248	.9078		
Total	3746.55	2141	85721.99		

Hotelling's T-Squared = 17.9209, F = 4.2634, Prob. = 0.0043, Degrees of Freedom, Numerator = 4, Denominator = 59

APPENDIX G : STRUCTURAL EQUATION MODELLING RESULTS

TABLE G1: FIRST and SECOND ORDER RESULTS OF THE TQM DEPLOYMENT CONSTRUCTS: FULL SAMPLE

Fit Measure	TWO FACTOR MODEL (Soft- Hard)			SECOND ORDER TQM (10 Factors)			ONE FACTOR TQM MODEL			Macro
	Default Model	Saturated	Independence	Default Model	Saturated	Independence	Default Model	Saturated	Independence	
1	2	3	4	5	6	7	8	9	10	11
Discrepancy	44.290	0.000	117.909	1091.89	0.000	2641.159	1757.31	0.000	2641.159	CMIN
Degrees of Freedom	34	0	45	517	0	561	527	0	561	DF
P	0.111		0.000	0.000		0.000	0.000		0.000	P
Number of parameters	21	55	10	78	595	34	68	595	34	NPAR
Discrepancy / df	1.303		2.620	2.112		4.708	3.335		4.708	CMINDF
RMR	0.115	0.000	0.468	0.237	0.000	0.639	0.264	0.000	0.639	RMR
GFI	0.740	1.000	0.383	0.543	1.000	0.148	0.326	1.000	0.148	GFI
Adjusted GFI	0.579		0.246	0.474		0.097	0.239		0.097	AGFI
Parsimony-adjusted GFI	0.457		0.314	0.471		0.140	0.288		0.140	PGFI
Normed fit index	0.624	1.000	0.000	0.587	1.000	0.000	0.335	1.000	0.000	NFI
Relative fit index	0.503		0.000	0.551		0.000	0.292		0.000	RFI
Incremental fit index	0.877	1.000	0.000	0.729	1.000	0.000	0.418	1.000	0.000	IFI
Tucker-Lewis index	0..813		0.000	0.700		0.000	0.370		0.000	TLI
Comparative fit index	0.859	1.000	0.000	0.724	1.000	0.000	0.409	1.000	0.000	CFI
Parsimony ratio	0.756	0.000	1.000	0.922	0.000	1.000	0.939	0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.472	0.000	0.000	0.541	0.000	0.000	0.314	0.000	0.000	PNFI
Parsimony-adjusted CFI	0.649	0.000	0.000	0.667	0.000	0.000	0.384	0.000	0.000	PCFI
Akaike information criterion	86.290	110.00	137.909			2709.159	1893.31	1190.000	2709.159	AIC
Browne-Cudeck criterion	144.040	261.250	165.409			2797.307	2069.61	2732.593	2797.307	BCC
Bayes information criterion	155.555	291.407	170.892			2901.922	2278.84	4563.350	2901.922	BIC
Consistent AIC	128.200	219.765	257.866			2816.026	2107.04	3060.165	2816.026	CAIC
Expected cross validation index	4.542	5.789	7.258			43.696	30.537	19.194	43.696	ECVI
ECVI lower bound	4.000	5.789	5.765			41.177	28.547	19.194	41.177	ECVILO
ECVI upper bound	5.664	5.789	9.155			46.335	32.650	19.194	46.335	ECVIHI
MECVI	7.581	13.750	8.706			45.118	33.381	44.074	45.118	MECVI

TABLE G2: FIRST and SECOND ORDER RESULTS OF TQM DEPLOYMENT CONSTRUCTS: (Non-TQM Deploying)

Fit Measure	SOF MODEL (10 Constructs)			RE-SPECIFIED SOF MODEL			RE-SPECIFIED (2^{nd}) SOF MODEL			Macro
	Default Model	Saturated	Independence	Default Model	Saturated	Independence	Default Model	Saturated	Independence	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Discrepancy	139.350	0.000	308.912	59.055	0.000	308.912	44.748	0.000	308.912	CMIN
Degrees of Freedom	35	0	45	31	0	45	29	0	45	DF
P	0.000		0.000	0.002		0.000	0.031		0.000	P
Number of parameters	20	55	10	24	595	10	26	595	10	NPAR
Discrepancy / df	3.981		6.865	1.905		6.865	1.543		6.865	CMINDF
RMR	0.216	0.000	0.526	0.142	0.000	0.526	0.136	0.000	0.526	RMR
GFI	0.581	1.000	0.320	0.785	1.000	0.320	0.817	1.000	0.320	GFI
Adjusted GFI	0.342		0.169	0.618		0.169	0.654		0.169	AGFI
Parsimony-adjusted GFI	0.370			0.442			0.431			PGFI
Normed fit index	0.549	1.000	0.000	0.809	1.000	0.000	0.855	1.000	0.000	NFI
Relative fit index	0.420		0.000	0.722		0.000	0.775		0.000	RFI
Incremental fit index	0.619	1.000	0.000	0.899	1.000	0.000	0.944	1.000	0.000	IFI
Tucker-Lewis index	0.492		0.000	0.846		0.000	0.907		0.000	TLI
Comparative fit index	0.605	1.000	0.000	0.894	1.000	0.000	0.940	1.000	0.000	CFI
Parsimony ratio	0.778	0.000	1.000	0.689	0.000	1.000	0.644	0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.427	0.000	0.000	0.557	0.000	0.000	0.551	0.000	0.000	PNFI
Parsimony-adjusted CFI	0.470	0.000	0.000	0.616	0.000	0.000	0.606	0.000	0.000	PCFI
Akaike information criterion	179.350	110.00	263.912	107.055	110.000	263.912	96.748	110.000	263.912	AIC
Browne-Cudeck criterion	193.543	149.032	336.009	124.088	149.032	336.009	115.200	149.032	336.009	BCC
Bayes information criterion	260.626	333.508	369.550	204.586	333.508	369.550	202.406	333.508	369.550	BIC
Consistent AIC	234.574	261.866	356.524	173.324	261.866	356.524	168.539	261.866	356.524	CAIC
Expected cross validation index	4.270	2.619	7.831	2.549	2.619	7.831	2.304	2.619	7.831	ECVI
ECVI lower bound	3.494	2.619	6.594	2.122	2.619	6.594	1.964	2.619	6.594	ECVILO
ECVI upper bound	5.227	2.619	9.247	3.161	2.619	9.247	2.831	2.619	9.247	ECVIHI
MECVI	4.608	3.548	8.000	2.954	3.548	8.000	2.743	3.548	8.000	MECVI

TABLE G3: STRUCTURAL EQUATION MODELLING RESULTS

Fit Measure	NON-MECHANISTIC MODEL			MEASUREMENT MODEL			RESPECIFIED TWO FACTOR MODEL			Macro
	Default Model	Saturated	Independence	Default Model	Saturated	Independence	Default Model	Saturated	Independence	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Discrepancy	13.966	0.000	47.256	11.758	0.000	178.803	26.11	0.000	117.909	CMIN
Degrees of Freedom	5	0	10	2	0	6	32	0	45	DF
P	0.016		0.000	0.003		0.000	0.759		0.000	P
Number of parameters	10	15	5	8	10	4		55	10	NPAR
Discrepancy / df	2.793		4.726	5.879		29.800			2.620	CMINDF
RMR	0.081	0.000	0.449	0.078	0.000	0.953	0.012	0.000	0.468	RMR
GFI	0.820	1.000	0.495	0.906	1.000	0.407	0.804	1.000	0.383	GFI
Adjusted GFI	0.461		0.242	0.528		0.012			0.246	AGFI
Parsimony-adjusted GFI	0.273		0.330	0.181		0.244			0.314	PGFI
Normed fit index	0.704	1.000	0.000	0.934	1.000	0.000		1.000	0.000	NFI
Relative fit index	0.409		0.000	0.803		0.000			0.000	RFI
Incremental fit index	0.788	1.000	0.000	0.945	1.000	0.000		1.000	0.000	IFI
Tucker-Lewis index	0.519		0.000	0.944		0.000	1.114		0.000	TLI
Comparative fit index	0.759	1.000	0.000		1.000	0.000	1.000	1.000	0.000	CFI
Parsimony ratio	0.500	0.000	1.000	0.333	0.000	1.000		0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.352	0.000	0.000	0.311	0.000	0.000		0.000	0.000	PNFI
Parsimony-adjusted CFI	0.380	0.000	0.000	0.315	0.000	0.000		0.000	0.000	PCFI
Akaike information criterion	33.966	30.000	57.256	27.758	20.000	186.803		110.00	137.909	AIC
Browne-Cudeck criterion	43.197	43.846	61.871	29.162	21.754	187.504		261.250	165.409	BCC
Bayes information criterion	60.018	69.078	70.281	55.994	55.294	200.920		291.407	170.892	BIC
Consistent AIC	53.923	59.936	67.234	52.903	51.431	199.375		219.765	257.866	CAIC
Expected cross validation index	1.788	1.579	3.013	0.448	0.323	3.013		5.789	7.258	ECVI
ECVI lower bound	1.390	1.579	2.080	0.330	0.323	2.368		5.789	5.765	ECVILO
ECVI upper bound	2.586	1.579	4.343	0.686	0.323	3.777		5.789	9.155	ECVIHI
MECVI	2.274	2.308	3.256	0.470	0.351	3.024		13.750	8.706	MECVI

TABLE G4: STRUCTURAL EQUATION MODELLING RESULTS

Fit Measure	TQM ON FINANCIAL PERF			TEN FACTOR MODEL (Fig 7.25)			ONE FACTOR MECHANISTIC MODEL (**Figure 6.70**)			Macro
	Default Model	Saturated	Independence	Default Model	Saturated	Independence	Default Model	Saturated	Independence	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Discrepancy	19.946	0.000	80.119	152.200	0.000	374.863	207.271	0.000	506.667	CMIN
Degrees of Freedom	14	0	28	35	0	45	44	0	55	DF
P	0.132		0.000	0.000		0.000	0.000		0.000	P
Number of parameters	22	36	8	20	55	10	22	66	11	NPAR
Discrepancy / df	1.425		2.861	4.349		8.330	4.711		9.212	CMINDF
RMR	0.371	0.000	0.379	0.172	0.000	0.498	0.591	1.000	0.000	RMR
GFI	0.817	1.000	0.480	0.671	1.000	0.350	0.489		0.000	GFI
Adjusted GFI	0.528		0.332	0.483		0.206	0.647	1.000	0.000	AGFI
Parsimony-adjusted GFI	0.318		0.374	0.427		0.287	0.548		0.000	PGFI
Normed fit index	0.751	1.000	0.000	0.594	1.000	0.000	0.591	1.000	0.000	NFI
Relative fit index	0.502		0.000	0.478		0.000	0.489		0.000	RFI
Incremental fit index	0.910	1.000	0.000	0.655	1.000	0.000	0.647	1.000	0.000	IFI
Tucker-Lewis index	0.772		0.000	0.543		0.000	0.548		0.000	TLI
Comparative fit index	0.886	1.000	0.000	0.645	1.000	0.000	0.639	1.000	0.000	CFI
Parsimony ratio	0.500	0.000	1.000	0.778	0.000	1.000	0.800	0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.376	0.000	0.000	0.462	0.000	0.000	0.473	0.000	0.000	PNFI
Parsimony-adjusted CFI	0.443	0.000	0.000	0.501	0.000	0.000	0.511	0.000	0.000	PCFI
Akaike information criterion	63.946	72.00	96.119	192.200	133.725	394.863	251.271	132.000	528.667	AIC
Browne-Cudeck criterion	103.54	136.80	110.519	200.827	133.725	399.177	261.831	163.680	533.947	BCC
Bayes information criterion	131.60	182.70	120.720	281.114	354.515	439.321	351.174	431.708	578.618	BIC
Consistent AIC	107.85	143.85	112.720	255.063	282.872	429.295	320.420	339.447	563.241	CAIC
Expected cross validation index	3.366	3.789	5.059	3.100	1.774	6.369	4.053	2.129	8.527	ECVI
ECVI lower bound	3.053	3.789	3.847	2.544	1.774	5.432	3.390	2.129	7.425	ECVILO
ECVI upper bound	4.207	3.789	6.673	3.778	1.774	7.426	4.837	2.129	9.749	ECVIHI
MECVI	5.450	7.2000	5.817	3.239	2.157	6.438	4.223	2.640	8.612	MECVI

