AN ASSESSMENT OF THE EFFECTIVENESS OF QUALITY ASSURANCE SYSTEMS IN THE CONSTRUCTION INDUSTRY

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This research programme was carried out in collaboration with the British Standards Institution.
This is to certify that, except where specific reference is made, the work described in this thesis is the result of the candidate. Neither this thesis, nor any part of it, has been presented, or is currently submitted, in candidature for any degree at any other University.

Candidate: __________________________ Director of Studies: T. Williams
DECLARATION

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Candidate: ______________________
ABSTRACT

More than two decades have passed since the introduction of Quality Assurance Systems in the form of BS 5750 / ISO 9000 yet the effectiveness of these systems are still a matter of controversy and debate.

Although the implementation of Quality Assurance Systems in the construction industry has been slow to emerge, most large construction organisations are currently implementing such systems.

Much has been written about the advantages and disadvantages of Quality Assurance Systems but unfortunately without any direct reference to any hard data. Most of the reported advantages and disadvantages are based purely on perceptions and views of individuals involved.

The British Standards Institution (BSI) acts as a collaborating establishment for this research. This is the first research that attempts to assess the effectiveness of Quality Assurance Systems, in the construction industry.

Based on data collected from literature, construction companies and experts in the field of Quality Management, the research provides a better understanding of the objectivity of available data regarding the effectiveness of QA Systems and examines the possibility of finding reliable measures.

This thesis shows that no construction company has managed to assess the effectiveness of its Quality Assurance Systems in an objective manner. Regarding measures of the effectiveness of QA Systems, most experts believed that such measures are very important because an organisation must justify the existence of such systems, which are considered as overheads. However, all experts declared
that they are not aware of any construction company that has managed to assess the effectiveness of its ISO 9000 in any reliable manner.

This research is of a particular value to construction companies who are considering implementing an ISO 9000 as well as those companies that are already implementing such systems.
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CHAPTER ONE

Introduction
CHAPTER ONE

Introduction

1.1 INTRODUCTION

This chapter discusses the concept of quality and provides definitions to various quality related terms. Importance of quality and its relevance to the construction industry are also discussed in this chapter.

Furthermore, a brief description of the aim of the research is given before outlining the structure and content of this thesis by providing a brief description of each chapter.

1.2 THE CONCEPT OF QUALITY

'Quality' is one of the latest buzzwords that must have been used much more during the last two decades than any other time, yet many people are still confused and argue about the true meaning of quality.

According to Moir (1988), the word 'quality' is derived from Latin quails, meaning of what kind. However, more precise definitions of quality include:
According to BS 4778, (Glossary of terms used in quality assurance including reliability and maintainability terms), the word quality is often used for several distinct purposes:

(a) 'comparative sense' or 'degree of excellence', whereby products may be ranked on a relative basis, sometimes referred to as 'grade'.

(b) 'quantitative sense' as used in manufacturing, product release and for technical evaluations, sometimes referred to as 'quality levels'.

(c) 'fitness for purpose sense' which relates the evaluation of a product or service to its ability to satisfy a given need.

Within the context of the BS 4778 standard and in accordance with established usage in the quality assurance field the word 'quality' is used in the 'fitness for purpose' sense and defined as: The totality of features and characteristics of a product or service that bear on its ability to satisfy a given need.

Quality is defined as “conformance to requirement” (Crosby, 1979, p.17).
In the context of construction, quality is described as:

“The totality of the attributes of a building that enable it to satisfy needs, including the way in which individual attributes (external attributes; performance attributes; and aesthetic and amenity attributes) are related, balanced and integrated in the whole building and its surroundings” (BRE, 1978).

Quality is, therefore, complex, multidimensional, and prone to personal interpretations. According to McCabe (1998), quality, like beauty, appears to be in the eyes of the beholder.

1.3 IMPORTANCE OF QUALITY

Is quality important? Logic suggests the answer is yes. An organisation known for its ‘quality’ product or service is certainly better than a company that is not renowned to produce ‘quality’.