TABLE G5: STRUCTURAL EQUATION MODELLING RESULTS

Fit Measure	BOPI -EMPLOYEE RELATIONS MODEL (**Figure 7.6**)			RE-SPECIFIED (3rd) SOF MODEL			RE-SPECIFIED (2nd) SOF MODEL			RE-SPECIFIED (2nd) SOF MODEL
	Default Model	Default Model	Default Model	Default Model	Saturated	Independence	Default Model	Saturated	Independence	
1	**2**	**8**	**8**	**8**	**6**	**7**	**8**	**9**	**10**	**11**
Discrepancy	1.734	44.748	44.748	38.40	0.000	46.325	19.946	0.000	80.119	CMIN
Degrees of Freedom	2	29	29	28	0	6	14	0	28	DF
P	0.420	0.031	0.031	0.092		0.000	0.132		0.000	P
Number of parameters	8	26	26	26	10	4	22	36	8	NPAR
Discrepancy / df	0.867	1.543	1.543	1.543		7.721	1.425		2.861	CMINDF
RMR	0.078	0.136	0.136	0.096	0.000	0.327	0.371	0.000	0.379	RMR
GFI	0.960	0.817	0.817	0.842	1.000	0.732	0.817	1.000	0.480	GFI
Adjusted GFI	0.798	0.654	0.654	0.691		0.553	0.528		0.332	AGFI
Parsimony-adjusted GFI	0.192	0.431	0.431	0.431		0.439	0.318		0.374	PGFI
Normed fit index	0.945	0.855	0.855	0.855	1.000	0.000	0.751	1.000	0.000	NFI
Relative fit index	0.836	0.775	0.775	0.775		0.000	0.502		0.000	RFI
Incremental fit index	1.009	0.944	0.944	0.944	1.000	0.000	0.910	1.000	0.000	IFI
Tucker-Lewis index	1.031	0.907	0.907	0.907		0.000	0.772		0.000	TLI
Comparative fit index	1.000	0.940	0.940	0.940	1.000	0.000	0.886	1.000	0.000	CFI
Parsimony ratio	0.333	0.644	0.644	0.644	0.000	1.000	0.500	0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.315	0.551	0.551	0.551	0.000	0.000	0.376	0.000	0.000	PNFI
Parsimony-adjusted CFI	0.333	0.606	0.606	0.606	0.000	0.000	0.443	0.000	0.000	PCFI
Akaike information criterion	17.734	96.748	96.748	96.748	20.000	54.325	63.946	72.000	96.119	AIC
Browne-Cudeck criterion	23.448	115.200	115.200	115.200	21.754	55.027	103.546	136.800	110.519	BCC
Bayes information criterion	36.790	202.406	202.406	202.406	55.294	68.443	131.600	182.706	120.720	BIC
Consistent AIC	33.700	168.539	168.539	168.539	51.431	66.898	107.852	143.846	112.085	CAIC
Expected cross validation index	0.933	2.304	2.304	2.304	0.323	0.876	3.366	3.789	5.059	ECVI
ECVI lower bound	0.947	1.964	1.964	1.964	0.323	0.585	3.053	3.789	3.847	ECVILO
ECVI upper bound	1.327	2.831	2.831	2.831	0.323	1.288	4.207	3.789	6.673	ECVIHI
MECVI	1.234	2.743	2.743	2.743	0.351	0.888	5.450	7.200	5.817	MECVI

TABLE G6: STRUCTURAL EQUATION MODELLING RESULTS

Fit Measure	BOPI (**Figure 7.7**)			NON-MECHANISTIC MODEL (Fig			THREE FACTOR (11 Variables) MECHANISTIC MODEL (Powell 1995) - **Figure 6.71**			Macro
	Default Model	Saturated	Independence	Default Model	Saturated	Independence	Default Model	Saturated	Independence	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Discrepancy	0.060	0.000	103.933	88.704	0.000	235.388	72.665	0.000	506.667	CMIN
Degrees of Freedom	1	0	6	14	0	21	41	0	55	DF
P	0.806		0.000	0.000		0.000	0.002		0.000	P
Number of parameters	9	10	4	14	28	7	25	66	11	NPAR
Discrepancy / df	0.060		17.322	6.336		11.209	1.772		9.212	CMINDF
RMR	0.007	0.000	1.146	0.167	0.000	0.473	0.136	0.000	0.736	RMR
GFI	0.998	1.000	0.326	0.755	1.000	0.433	0.833	1.000	0.302	GFI
Adjusted GFI	0.984		-0.124	0.509		0.244	0.731		0.162	AGFI
Parsimony-adjusted GFI	0.100		0.195	0.377		0.325	0.517		0.251	PGFI
Normed fit index	0.999	1.000	0.000	0.623	1.000	0.000	0.857	1.000	0.000	NFI
Relative fit index	0.997		0.000	0.435		0.000	0.808		0.000	RFI
Incremental fit index	1.009	1.000	0.000	0.663	1.000	0.000	0.932	1.000	0.000	IFI
Tucker-Lewis index	1.058		0.000	0.477		0.000	0.906		0.000	TLI
Comparative fit index	1.000	1.000	0.000	0.652	1.000	0.000	0.930	1.000	0.000	CFI
Parsimony ratio				0.667	0.000	1.000	0.745	0.000	1.000	PRATIO
Parsimony-adjusted NFI				0.415	0.000	0.000	0.639	0.000	0.000	PNFI
Parsimony-adjusted CFI				0.434	0.000	0.000	0.693	0.000	0.000	PCFI
Akaike information criterion	18.060	20.000	111.933	116.704	56.000	249.388	122.665	132.000	528.667	AIC
Browne-Cudeck criterion	24.489	27.143	114.790	120.852	64.296	251.462	134.665	163.680	533.947	BCC
Bayes information criterion	39.499	43.820	121.461	173.950	170.493	278.011	236.191	431.708	578.618	BIC
Consistent AIC	36.022	39.957	119.916	160.708	144.008	271.390	201.244	339.447	563.241	CAIC
Expected cross validation index	0.951	1.053	5.891	1.882	0.903	4.022	1.978	2.129	8.527	ECVI
ECVI lower bound	1.000	1.053	4.343	1.462	0.903	3.286	1.657	2.129	7.425	ECVILO
ECVI upper bound	1.146	1.053	7.831	2.424	0.903	4.879	2.426	2.129	9.749	ECVIHI
MECVI	1.289	1.429	6.042	1.949	1.037	4.056	4.010	2.157	8.099	MECVI

TABLE G7 : Computation of Degrees of Freedom

Computation	Ten Factor Model (Figure 7.25)	Competitive Factors Model	Second Order Factor 34 Variables	TQM Soft on Financial Performance	BOPI (Fugure 7.7)	7 Factor Mechanistic Model
Number of distinct sample moments	55	10	595	36	10	28
Number of distinct parameters to be estimated	20	8	80	22	9	14
Degrees of freedom	35	2	515	14	1	14

TABLE G8: Variables in the Model

Variables in the Model	Ten Factor Model (Figure 7.25)	Competitive Factors Model	34 Variables	TQM Soft on Financial Performance	BOPI (Figure 7.7)	7 Factor Mechanistic Model
Number of variables in the Model	21	9	69	9	9	15
Number of observed variables	10	4	34	8	4	7
Number of unbserved variables	11	5	35	1	5	8
Number of exogenous variable	11	5	35	8	5	8
Number of endogenous variable	10	4	34	1	4	7

TABLE G9: SUMMARY OF STANDARDISED

ONE FACTOR TQM MODEL	Standardised Regression Weights	Squared Multiple Correlation	Sample covariance Matrix	Sample correlation Matrix
1	**2**	**3**	**4**	**5**
Variable 1←TQM	0.446	0.199	21.517	13.710
Variable 2←TQM	0.533	0.284	8.002	4.773
Variable 3←TQM	0.559	0.312	4.278	2.641
Variable 4←TQM	0.445	0.198	2.397	1.561
Variable 5←TQM	0.436	0.190	2.232	1.462
Variable 6←TQM	0.130	0.017	1.951	1.209
Variable 7←TQM	0.792	0.628	1.729	1.086
Variable 8←TQM	0.739	0.546	1.497	0.990
Variable 9←TQM	0.650	0.423	1.277	0.807
Variable 10←TQM	0.642	0.412	1.154	0.752
Variable 11←TQM	0.617	0.381	1.110	0.719
Variable 12←TQM	0.631	0.398	0.817	0.536
Variable 13←TQM	0.454	0.206	0.696	0.431
Variable 14←TQM	0.544	0.296	0.651	0.420
Variable 15←TQM	0.587	0.344	0.590	0.376
Variable 16←TQM	0.510	0.261	0.521	0.326
Variable 17←TQM	0.665	0.442	0.483	0.300
Variable 18←TQM	0.676	0.457	0.430	0.275
Variable 19←TQM	0.681	0.464	0.372	0.230
Variable 20←TQM	0.691	0.477	0.332	0.202
Variable 21←TQM	0.816	0.665	0.313	0.194
Variable 22←TQM	0.771	0.594	0.268	0.171
Variable 23←TQM	0.734	0.539	0.240	0.162
Variable 24←TQM	0.716	0.513	0.201	0.128
Variable 25←TQM	0.626	0.392	0.177	0.110
Variable 26←TQM	0.686	0.471	0.135	0.089
Variable 27←TQM	0.727	0.528	0.127	0.079
Variable 28←TQM	0.505	0.255	0.091	0.060
Variable 29←TQM	0.799	0.638	0.077	0.051
Variable 30←TQM	0.668	0.446	0.068	0.045
Variable 31←TQM	0.647	0.418	0.057	0.032
Variable 32←TQM	0.577	0.333	0.049	0.031
Variable 33←TQM	0.430	0.185	0.033	0.021
Variable 34←TQM	0.294	0.087	0.030	0.020

TABLE G10 SUMMARY OF STANDARDISED

TQM ON FINANCIAL PERFORMANCE	**Standardised Regression Weights**	**Squared Multiple Correlation**	**Sample covariance Matrix**	**Sample correlation Matrix**
FPEINDEX ←FACTOR1	0.153	0.199	21.517	13.710
FPEINDEX ←FACTOR2	0.249	0.284	8.002	4.773
FPEINDEX ←FACTOR3	0.382	0.312	4.278	2.641
FPEINDEX ←FACTOR4	-0.324	0.198	2.397	1.561
FPEINDEX ←FACTOR6	-0.033	0.190	2.232	1.462
FPEINDEX ←FACTOR7	-0.146	0.017	1.951	1.209
FPEINDEX ←FACTOR8	-0.498	0.628	1.729	1.086

Table G11: Summary of Standardised Regression Weights, SMC, Sample covariance and correlation Matrix

TQM ON FINANCIAL PERFORMANCE	Standardised Regression Weights	Squared Multiple Correlation	Sample covariance Matrix	Sample correlation Matrix
FPEINDEX ←FACTOR1	0.153	0.199	21.517	13.710
FPEINDEX ←FACTOR2	0.249	0.284	8.002	4.773
FPEINDEX ←FACTOR3	0.382	0.312	4.278	2.641
FPEINDEX ←FACTOR4	-0.324	0.198	2.397	1.561
FPEINDEX ←FACTOR6	-0.033	0.190	2.232	1.462
FPEINDEX ←FACTOR7	-0.146	0.017	1.951	1.209
FPEINDEX ←FACTOR8	-0.498	0.628	1.729	1.086

Table G12: Sample Correlation Matrix for the Ten Factor Model (Figure 7.25)

Construct	EC	QP	CF	SF	BM	TR	OO	EM	ZD	ME
EC	1.000	0.384	0.330	0.251	0.280	0.606	0.279	0.348	0.658	0.541
QP	0.384	1.000	0.553	0.664	0.478	0.471	0.417	0.596	0.207	0.160
CF	0.330	0.553	1.000	0.719	0.426	0.345	0.397	0.550	0.181	0.194
SF	0.251	0.664	0.719	1.000	0.629	0.392	0.454	0.600	0.252	0.285
BM	0.280	0.478	0.426	0.629	1.000	0.421	0.395	0.527	0.296	0.345
TR	0.606	0.471	0.345	0.392	0.421	1.000	0.385	0.368	0.484	0.477
OO	0.279	0.417	0.397	0.454	0.395	0.385	1.000	0.657	0.302	0.424
EM	0.348	0.596	0.550	0.600	0.527	0.368	0.657	1.000	0.276	0.388
ZD	0.658	0.207	0.181	0.252	0.296	0.484	0.302	0.276	1.000	0.825
ME	0.541	0.160	0.194	0.285	0.345	0.477	0.424	0.388	0.825	1.000

Table G13: Sample Covariance Matrix for the Ten Factor Model (Figure 7.25)

Construct	EC	QP	CF	SF	BM	TR	OO	EM	ZD	ME
EC	1.349	0.509	0.404	0.338	0.345	0.805	0.309	0.430	0.729	0.806
QP	0.509	1.300	0.664	0.877	0.578	0.614	0.452	0.724	0.225	0.234
CF	0.404	0.664	1.110	0.878	0.476	0.415	0.398	0.616	0.182	0.262
SF	0.338	0.877	0.878	1.342	0.773	0.520	0.500	0.740	0.278	0.423
BM	0.345	0.578	0.476	0.773	1.126	0.511	0.399	0.595	0.300	0.470
TR	0.805	0.614	0.415	0.520	0.511	1.308	0.419	0.448	0.527	0.699
OO	0.309	0.452	0.398	0.500	0.399	0.419	0.904	0.665	0.274	0.517
EM	0.430	0.724	0.616	0.740	0.595	0.448	0.665	1.133	0.280	0.529
ZD	0.729	0.225	0.182	0.278	0.300	0.527	0.274	0.280	0.909	1.010
ME	0.806	0.234	0.262	0.423	0.470	0.699	0.517	0.529	1.010	1.645

Table G14: Total Effects Estimates

Construct	Total Effects	Standardised Effects	Direct Effects	Indirect Effects
	TQM	TQM	TQM	TQM
ME	0.943	0.528	0.943	0.000
ZD	1.285	0.733	1.285	0.000
EM	1.136	0.701	1.136	0.000
OO	1.419	0.797	1.419	0.000
TR	1.105	0.677	1.105	0.000
BM	1.064	0.605	1.064	0.000
SF	0.938	0.642	0.938	0.000
CF	1.267	0.774	1.267	0.000
QP	0.690	0.471	0.690	0.000
EC	1.000	0.507	1.000	0.000

Table G15: Modification Indices

Covariances			MI	Par Change	MI	Par Change
e-7	↔	e-10	8.524	-0.288	7.348	0.303
e-7	↔	e-8	11.465	0.261	15.066	0.521
e-5	↔	e-10	12.306	0.421	6.707	0.258
e-3	↔	e-4	8.514	0.205	6.819	-0.214
e-2	↔	e-10	19.922	0.487	5.954	-0.207
e-2	↔	e-7	4.147	-0.171	5.364	0.216
e-2	↔	e-5	5.441	0.238	8.539	0.300
e-1	↔	e-10	9.355	0.440	4.118	0.254
e-1	↔	e-9	9.477	-0.364	4.708	0.213
e-1	↔	e-8	4.934	-0.251	13.803	0.347
e-1	↔	e-7	4.089	-0.223	28.273	0.450
e-1	↔	e-5	4.184	0.275	6.484	0.314
e-1	↔	e-2	39.454	0.767	29.832	0.819

Table G16: Variances

Construct-Error	Estimate	SE	Critica Ratio	P Label
TQM	0.423	0.208	2.033	0.042
e-1	1.222	0.229	5.340	0.000
e-2	0.708	0.132	5.381	0.000
e-3	0.454	0.099	4.576	0.000
e-4	0.532	0.104	5.106	0.000
e-5	0.830	0.160	5.187	0.000
e-6	0.609	0.122	5.008	0.000
e-7	0.491	0.111	4.415	0.000
e-8	0.564	0.114	4.928	0.000
e-9	0.602	0.125	4.799	0.000
e-10	0.973	0.183	5.314	0.000

APPENDIX H– VARIOUS DEFINITION OF TQM

Respondents were asked to provide their organisations brief definition of TQM and below are The typical responses

No	TQM	Designation of Respondent	No of Years Employed	DEFINITION of TQM
1	Yes	Quality Co-ordinator	2.5 Years but moved into TQM 2 weeks earlier	Quality Policy Statement "ACL is fully committed to the supply of products and services which are not only fit for their intended purposes and satisfy ISO 9002 requirements as a minimum, but also exceeds our client's expectations"
2	Yes	Quality Manager	2	Providing a quality services from first call to end product to include administrative backup and personnel
3	Yes	Quality Manager	25	To ensure all work carried out by the company meets our client's specific requirements and is documented
4	Yes	Quantity Surveyor	6	Finish the contract on time, work as a team (Q.S, Agent, Engineer, Foreman, and Contracts Manager) and have job satisfaction, early decisions and communication are key to success.
5	No	Director	28 years	"We think TQM is now "old hat" leading to unnecessary, prescriptive procedures which depletes entrepreneurial activities. As a company we strive at every level to provide clients with a quality of service which goes beyond what they have asked, to include areas to their advantage that they haven't considered. We provide a total package for all works on or underground which is every 'developer's problem area'
6	Yes	Safety Manager	4	*None Provided*
7	Yes	Quality Manager	3	*None Provided*
8	Yes	Quality Manager	7.5	Our group Quality Management System is designed to interpret and fulfil our client's requirement through awareness of the group's commitment to continued improvement and quality through active support and demonstration of the commitment
9	Yes	Quality Manager	1	9000:2000
10	Yes	Quality Director	20	ISO 9002 94 Progressing now to ISO 9000 2000
11	Yes	Managing Director Quality Manager	29 4.5	All functions, department work towards satisfying each other needs & ultimately providing our customer's product/service that was asked for in a cost effective manner, on time. Includes our suppliers & subcontractors as part of our team.

No	TQM	Designation of Respondent	No of Years Employed	DEFINITION of TQM
12	Yes	Quality Manager	1	Meeting the client requirements across the entire organisation process
13	Yes	Quality Manager	9	TQM advocates an organisation wide effort in continual Quality improvement. To attain high quality in Construction all parties involved must work together as a team. The practice of TQM promotes good relationships
14	Yes	Business Improvement Manager	18 Months	The continual pursuit of business improvement (not just quality improvement) using best practice initiatives
15	Yes	Quality Manager	2	*None Provided*
16	Yes	Quality Manager	7	We use the EFQM Excellence Model. Refer to efqm.org for definitions
17	Yes	Quality Manager	8	A managed system used throughout the company by all personnel
18	Yes	Business Systems Manager	2	Continuously meeting agreed customer requirements at the lowest cost, by releasing the potential of all employees
19	Yes	Quality Manager	10	Integration of Quality , Health & Safety Environmental and Investors in People
20	Yes	Quality Manager	4	*None Provided*
21	No	Quality Manager	4	*None Provided*
22	No	Quality Manager	>13	*None Provided*
23	No	Marketing Manager	-	*None Provided*
24	No	Quality Manager	10	TQM often equates to an inflexible system - ordinary quality management systems (i.e. BS EN ISO 9000 series) suit most construction companies
25	No	Quality Director	14	TQM was dropped 3-5 years ago. We currently use EFQM to measure ourselves internally
26	No	Quality Manager	12	A way of managing the entire business to ensure customer satisfaction, internal and external
27	No	Other	15	*None Provided*
28	No	Quality Manager	15	*None Provided*
29	No	Quality Manager	23	*None Provided*
30	No	Quality Manager	-	*x*

No	TQM	Designation of Respondent	No of Years Employed	DEFINITION of TQM
31	No	Quality Manager	14	Full documented procedures including review of performance. We have a total commitment to exceeding our client's expectation but do not have a traditional TQM
32	No	Chief Executive Officer (CEO)	4	*None Provided*
No	TQM	Designation of Respondent	No of Years Employed	DEFINITION of TQM
33	No	Managing Director	3	*N/A*
34	No	Quality and Environmental Manager	1 week	TQM has not yet been introduced to our organisation, but there is a will at executive level to implement a quality system aimed at providing the organisation with a sustainable competitive advantage and to improve the effectiveness of the organisation
35*	No	Quality Manager	12	*None provided*
36*	No	Commercial Director	6	*None Provided*
37	No	Quality Manager	34	*None Provided*
38*	No	Quality Director	5	*NP*
39*	No	Managing Director	11	*NP*
40*	No	Quality Manager	20	*Do not operate TQM*
41	No	Managing Director	4	*NP*
42	No	Quality Manager	11	*Not applicable, we are implementing EFQM Excellence Model*
43	No	Director	5	*NP*
44	Yes*	HSQE Manager	15	Fully integrated health, safety, quality and environmental management system which is operated as a core business objective.
45	No	Quality Manager	1	*NP*
46	No	Estimator/Surveyor	1	*NP*
47	No	Managing Director	18	*Know Nothing About it*
48	No	Operational Director	8	TQM is a process of series of processes which allow an organisation to provide quality service to its clients, and must be driven from the top to be effective.
49	No	Managing Director	3	Delivering added value for customers through the involvement of all staff
50	No	Quality Manager	1	Accountability of all departments back to a single source
51	No	Quality Director	11	Commitment to ISO / Quality mark
52	No	Managing Director	16	Only use if we are working for large main contractors
53	No	Managing Director	34	*NP*
54	No	Managing Director	35	*NP*

No	TQM	Designation of Respondent	No of Years Employed	DEFINITION of TQM
55	No	Quality Director	21	*Our ordinary office QA system seems to suffice. If we are not implementing TQM them the rest of the questionnaire does not apply*
56	No	Marketing Manager	6	BSI 9000:2000 system implemented
57	No	Quality Manager	5	The management of all processes and procedures within an organisation to ensure that they continually improve for the betterment / improvement of the company and its customers/suppliers
58	No	Managing Director	28	CUSTOMER IS KING
59	No	Quality Manager	12	*NP*
60	No	Managing Director	9	*NP*
61	No	Director	2	*NP*
62	No	Quality Manager	24	*NP*
63	No	Quality Director	13	Octagon-Priority Development Company Site Manager-Contracts Manage-Regional Building Director Customer Care Director(Reg) - "Wash Up" Meeting Sales response + bi-monthly meetings.
64	No	Managing Director	13	We look for improvement, not with the system like BS 5750 & ISO 1001/2, but with semitile Personal Development Plan which incorporate standards in line with the company's strategy.

Further comments

Other comments: In our area of work TQM tends to be overwhelmed by everyday problems arising out of the traditional construction industry difficulties. It is an achievement to complete a scheme on time and to our client's reasonable satisfaction so quality as a definable factor is, at best ephemeral

Given that the industry operates in an essentially under-trained/ under capitalised way for consultants who are similarly limited and that our clients demand Rolls Royce quality for sub-ford prices, TQM / EFQM and similar concepts have more in common with deck chairs on RMS Titanic!

Our industry will remain mixed in the dark ages until we take ourselves seriously and change accordingly so that we can train our workforce/ employ sufficient supervisors and insist on competent designs / specifications.

Sample Correlations - Estimates

	VARIAB34	TRAINI17	VARIAB18	VARIAB19	VARIAB20	OPEN21	VARIAB22	VARIAB23	EMPLYE24	VARIAB25
VARIAB34	1.000	0.200	0.283	0.283	0.202	0.053	0.075	0.058	0.169	0.050
TRAINI17	0.200	1.000	0.861	0.590	0.483	0.516	0.499	0.469	0.305	0.234
VARIAB18	0.283	0.861	1.000	0.611	0.484	0.467	0.489	0.388	0.338	0.279
VARIAB19	0.283	0.590	0.611	1.000	0.839	0.586	0.534	0.626	0.466	0.477
VARIAB20	0.202	0.483	0.484	0.839	1.000	0.580	0.504	0.604	0.506	0.546
OPEN21	0.053	0.516	0.467	0.586	0.580	1.000	0.808	0.818	0.608	0.578
VARIAB22	0.075	0.499	0.489	0.534	0.504	0.808	1.000	0.831	0.598	0.501
VARIAB23	0.058	0.469	0.388	0.626	0.604	0.818	0.831	1.000	0.577	0.578
EMPLYE24	0.169	0.305	0.338	0.466	0.506	0.608	0.598	0.577	1.000	0.694
VARIAB25	0.050	0.234	0.279	0.477	0.546	0.578	0.501	0.578	0.694	1.000
VARIAB26	0.105	0.257	0.233	0.441	0.517	0.700	0.633	0.743	0.704	0.780
VARIAB27	0.066	0.375	0.415	0.511	0.471	0.734	0.695	0.668	0.710	0.738
ZERODE28	0.184	0.318	0.276	0.401	0.435	0.425	0.416	0.418	0.240	0.247
VARIAB29	0.202	0.402	0.428	0.488	0.531	0.698	0.734	0.628	0.609	0.521
VARIAB30	0.176	0.334	0.397	0.382	0.386	0.519	0.586	0.509	0.467	0.490
MEASUR31	0.479	0.527	0.553	0.416	0.479	0.422	0.370	0.316	0.341	0.380
VARIAB32	0.628	0.494	0.525	0.253	0.296	0.267	0.328	0.231	0.315	0.227
VARIAB33	0.757	0.413	0.480	0.245	0.243	0.118	0.192	0.097	0.254	0.164
VARIAB16	0.429	0.384	0.366	0.378	0.294	0.336	0.301	0.256	0.336	0.294
VARIAB15	0.376	0.431	0.414	0.488	0.444	0.454	0.427	0.383	0.310	0.281
BENCH14	0.331	0.384	0.410	0.453	0.398	0.295	0.326	0.240	0.318	0.183
VARIAB13	0.206	0.172	0.303	0.366	0.216	0.305	0.282	0.176	0.333	0.208
VARIAB12	0.174	0.441	0.409	0.337	0.342	0.489	0.468	0.328	0.399	0.261
SUPPLI11	0.052	0.522	0.512	0.470	0.539	0.442	0.403	0.403	0.424	0.315
VARIAB10	0.104	0.352	0.446	0.351	0.419	0.461	0.536	0.433	0.575	0.349
VARIABL9	0.073	0.426	0.359	0.306	0.440	0.478	0.430	0.427	0.429	0.316
VARIABL8	0.048	0.427	0.452	0.389	0.507	0.576	0.482	0.485	0.611	0.445
CUSTOME7	0.161	0.487	0.531	0.452	0.479	0.628	0.499	0.481	0.614	0.498
VARIABL6	0.500	0.171	0.177	0.212	0.076	0.068	0.157	0.145	0.060	-0.053
VARIABL5	0.370	0.442	0.481	0.148	0.184	0.291	0.150	0.065	0.137	0.075
PHILOSP4	0.254	0.441	0.452	0.172	0.221	0.291	0.162	0.196	0.247	0.134
VARIABL3	0.347	0.559	0.551	0.311	0.255	0.361	0.290	0.196	0.221	0.089
VARIABL2	0.313	0.517	0.516	0.251	0.174	0.417	0.264	0.210	0.254	0.157
EXECUTI1	0.284	0.493	0.428	0.179	0.206	0.317	0.175	0.196	0.194	0.126

66A

66b

Sample Correlations - Estimates

	VARIAB34	TRAINI17	VARIAB18	VARIAB19	VARIAB20	OPEN21	VARIAB22	VARIAB23	EMPLYE24	VARIAB25
VARIAB34	1.000	0.200	0.283	0.283	0.202	0.053	0.075	0.058	0.169	0.050
TRAINI17	0.200	1.000	0.861	0.590	0.483	0.516	0.499	0.469	0.305	0.234
VARIAB18	0.283	0.861	1.000	0.611	0.484	0.467	0.489	0.388	0.338	0.279
VARIAB19	0.283	0.590	0.611	1.000	0.839	0.586	0.534	0.626	0.466	0.477
VARIAB20	0.202	0.483	0.484	0.839	1.000	0.580	0.504	0.604	0.506	0.546
OPEN21	0.053	0.516	0.467	0.586	0.580	1.000	0.808	0.818	0.608	0.578
VARIAB22	0.075	0.499	0.489	0.534	0.504	0.808	1.000	0.831	0.598	0.501
VARIAB23	0.058	0.469	0.388	0.626	0.604	0.818	0.831	1.000	0.577	0.578
EMPLYE24	0.169	0.305	0.338	0.466	0.506	0.608	0.598	0.577	1.000	0.694
VARIAB25	0.050	0.234	0.279	0.477	0.546	0.578	0.501	0.578	0.694	1.000
VARIAB26	0.105	0.257	0.233	0.441	0.517	0.700	0.633	0.743	0.704	0.780
VARIAB27	0.066	0.375	0.415	0.511	0.471	0.734	0.695	0.668	0.710	0.738
ZERODE28	0.184	0.318	0.276	0.401	0.435	0.425	0.416	0.418	0.240	0.247
VARIAB29	0.202	0.402	0.428	0.488	0.531	0.698	0.734	0.628	0.609	0.521
VARIAB30	0.176	0.334	0.397	0.382	0.386	0.519	0.586	0.509	0.467	0.490
MEASUR31	0.479	0.527	0.553	0.416	0.479	0.422	0.370	0.316	0.341	0.380
VARIAB32	0.628	0.494	0.525	0.253	0.296	0.267	0.328	0.231	0.315	0.227
VARIAB33	0.757	0.413	0.480	0.245	0.243	0.118	0.192	0.097	0.254	0.164
VARIAB16	0.429	0.384	0.366	0.378	0.294	0.336	0.301	0.256	0.336	0.294
VARIAB15	0.376	0.431	0.414	0.488	0.444	0.454	0.427	0.383	0.310	0.281
BENCH14	0.331	0.384	0.410	0.453	0.398	0.295	0.326	0.240	0.318	0.183
VARIAB13	0.206	0.172	0.303	0.366	0.216	0.305	0.282	0.176	0.333	0.208
VARIAB12	0.174	0.441	0.409	0.337	0.342	0.489	0.468	0.328	0.399	0.261
SUPPLI11	0.052	0.522	0.512	0.470	0.539	0.442	0.403	0.403	0.424	0.315
VARIAB10	0.104	0.352	0.446	0.351	0.419	0.461	0.536	0.433	0.575	0.349
VARIABL9	0.073	0.426	0.359	0.306	0.440	0.478	0.430	0.427	0.429	0.316
VARIABL8	0.048	0.427	0.452	0.389	0.507	0.576	0.482	0.485	0.611	0.445
CUSTOME7	0.161	0.487	0.531	0.452	0.479	0.628	0.499	0.481	0.614	0.498
VARIABL6	0.500	0.171	0.177	0.212	0.076	0.068	0.157	0.145	0.060	-0.053
VARIABL5	0.370	0.442	0.481	0.148	0.184	0.291	0.150	0.065	0.137	0.075
PHILOSP4	0.254	0.441	0.452	0.172	0.221	0.291	0.162	0.196	0.247	0.134
VARIABL3	0.347	0.559	0.551	0.311	0.255	0.361	0.290	0.196	0.221	0.089
VARIABL2	0.313	0.517	0.516	0.251	0.174	0.417	0.264	0.210	0.254	0.157
EXECUTI1	0.284	0.493	0.428	0.179	0.206	0.317	0.175	0.196	0.194	0.126

VARIAB26	VARIAB27	ZERODE28	VARIAB29	VARIAB30	MEASUR31	VARIAB32	VARIAB33	VARIAB16	VARIAB15	BENCH14
0.105	0.066	0.184	0.202	0.176	0.479	0.628	0.757	0.429	0.376	0.331
0.257	0.375	0.318	0.402	0.334	0.527	0.494	0.413	0.384	0.431	0.384
0.233	0.415	0.276	0.428	0.397	0.553	0.525	0.480	0.366	0.414	0.410
0.441	0.511	0.401	0.488	0.382	0.416	0.253	0.245	0.378	0.488	0.453
0.517	0.471	0.435	0.531	0.386	0.479	0.296	0.243	0.294	0.444	0.398
0.700	0.734	0.425	0.698	0.519	0.422	0.267	0.118	0.336	0.454	0.295
0.633	0.695	0.416	0.734	0.586	0.370	0.328	0.192	0.301	0.427	0.326
0.743	0.668	0.418	0.628	0.509	0.316	0.231	0.097	0.256	0.383	0.240
0.704	0.710	0.240	0.609	0.467	0.341	0.315	0.254	0.336	0.310	0.318
0.780	0.738	0.247	0.521	0.490	0.380	0.227	0.164	0.294	0.281	0.183
1.000	0.821	0.391	0.611	0.601	0.318	0.268	0.165	0.215	0.258	0.185
0.821	1.000	0.338	0.645	0.600	0.379	0.235	0.156	0.233	0.239	0.175
0.391	0.338	1.000	0.625	0.527	0.427	0.281	0.257	0.177	0.311	0.432
0.611	0.645	0.625	1.000	0.793	0.471	0.419	0.262	0.407	0.481	0.537
0.601	0.600	0.527	0.793	1.000	0.346	0.279	0.243	0.234	0.363	0.416
0.318	0.379	0.427	0.471	0.346	1.000	0.754	0.675	0.571	0.492	0.462
0.268	0.235	0.281	0.419	0.279	0.754	1.000	0.830	0.575	0.517	0.527
0.165	0.156	0.257	0.262	0.243	0.675	0.830	1.000	0.490	0.487	0.508
0.215	0.233	0.177	0.407	0.234	0.571	0.575	0.490	1.000	0.815	0.643
0.258	0.239	0.311	0.481	0.363	0.492	0.517	0.487	0.815	1.000	0.725
0.185	0.175	0.432	0.537	0.416	0.462	0.527	0.508	0.643	0.725	1.000
0.252	0.347	0.120	0.300	0.330	0.160	0.248	0.206	0.237	0.267	0.357
0.315	0.430	0.193	0.542	0.401	0.351	0.390	0.203	0.220	0.281	0.347
0.272	0.354	0.312	0.415	0.359	0.274	0.297	0.097	0.261	0.377	0.360
0.462	0.443	0.333	0.497	0.620	0.313	0.298	0.264	0.304	0.371	0.326
0.427	0.451	0.295	0.494	0.427	0.424	0.342	0.189	0.280	0.298	0.250
0.538	0.493	0.291	0.562	0.507	0.365	0.351	0.144	0.197	0.263	0.258
0.510	0.578	0.326	0.630	0.524	0.479	0.447	0.263	0.269	0.328	0.330
0.032	-0.068	0.248	0.068	-0.012	0.196	0.345	0.396	0.306	0.400	0.387
-0.018	0.052	0.150	0.211	0.042	0.601	0.611	0.532	0.394	0.316	0.358
0.083	0.147	0.108	0.203	0.117	0.473	0.441	0.369	0.260	0.254	0.292
0.090	0.155	0.173	0.303	0.205	0.636	0.591	0.446	0.435	0.411	0.441
0.100	0.181	0.027	0.238	0.094	0.558	0.576	0.428	0.483	0.435	0.434
0.042	0.057	0.068	0.202	0.059	0.456	0.525	0.415	0.366	0.354	0.353

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VARIAB26	VARIAB27	ZERODE28	VARIAB29	VARIAB30	MEASUR31	VARIAB32	VARIAB33	VARIAB16	VARIAB15	BENCH14
0.105	0.066	0.184	0.202	0.176	0.479	0.628	0.757	0.429	0.376	0.331
0.257	0.375	0.318	0.402	0.334	0.527	0.494	0.413	0.384	0.431	0.384
0.233	0.415	0.276	0.428	0.397	0.553	0.525	0.480	0.366	0.414	0.410
0.441	0.511	0.401	0.488	0.382	0.416	0.253	0.245	0.378	0.488	0.453
0.517	0.471	0.435	0.531	0.386	0.479	0.296	0.243	0.294	0.444	0.398
0.700	0.734	0.425	0.698	0.519	0.422	0.267	0.118	0.336	0.454	0.295
0.633	0.695	0.416	0.734	0.586	0.370	0.328	0.192	0.301	0.427	0.326
0.743	0.668	0.418	0.628	0.509	0.316	0.231	0.097	0.256	0.383	0.240
0.704	0.710	0.240	0.609	0.467	0.341	0.315	0.254	0.336	0.310	0.318
0.780	0.738	0.247	0.521	0.490	0.380	0.227	0.164	0.294	0.281	0.183
1.000	0.821	0.391	0.611	0.601	0.318	0.268	0.165	0.215	0.258	0.185
0.821	1.000	0.338	0.645	0.600	0.379	0.235	0.156	0.233	0.239	0.175
0.391	0.338	1.000	0.625	0.527	0.427	0.281	0.257	0.177	0.311	0.432
0.611	0.645	0.625	1.000	0.793	0.471	0.419	0.262	0.407	0.481	0.537
0.601	0.600	0.527	0.793	1.000	0.346	0.279	0.243	0.234	0.363	0.416
0.318	0.379	0.427	0.471	0.346	1.000	0.754	0.675	0.571	0.492	0.462
0.268	0.235	0.281	0.419	0.279	0.754	1.000	0.830	0.575	0.517	0.527
0.165	0.156	0.257	0.262	0.243	0.675	0.830	1.000	0.490	0.487	0.508
0.215	0.233	0.177	0.407	0.234	0.571	0.575	0.490	1.000	0.815	0.643
0.258	0.239	0.311	0.481	0.363	0.492	0.517	0.487	0.815	1.000	0.725
0.185	0.175	0.432	0.537	0.416	0.462	0.527	0.508	0.643	0.725	1.000
0.252	0.347	0.120	0.300	0.330	0.160	0.248	0.206	0.237	0.267	0.357
0.315	0.430	0.193	0.542	0.401	0.351	0.390	0.203	0.220	0.281	0.347
0.272	0.354	0.312	0.415	0.359	0.274	0.297	0.097	0.261	0.377	0.360
0.462	0.443	0.333	0.497	0.620	0.313	0.298	0.264	0.304	0.371	0.326
0.427	0.451	0.295	0.494	0.427	0.424	0.342	0.189	0.280	0.298	0.250
0.538	0.493	0.291	0.562	0.507	0.365	0.351	0.144	0.197	0.263	0.258
0.510	0.578	0.326	0.630	0.524	0.479	0.447	0.263	0.269	0.328	0.330
0.032	-0.068	0.248	0.068	-0.012	0.196	0.345	0.396	0.306	0.400	0.387
-0.018	0.052	0.150	0.211	0.042	0.601	0.611	0.532	0.394	0.316	0.358
0.083	0.147	0.108	0.203	0.117	0.473	0.441	0.369	0.260	0.254	0.292
0.090	0.155	0.173	0.303	0.205	0.636	0.591	0.446	0.435	0.411	0.441
0.100	0.181	0.027	0.238	0.094	0.558	0.576	0.428	0.483	0.435	0.434
0.042	0.057	0.068	0.202	0.059	0.456	0.525	0.415	0.366	0.354	0.353

VARIAB13	VARIAB12	SUPPLI11	VARIAB10	VARIABL9	VARIABL8	CUSTOME7	VARIABL6	VARIABL5	PHILOSP4	VARIABL3
0.206	0.174	0.052	0.104	0.073	0.048	0.161	0.500	0.370	0.254	0.347
0.172	0.441	0.522	0.352	0.426	0.427	0.487	0.171	0.442	0.441	0.559
0.303	0.409	0.512	0.446	0.359	0.452	0.531	0.177	0.481	0.452	0.551
0.366	0.337	0.470	0.351	0.306	0.389	0.452	0.212	0.148	0.172	0.311
0.216	0.342	0.539	0.419	0.440	0.507	0.479	0.076	0.184	0.221	0.255
0.305	0.489	0.442	0.461	0.478	0.576	0.628	0.068	0.291	0.291	0.361
0.282	0.468	0.403	0.536	0.430	0.482	0.499	0.157	0.150	0.162	0.290
0.176	0.328	0.403	0.433	0.427	0.485	0.481	0.145	0.065	0.196	0.196
0.333	0.399	0.424	0.575	0.429	0.611	0.614	0.060	0.137	0.247	0.221
0.208	0.261	0.315	0.349	0.316	0.445	0.498	-0.053	0.075	0.134	0.089
0.252	0.315	0.272	0.462	0.427	0.538	0.510	0.032	-0.018	0.083	0.090
0.347	0.430	0.354	0.443	0.451	0.493	0.578	-0.068	0.052	0.147	0.155
0.120	0.193	0.312	0.333	0.295	0.291	0.326	0.248	0.150	0.108	0.173
0.300	0.542	0.415	0.497	0.494	0.562	0.630	0.068	0.211	0.203	0.303
0.330	0.401	0.359	0.620	0.427	0.507	0.524	-0.012	0.042	0.117	0.205
0.160	0.351	0.274	0.313	0.424	0.365	0.479	0.196	0.601	0.473	0.636
0.248	0.390	0.297	0.298	0.342	0.351	0.447	0.345	0.611	0.441	0.591
0.206	0.203	0.097	0.264	0.189	0.144	0.263	0.396	0.532	0.369	0.446
0.237	0.220	0.261	0.304	0.280	0.197	0.269	0.306	0.394	0.260	0.435
0.267	0.281	0.377	0.371	0.298	0.263	0.328	0.400	0.316	0.254	0.411
0.357	0.347	0.360	0.326	0.250	0.258	0.330	0.387	0.358	0.292	0.441
1.000	0.699	0.420	0.424	0.252	0.395	0.486	0.003	0.179	0.181	0.278
0.699	1.000	0.522	0.346	0.540	0.579	0.675	-0.029	0.314	0.327	0.407
0.420	0.522	1.000	0.489	0.435	0.596	0.541	0.064	0.287	0.383	0.370
0.424	0.346	0.489	1.000	0.595	0.642	0.539	-0.059	0.184	0.233	0.275
0.252	0.540	0.435	0.595	1.000	0.774	0.714	-0.165	0.318	0.280	0.454
0.395	0.579	0.596	0.642	0.774	1.000	0.846	-0.150	0.332	0.350	0.451
0.486	0.675	0.541	0.539	0.714	0.846	1.000	-0.098	0.399	0.371	0.508
0.003	-0.029	0.064	-0.059	-0.165	-0.150	-0.098	1.000	0.126	-0.003	0.137
0.179	0.314	0.287	0.184	0.318	0.332	0.399	0.126	1.000	0.741	0.787
0.181	0.327	0.383	0.233	0.280	0.350	0.371	-0.003	0.741	1.000	0.703
0.278	0.407	0.370	0.275	0.454	0.451	0.508	0.137	0.787	0.703	1.000
0.356	0.465	0.389	0.189	0.296	0.371	0.478	0.178	0.803	0.770	0.875
0.192	0.349	0.420	0.149	0.237	0.318	0.371	0.143	0.751	0.783	0.743

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VARIAB13	VARIAB12	SUPPLI11	VARIAB10	VARIABL9	VARIABL8	CUSTOME7	VARIABL6	VARIABL5	PHILOSP4	VARIABL3
0.206	0.174	0.052	0.104	0.073	0.048	0.161	0.500	0.370	0.254	0.347
0.172	0.441	0.522	0.352	0.426	0.427	0.487	0.171	0.442	0.441	0.559
0.303	0.409	0.512	0.446	0.359	0.452	0.531	0.177	0.481	0.452	0.551
0.366	0.337	0.470	0.351	0.306	0.389	0.452	0.212	0.148	0.172	0.311
0.216	0.342	0.539	0.419	0.440	0.507	0.479	0.076	0.184	0.221	0.255
0.305	0.489	0.442	0.461	0.478	0.576	0.628	0.068	0.291	0.291	0.361
0.282	0.468	0.403	0.536	0.430	0.482	0.499	0.157	0.150	0.162	0.290
0.176	0.328	0.403	0.433	0.427	0.485	0.481	0.145	0.065	0.196	0.196
0.333	0.399	0.424	0.575	0.429	0.611	0.614	0.060	0.137	0.247	0.221
0.208	0.261	0.315	0.349	0.316	0.445	0.498	-0.053	0.075	0.134	0.089
0.252	0.315	0.272	0.462	0.427	0.538	0.510	0.032	-0.018	0.083	0.090
0.347	0.430	0.354	0.443	0.451	0.493	0.578	-0.068	0.052	0.147	0.155
0.120	0.193	0.312	0.333	0.295	0.291	0.326	0.248	0.150	0.108	0.173
0.300	0.542	0.415	0.497	0.494	0.562	0.630	0.068	0.211	0.203	0.303
0.330	0.401	0.359	0.620	0.427	0.507	0.524	-0.012	0.042	0.117	0.205
0.160	0.351	0.274	0.313	0.424	0.365	0.479	0.196	0.601	0.473	0.636
0.248	0.390	0.297	0.298	0.342	0.351	0.447	0.345	0.611	0.441	0.591
0.206	0.203	0.097	0.264	0.189	0.144	0.263	0.396	0.532	0.369	0.446
0.237	0.220	0.261	0.304	0.280	0.197	0.269	0.306	0.394	0.260	0.435
0.267	0.281	0.377	0.371	0.298	0.263	0.328	0.400	0.316	0.254	0.411
0.357	0.347	0.360	0.326	0.250	0.258	0.330	0.387	0.358	0.292	0.441
1.000	0.699	0.420	0.424	0.252	0.395	0.486	0.003	0.179	0.181	0.278
0.699	1.000	0.522	0.346	0.540	0.579	0.675	-0.029	0.314	0.327	0.407
0.420	0.522	1.000	0.489	0.435	0.596	0.541	0.064	0.287	0.383	0.370
0.424	0.346	0.489	1.000	0.595	0.642	0.539	-0.059	0.184	0.233	0.275
0.252	0.540	0.435	0.595	1.000	0.774	0.714	-0.165	0.318	0.280	0.454
0.395	0.579	0.596	0.642	0.774	1.000	0.846	-0.150	0.332	0.350	0.451
0.486	0.675	0.541	0.539	0.714	0.846	1.000	-0.098	0.399	0.371	0.508
0.003	-0.029	0.064	-0.059	-0.165	-0.150	-0.098	1.000	0.126	-0.003	0.137
0.179	0.314	0.287	0.184	0.318	0.332	0.399	0.126	1.000	0.741	0.787
0.181	0.327	0.383	0.233	0.280	0.350	0.371	-0.003	0.741	1.000	0.703
0.278	0.407	0.370	0.275	0.454	0.451	0.508	0.137	0.787	0.703	1.000
0.356	0.465	0.389	0.189	0.296	0.371	0.478	0.178	0.803	0.770	0.875
0.192	0.349	0.420	0.149	0.237	0.318	0.371	0.143	0.751	0.783	0.743

VARIABL2	EXECUTI1
0.313	0.284
0.517	0.493
0.516	0.428
0.251	0.179
0.174	0.206
0.417	0.317
0.264	0.175
0.210	0.196
0.254	0.194
0.157	0.126
0.100	0.042
0.181	0.057
0.027	0.068
0.238	0.202
0.094	0.059
0.558	0.456
0.576	0.525
0.428	0.415
0.483	0.366
0.435	0.354
0.434	0.353
0.356	0.192
0.465	0.349
0.389	0.420
0.189	0.149
0.296	0.237
0.371	0.318
0.478	0.371
0.178	0.143
0.803	0.751
0.770	0.783
0.875	0.743
1.000	0.868
0.868	1.000

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VARIABL2	EXECUTI1
0.313	0.284
0.517	0.493
0.516	0.428
0.251	0.179
0.174	0.206
0.417	0.317
0.264	0.175
0.210	0.196
0.254	0.194
0.157	0.126
0.100	0.042
0.181	0.057
0.027	0.068
0.238	0.202
0.094	0.059
0.558	0.456
0.576	0.525
0.428	0.415
0.483	0.366
0.435	0.354
0.434	0.353
0.356	0.192
0.465	0.349
0.389	0.420
0.189	0.149
0.296	0.237
0.371	0.318
0.478	0.371
0.178	0.143
0.803	0.751
0.770	0.783
0.875	0.743
1.000	0.868
0.868	1.000

APPENDIX J – VALIDATION OF TQ-SMART MODEL ASSESSMENT RESULTS

TQM DEPLOYING ORGANISATION No. 1

Number of Employees		**0-9**		**10-49**		**50-149**		**150-499**		**>500**	
Size of Organisation		Macro		Micro		Small		<u>Medium</u>		Large	
		Implementation Construct									
Implementation Construct No.		1	2	3	4	5	6	7	8	9	10
Type of Implementation Construct		EC	QP	OO	EE	SF	CF	ME	BM	ZD	TR
a	Maximum RAI / CI	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
b	Advancement Index AI =	0.73	0.46	0.40	0.2	0.2	0.20	0.20	0.2	0.20	0.20
c	Commitment Index CI =	0.73	0.46	0.40	0.2	0.2	0.20	0.20	0.9	0.20	0.20
Deficit **AI/C1 = a – (b+c)/2**		**0.27**	**0.54**	**0.60**	**0.8**	**0.8**	**0.80**	**0.80**	**0.80**	**0.80**	**0.8**
d	Average $AI = \Sigma (AI_1 + AI_n)/ n$	0.299									
e	Average $CI = \Sigma (CI_1 + CI_n)/n$	0.299									
f	Rating Factor ϕ = **ΣRAI/AI**	3.34									
g	$\Psi = 1/$ (Rating Factor ϕ)	1.0	1.11	1.25	1.42	1.66	2.0	2.5	3.33	5.0	10.0
Matrix Result		HH	HH	HM	MH	HL	MM	LH	LM	ML	LL
TQM Assessment Rating		LM		$L_A \times M_C$				**Drifters-2**			

Definition of The 10 TQM Implementation Constructs

1. **EC** = Executive Commitment
2. **QP** = Quality Philosophy
3. **OO** = Open Organisation
4. **EE** = Employee Empowerment
5. **SF** = Supplier Focus
6. **CF** = Customer Focus
7. **ME** = Measurement
8. **BM** = Benchmarking
9. **ZD** = Zero Defects
10. **TR** = Training

<u>**Classification based on the Advancement/Commitment Matrix**</u>

1. HH = $H_A \times H_C$ = High Advancement, High Commitment = World Class Organisations
2. HM = $H_A \times M_C$ = High Advancement, Medium Commitment = Award Winners-2
3. MH = $M_A \times H_C$ = Medium Advancement, High Commitment = Award Winners-1
4. HL = $H_A \times H_C$ = High Advancement, Low Commitment = Improvers-2
5. MM = $M_A \times M_C$ = Medium Advancement, Medium Commitment = Middle of The Road
6. LH = $L_A \times H_C$ = Low Advancement, High Commitment = Improvers-1
7. **<u>LM = $L_A \times M_C$ = Low Advancement, Medium Commitment = Drifters-2</u>**
8. ML = $M_A \times L_C$ = Medium Advancement, Low Commitment = Drifters-1
9. LL = $L_A \times L_C$ = Low Advancement, Low Commitment = Uncommitted

Note: The H_A, M_A, L_A values are obtained from the TQM Advancement Radial Chart (Chileshe et al, 2003)
N = 10

TQM-DEPLOYING ORGANISATION No. 2

Number of Employees		0-9		10-49		50-149		150-499		>500	
Size of Organisation		Macro		Micro		Small		Medium		Large	
		Implementation Construct No.									
Implementation Construct No.		1	2	3	4	5	6	7	8	9	10
Type of Implementation Construct		EC	QP	OO	EE	SF	CF	ME	BM	ZD	TR
a	Maximum RAI / CI	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
b	Advancement Index AI =	0.80	0.75	0.67	0.73	0.7	0.65	0.80	0.65	0.80	0.53
c	Commitment Index CI_{1-10} =	0.80	0.75	0.67	0.73	0.7	0.65	0.80	0.65	0.80	0.53
Deficit AI/C1 = a – (b+c)/2		**0.2**	**0.25**	**0.33**	**0.27**	**0.3**	**0.35**	**0.2**	**0.35**	**0.2**	**0.47**
d	Average $AI = \Sigma (AI_1 + AI_n)/ n$	0.708									
e	Average $CI = \Sigma (CI_1 + CI_n)/n$	0.708									
f	Rating Factor ϕ = **ΣRAI/AI**	1.41									
g	Ψ = 1/ (Rating Factor ϕ)	1.0	1.11	1.25	1.42	1.66	2.0	2.5	3.33	5.0	10.0
Matrix Result		HH	HH	HM	MH	HL	MM	LH	LM	ML	LL
TQM Assessment Rating		HM		H_A x M_C				**Award Winners-2**			

Definition of TQM Implementation Constructs

1. **EC** = Executive Commitment
2. **QP** = Quality Philosophy
3. **OO** = Open Organisation
4. **EE** = Employee Empowerment
5. **SF** = Supplier Focus
6. **CF** = Customer Focus
7. **ME** = Measurement
8. **BM** = Benchmarking
9. **ZD** = Zero Defects
10. **TR** = Training

Classification based on the Advancement/Commitment Matrix

1. HH = H_A x H_C = High Advancement, High Commitment = World Class Organisations
2. **HM = H_A x M_C = High Advancement, Medium Commitment = Award Winners-2**
3. MH = M_A x H_C = Medium Advancement, High Commitment = Award Winners-1
4. HL = H_A x H_C = High Advancement, Low Commitment = Improvers-2
5. MM = M_A x M_C = Medium Advancement, Medium Commitment = Middle of The Road
6. LH = L_A x H_C = Low Advancement, High Commitment = Improvers-1
7. LM = L_A x M_C = Low Advancement, Medium Commitment = Drifters-2
8. ML = M_A x L_C = Medium Advancement, Low Commitment = Drifters-1
9. LL = L_A x L_C = Low Advancement, Low Commitment = Uncommitted

Note: The H_A, M_A, L_A values are obtained from the TQM Advancement Radial Chart (Chileshe et al, 2003)
N = 10

TQM DEPLOYING ORGANISATION No. 3

Number of Employees		**0-9**		**10-49**		**50-149**		**150-499**		**>500**	
Size of Organisation		Macro		Micro		Small		**Medium**		Large	
		Implementation Construct									
Implementation Construct No.		1	2	3	4	5	6	7	8	9	10
Type of Implementation Construct		EC	QP	OO	EE	SF	CF	ME	BM	ZD	TR
a	Maximum RAI / CI	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
b	Advancement Index AI =	0.73	0.66	0.53	0.2	0.7	0.65	0.40	0.85	0.60	0.8
c	Commitment Index CI =	0.73	0.66	0.53	0.2	0.7	0.65	0.40	0.85	0.60	0.8
Deficit **AI/C1 = a – (b+c)/2**		**0.27**	**0.34**	**0.47**	**0.8**	**0.3**	**0.35**	**0.60**	**0.15**	**0.40**	**0.2**
d	Average $AI = \Sigma (AI_1 + AI_n)/ n$	0.612									
e	Average $CI = \Sigma (CI_1 + CI_n)/n$	0.612									
f	Rating Factor Φ = **ΣRAI/AI**	1.63									
g	Ψ = 1/ (Rating Factor Φ)	1.0	1.11	1.25	1.42	1.66	2.0	2.5	3.33	5.0	10.0
Matrix Result		HH	HH	HM	MH	HL	MM	LH	LM	ML	LL
TQM Assessment Rating		HL		H_A x H_C				Improvers-2			

Definition of TQM Implementation Constructs

1. **EC** = Executive Commitment
2. **QP** = Quality Philosophy
3. **OO** = Open Organisation
4. **EE** = Employee Empowerment
5. **SF** = Supplier Focus
6. **CF** = Customer Focus
7. **ME** = Measurement
8. **BM** = Benchmarking
9. **ZD** = Zero Defects
10. **TR** = Training

Application of the Classification based on the Advancement/Commitment Matrix

10. HH = H_A x H_C = High Advancement, High Commitment = World Class Organisations
11. HM = H_A x M_C = High Advancement, Medium Commitment = Award Winners-2
12. MH = M_A x H_C = Medium Advancement, High Commitment = Award Winners-1
13. **HL = H_A x H_C = High Advancement, Low Commitment = Improvers-2**
14. MM = M_A x M_C = Medium Advancement, Medium Commitment = Middle of The Road
15. LH = L_A x H_C = Low Advancement, High Commitment = Improvers-1
16. LM = L_A x M_C = Low Advancement, Medium Commitment = Drifters-2
17. ML = M_A x L_C = Medium Advancement, Low Commitment = Drifters-1
18. LL = L_A x L_C = Low Advancement, Low Commitment = Uncommitted

Note: The H_A, M_A, L_A values are obtained from the TQM Advancement Radial Chart (Chileshe et al, 2003)
N = 10

VALIDATION OF TQ-SMART MODEL - ORGANISATIONAL ASSESSMENT RESULTS

TQM DEPLOYING ORGANISATION No. 4

Number of Employees	**0-9**		**10-49**		**50-149**		**150-499**		**>500**	
Size of Organisation	Macro		Micro		Small		Medium		Large	
	Implementation Construct									
Implementation Construct No.	1	2	3	4	5	6	7	8	9	10
Type of Implementation Construct	EC	QP	OO	EE	SF	CF	ME	BM	ZD	TR
a Maximum RAI / CI	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
b Advancement Index AI =	0.53	0.53	0.33	0.26	0.8	0.55	0.80	0.7	0.53	0.86
c Commitment Index CI_{1-10} =	0.53	0.53	0.33	0.26	0.8	0.55	0.80	0.7	0.53	0.86
Deficit **AI/C1 = a – (b+c)/2**	**0.47**	**0.47**	**0.67**	**0.74**	**0.2**	**0.45**	**0.2**	**0.3**	**0.47**	**0.14**
d Average $AI = \Sigma (AI_1 + AI_n)/ n$	0.589									
e Average $CI = \Sigma (CI_1 + CI_n)/n$	0.589									
f Rating Factor Φ = **ΣRAI/AI**	1.697									
g Ψ = 1/ (Rating Factor Φ)	1.0	1.11	1.25	1.42	1.66	2.0	2.5	3.33	5.0	10.0
Matrix Result	HH	HH	HM	MH	HL	MM	LH	LM	ML	LL
TQM Assessment Rating	MM		M_A x M_C				Middle of The Road			

Definition of TQM Implementation Constructs

1. **EC** = Executive Commitment
2. **QP** = Quality Philosophy
3. **OO** = Open Organisation
4. **EE** = Employee Empowerment
5. **SF** = Supplier Focused
6. **CF** = Customer Focused
7. **ME** = Measurement
8. **BM** = Benchmarking
9. **ZD** = Zero Defects
10. **TR** = Training

Classification based on the Advancement/Commitment Matrix

1. HH = H_A x H_C = High Advancement, High Commitment = World Class Organisations
2. HM = H_A x M_C = High Advancement, Medium Commitment = Award Winners-2
3. MH = M_A x H_C = Medium Advancement, High Commitment = Award Winners-1
4. HL = H_A x H_C = High Advancement, Low Commitment = Improvers-2
5. MM = M_A x M_C = Medium Advancement, Medium Commitment = Middle of The Road
6. LH = L_A x H_C = Low Advancement, High Commitment = Improvers-1
7. LM = L_A x M_C = Low Advancement, Medium Commitment = Drifters-2
8. ML = M_A x L_C = Medium Advancement, Low Commitment = Drifters-1
9. LL = L_A x L_C = Low Advancement, Low Commitment = Uncommitted

Note: The H_A, M_A, L_A values are obtained from the TQM Advancement Radial Chart (Chileshe et al, 2003)
N = 10

VALIDATION OF TQ-SMART MODEL - ORGANISATIONAL ASSESSMENT RESULTS

NON-TQM DEPLOYING ORGANISATION No. 5

	Number of Employees	**0-9**		**10-49**		**50-149**		**150-499**		**>500**	
	Size of Organisation	Macro		Micro		Small		Medium		Large	
		Implementation Construct									
	Implementation Construct No.	1	2	3	4	5	6	7	8	9	10
	Type of Implementation Construct	EC	QP	OO	EE	SF	CF	ME	BM	ZD	TR
a	Maximum RAI / CI	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
b	Advancement Index AI =	0.83	0.56	0.78	0.6	0.6	0.53	0.35	0.9	0.47	0.5
c	Commitment Index CI_{1-10} =	0.83	0.56	0.78	0.6	0.6	0.53	0.35	0.9	0.47	0.5
	Deficit **AI/C1 = a – (b+c)/2**	**0.17**	**0.44**	**0.22**	**0.40**	**0.4**	**0.47**	**0.65**	**0.1**	**0.53**	**0.50**
d	Average $AI = \Sigma (AI_1 + AI_n)/ n$	0.612									
e	Average $CI = \Sigma (CI_1 + CI_n)/n$	0.612									
f	Rating Factor ϕ = **ΣRAI/AI**	1.63									
g	Ψ = 1/ (Rating Factor ϕ)	1.0	1.11	1.25	1.42	1.66	2.0	2.5	3.33	5.0	10.0
	Matrix Result	HH	HH	HM	MH	HL	MM	LH	LM	ML	LL
	TQM Assessment Rating	HL		H_A x H_C				Improvers-2			

Definition of TQM Implementation Constructs

1. **EC** = Executive Commitment
2. **QP** = Quality Philosophy
3. **OO** = Open Organisation
4. **EE** = Employee Empowerment
5. **SF** = Supplier Focus
6. **CF** = Customer Focus
7. **ME** = Measurement
8. **BM** = Benchmarking
9. **ZD** = Zero Defects
10. **TR** = Training

Classification based on the Advancement/Commitment Matrix

1. HH = H_A x H_C = High Advancement, High Commitment = World Class Organisations
2. HM = H_A x M_C = High Advancement, Medium Commitment = Award Winners-2
3. MH = M_A x H_C = Medium Advancement, High Commitment = Award Winners-1
4. HL = H_A x H_C = High Advancement, Low Commitment = Improvers-2
5. MM = M_A x M_C = Medium Advancement, Medium Commitment = Middle of The Road
6. LH = L_A x H_C = Low Advancement, High Commitment = Improvers-1
7. LM = L_A x M_C = Low Advancement, Medium Commitment = Drifters-2
8. ML = M_A x L_C = Medium Advancement, Low Commitment = Drifters-1
9. LL = L_A x L_C = Low Advancement, Low Commitment = Uncommitted

Note: The H_A, M_A, L_A values are obtained from the TQM Advancement Radial Chart (Chileshe et al, 2003)
N = 10

APPENDIX K : COMPARATIVE MATRIX

RAI	Mean Score	Inverse RAI (1/RAI)	Conversion Factors (Mean Score to Degrees	Equivalent Degrees	Conversion Factors (Degrees to Points)	Equivalent Points (EFQM.EM) "Enablers"	Individual Organisation Scoring Sheet	TQM Levels	TQM Index %	Proposed Clssification (2004)	EFQM. EM Clssification (Dale & Lascelles)	Equivalent European Construction Institute
1	2	3	4	5	6	7	8	9	10	11	12	13
0.20	**1.00**	**5.00**	**72**	**72.00**	**1.3889**	**100**	**34.00**	**L**	**0.00**	**Uncomitted**	Uncommitted	**0-11, None**
0.22	1.10	4.55	72	79.20	1.3889	**110**	37.40	L	2.50	**Drifters-1 (ML)**		**12-24, Uncertainity**
0.24	1.20	4.17	72	86.40	1.3889	120	40.80	L	5.00		**Committed (Drifters)**	**25-32 Awakening**
0.26	1.30	3.85	72	93.60	1.3889	130	44.20	L	7.50			
0.28	1.40	3.57	72	100.80	1.3889	140	47.60	L	10.00			
0.30	**1.50**	**3.33**	**72**	**108.00**	1.3889	**150**	**51.00**	**L**	**12.50**	**Drifters-2 (LM)**		
0.32	1.60	3.13	72	115.20	1.3889	160	54.40	L	15.00			
0.34	1.70	2.94	72	112.40	1.3889	170	57.80	L	17.50			
0.36	1.80	2.78	72	129.60	1.3889	180	61.20	L	20.00			
0.38	1.90	2.63	72	136.80	1.3889	190	64.60	L	22.50			
0.40	**2.00**	**2.50**	**72**	**144.00**	1.3889	**200**	**68.00**	**L**	**25.00**	**Improvers-1 (LH)**	**Adopters (Improvers)**	**33-49 Enlightment**
0.42	2.10	2.38	72	151.20	1.3889	210	71.40	L	27.50			
0.44	2.20	2.27	72	158.40	1.3889	220	74.80	L	30.00			
0.46	2.30	2.17	72	165.60	1.3889	230	78.20	L	32.50			
0.48	2.40	2.08	72	172.80	1.3889	240	81.60	L	35.00			
0.50	**2.50**	**2.00**	**72**	**180.00**	1.3889	**250**	**85.00**	**L**	**37.50**	**MoR (MM) Improver-2 (HL)**		
0.52	2.60	1.92	72	187.20	1.3889	260	88.40	L	40.00			
0.54	2.70	1.85	72	194.20	1.3889	270	91.80	L	42.50			
0.56	2.80	1.79	72	210.60	1.3889	280	95.20	L	45.00			
0.58	2.90	1.72	72	208.80	1.3889	290	98.60	L	47.50			
0.60	**3.00**	**1.67**	**72**	**216.00**	1.3889	**300**	**102.00**	**M**	**50.00**	**Award Winers-1 (MH)**	**Award Winners (TQM)**	**45-54 Empowerment**
0.62	3.10	1.61	72	223.20	1.3889	310	105.40	M	52.50			
0.64	3.20	1.56	72	230.40	1.3889	320	108.80	M	55.00			
0.66	3.30	1.52	72	237.60	1.3889	330	112.20	M	57.50			
0.68	3.40	1.47	72	244.80	1.3889	340	115.60	M	60.00			
0.70	**3.50**	**1.43**	**72**	**252.00**	1.3889	**350**	**119.00**	**M**	**62.50**	**Award Winners-2 (HM)**		
0.72	3.60	1.39	72	259.20	1.3889	360	122.40	M	65.00			
0.74	3.70	1.35	72	266.40	1.3889	370	125.80	M	67.50			
0.76	3.80	1.32	72	273.60	1.3889	380	129.20	M	70.00			
0.78	3.90	1.28	72	280.80	1.3889	390	132.60	M	72.50			

RAI	Mean Score	Inverse RAI (1/RAI)	Conversion Factors (Mean Score to Degrees	Equivalent Degrees	Conversion Factors (Degrees to Points)	Equivalent Points (EFQM.EM) "Enablers"	Individu1al Organisation Scoring Sheet	TQM Level (Low, Medium, High)	TQM Index	Proposed Calssification (2004)	EFQM. EM Clssification	Equivalent European Construction Instutute
1	2	3	5	6	7	8	9	10	11	12	13	14
0.80	**4.00**	**1.25**	**72**	**288.00**	1.3889	**400**	**136.00**	**H**	**75.00**			
0.82	4.10	1.22	72	295.20	1.3889	410	139.40	H	77.50			
0.84	4.20	1.19	72	302.40	1.3889	420	142.80	H	80.00			
0.86	4.30	1.16	72	309.60	1.3889	430	146.20	H	82.50			55-60
0.88	4.40	1.14	72	316.80	1.3889	440	149.60	H	85.00	**World Class**	**WCO**	**Wisdom**
0.90	**4.50**	**1.11**	**72**	**324.00**	1.3889	**450**	**153.00**	**H**	**87.50**	**Organisations**	**World Class**	
0.92	4.60	1.09	72	331.20	1.3889	460	156.40	H	90.00	**HH**	**Organisation**	
0.94	4.70	1.06	72	338.40	1.3889	470	159.80	H	92.50			
0.96	4.80	1.04	72	345.60	1.3889	480	163.20	H	95.00			
0.98	4.90	1.02	72	352.80	1.3889	490	166.60	H	97.50			
1.00	**5.00**	**1.00**	**72**	**360.00**	1.3889	**500**	**170.00**	**H**	**100.00**			

From the Total Quality Management Index (Column 11), the index scores exceeding 75% are considered Excellencent and these correspond to the High (H) Levels of TQM (Column 10)

APPENDIX L: LIST OF PUBLICATIONS

Forthcoming accepted abstracts, papers / conference and journal papers

1. **Chileshe, N.** (2005a) PhD in Construction Management Research: What is Original Contribution to Knowledge? The Case of TQM, **In:** Khosrowshahi, F. *(Ed.)* *21st Annual ARCOM Conference*, 7-9 September 2005, School of Oriental and African Studies, University of London. Association of Researchers in Construction Management.

2. **Chileshe, N.** (2004b) An Investigation into Quality Management Research Published in ARCOM between 2000 and 2004 (Part I), **In:** Khosrowshahi, F. *(Ed.)* *21st Annual ARCOM Conference*, 7-9 September 2005, School of Oriental and African Studies, University of London. Association of Researchers in Construction Management.

3. **Chileshe, N.** (2004c) An Investigation into Quality Management Research Published in ARCOM between 2000 and 2004 (Part II), **In:** Khosrowshahi, F. *(Ed.)* *21st Annual ARCOM Conference*, 7-9 September 2005, School of Oriental and African Studies, University of London. Association of Researchers in Construction Management.

4. **Chileshe, N.**, Watson, P., Dmitry, M. and Belokorovin. E. (2005) TQM Deployment: The Russian Experience, **In:** Khosrowshahi, F. *(Ed.)* *21st Annual ARCOM Conference*, 7-9 September 2005, School of Oriental and African Studies, University of London. Association of Researchers in Construction Management.

5. **Chileshe, N**. (2005d) Critical Success Factors of TQM: A Structural Equation Modelling (SEM) Approach. Paper Submitted to the *6th Construction Speciality Conference, 33rd Canadian Society of Civil Engineers (CSCE) Annual Conference*, to be held in Toronto, Canada, May 2005

6. Rayner, S., **Chileshe, N**. and Watson, P. (2005) Application of Key Performance Indicators (KPI's) to Infrastructure Projects: Key Empirical Findings. Abstract submitted to the *33rd Canadian Society of Civil Engineers (CSCE) Annual Conference*, to be held in Toronto, Canada, May 2005

7. **Chileshe, N.** (2005e) Critical Success Factors of TQM: Regression Analysis versus Structural Equation Modelling Approach. Abstract Submitted to *Third International Conference on Construction in the 21st Century*, CITC-III to be held in Athens, Greece, September 15-17.

8. **Chileshe, N.** (2005f) Validation of the EFQM Excellence Model in Construction Organisations: A Structural Equation Modelling (SEM) Approach, *In*: Sidwell, T. (Ed.) *COBRA 2005*, *The International Construction Conference: Responding to Change*, 4-8 July 2005, Queensland University of Technology, Brisbane, Australia, Construction Building Research.

9. **Chileshe, N.,** Watson, P. and Maslow, D. (2005) Modelling Sustainable Competitive Advantage in Service Organisations. Abstract submitted to *Third International Conference on Construction in the 21st Century*, CITC-III to be held in Athens, Greece, September 15-17.

10. **Chileshe, N.** and Watson, P. (2005a) Impact of Organisational Size and Maturity on Implementation of TQM: Empirical Findings from the UK Constructional Related SMEs. Abstract submitted to *Second International Conference on Construction in the 21st Century,* CITC-III to be held in Athens, Greece, September 15-17.

11. **Chileshe, N.** and Watson, P. (2005b) Investigating the Impact of Organisational Size on TQM Implementation. Abstract submitted to *The 3rd International Structural Engineering and Construction Conference*, ISEC-03 to be held in Shunan, Japan, September 20-23.

12. **Chileshe, N.** and Watson, P. (2005c) Impact of Time Lag Analysis on TQM Implementation within UK Construction Related SMEs, Abstract submitted to *The 3rd International Structural Engineering and Construction Conference*, ISEC-03 to be held in Shunan, Japan, September 20-23.

13. **Chileshe, N.** and Watson, P. (2005d) Application of Methodological Triangulation in Construction Management Research: Some Key Empirical Findings, *Paper accepted* to *WW99 Working Commission, 4th Triennial International Conference*, to be held in Port Elizabeth, South Africa, May 10-13.

14. **Chileshe, N.** and Watson, P. (2005e) Impact of Environmental Competitive Factors on TQM Implementation, Paper Accepted to *The 2nd International SCRI Symposium*, to be held in Manchester, University of Salford, April 12th - 13th 2005.

15. Watson, P., **Chileshe, N.** and Maslow, D. (2005b) Addressing Sustainable Competitive Advantage via a Functional Assessment Model. Paper Accepted to *First Commercial Management Conference*, CMC to be held in Manchester, April 7-8.

Internet Publications

16. Watson, P., **Chileshe, N.** and Maslow, D. (2005a) A New Model for Obtaining Sustainable Competitive Advantage. Paper Accepted in *EFQM Excellence One*. News Zone, Week 10, March 2005

17. Watson, P., **Chileshe, N.** and Maslow, D. (2005b) Management Functional Assessment: A Practical Application Developed From The Russian Experience. Paper Accepted to *Six Sigma Journal*.

Published

18. Watson, P., Maslow, D. and **Chileshe, N.** (2004) Deploying Total Quality Management in Russia. *European Quality Journal*, **11**(2), 58-69

19. Watson, P., **Chileshe, N.** and Maslow, D. (2004) A New Model for Obtaining Sustainable Competitive Advantage, *In*: Root, D., Massyn, M. and Shakantu, W. *(Eds.)* *2nd CIDB Postgraduate Conference,* 10-12 October 2004, Cape Town, South Africa, Construction Industry Development, 129-141.

20. **Chileshe, N.** and Watson, P.A. (2004a) Quality Management Levels Within Construction SMEs: An Empirical Investigation (Part One), *In*: Root, D., Massyn, M. and Shakantu, W. *(Eds.)* *2nd CIDB Postgraduate Conference,* 10-12 October 2004, Cape Town, South Africa, Construction Industry Development Board, 80-94.

21. **Chileshe, N.** and Watson, P.A.(2004b) Quality Management Levels Within Construction SMEs: An Empirical Investigation (Part Two), *In*: Root, D., Massyn, M. and Shakantu, W. *(Eds.)* *2nd CIDB Postgraduate Conference,* 10-12 October 2004, Cape Town, South Africa, Construction Industry Development Board, 175-188.

22. **Chileshe, N.** and Watson, P.A. (2004b) The Measurement of Quality Management Levels Within UK Construction SMEs: Development and Validation of TQ-SMART, **In:** Khosrowshahi, F. *(Ed.)* *20th Annual ARCOM Conference*, 1-3 September 2004, Heriot Watt University. Association of Researchers in Construction Management, Vol. 1, 77-87.

23. Watson, P.A. and **Chileshe, N.** (2004b) Establishing a Valid Methodology for Measuring The Effectiveness of Total Quality Management (TQM) Deployment Initiatives, *In*: Ellis, R. and Bell, M. (Eds.) *COBRA2004*, *The International Construction Conference: responding to change*, 7-8 September 2004, Leeds, Construction Building Research, Vol. 1,

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