According to Ahmed and Kangari (1995), quality has become one of the important forces leading to organisational success and company growth in national and international markets.

The construction industry is a very important sector of the UK’s economy. The importance of this industry is emphasised by McCabe (1998, p.vii) as he stated:
"The Construction Industry is the hub for wealth creation, progress and advancement in any nation. It is therefore not surprising to see the real measure of economic strength has always been ‘how thriving’ the construction industry sector is”.

Various publications, such as, Latham report 1994 and a report entitled ‘Constructing Quality’ (November 1995) by the Quality Liaison Group also emphasised the importance of quality aspects in construction. In fact, according to the Latham report ‘Constructing The Team’ (1994), every client has the right to expect high quality from the project which it has commissioned, but unfortunately that is by no means always the outcome. Each year, defects or failures in design and construction cost members of the construction industry more than £1000 million.

There have been some disturbing reports regarding the cost of ‘failure’ in the construction industry. All those reports emphasise the importance of improving quality in the industry. Hellard (1993), claimed that construction disputes in the UK come to a value of 7% of the industry’s turnover, and if we assume that only one third of the defective work becomes the subject of a formal dispute, we could estimate the costs of failure as around 20% of turnover. The estimate of Sjoholt (1988), is even more disturbing, as he estimated the value of failure could be as high as 25 – 30 % of total project costs.

Furthermore, according to Gunning (1996), in the United Kingdom’s construction industry failure costs could reach £10 billion per year.
Pheng (1993), noted that one of the main objectives of any building procurement exercise would be to obtain a quality standard that matches the client's expectations. As a result, there has always been great interest in what constitutes quality standards in the industry and how they can be maintained, improved, and assured.

Also in relation to the construction industry, Giles (1996, p. 13) emphasised the importance of quality as he stated the following:

"Obtaining work is likely to be increasingly dependant upon a reputation for quality and reliability and being able to provide tangible proof of quality practices".

The importance of 'quality' in the construction industry is very clear from the literature above. The costs of failure can be very high and could well be life threatening to organisations, not only in terms of formal dispute costs but also in terms of losing customers.

The need for quality assurance in the construction industry, according to Griffith (1990), is an implication of the many inefficiencies and problems in construction, the consequential occurrence of protected litigation and a loss of professional, commercial and public acceptance of construction.
1.4 AIM OF RESEARCH

The importance of quality, particularly in the construction industry, was discussed earlier in this chapter. In an effort to improve quality, in construction and in other industries, various techniques and systems have been adopted. This research is concerned with Quality Assurance Systems.

The evolution and development of QA Systems are discussed, in detail, in the following chapter.

Although precise statements of aims of the research are stated in Chapter Four, section 4.2, it is perhaps, appropriate at this point to provide a brief description of the aims in order to offer readers a better understanding as to the purpose of the investigation.

The research examines measures currently used by construction companies to assess the effectiveness of their QA Systems. The research also aims to determine whether the effectiveness of QA Systems, in the construction industry, can be measured in a reliable objective manner.
1.5 QUALITY RELATED DEFINITIONS

In this section some quality related terms and their abbreviations, gathered from various reliable references, are defined in alphabetical order.

**Defect:**

The nonfulfilment of intended usage requirements. (BS 4778: 1987).

**Non-conformity:**

The nonfulfilment of specified requirements. (BS 4778: 1987).

**Quality Assurance (QA):**

All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality. (BS 4778: 1987).

A systematic way of ensuring that organised activities happen in the way they are planned. It is a management discipline concerned with anticipating problems and creating the attributes and controls which prevent problems arising. (CIRIA: Report 109)

A management process designed to give confidence to the client by consistently meeting stated
objectives. (RICS: Quality Assurance, Introductory
Guidance, 1989)

The means by which an organisation can
demonstrate that they practice quality management
to a recognised standard. (Baverstock, 1992, p.11)

**Quality Control (QC):** The operational techniques and activities that are
used to fulfil requirements for quality. (BS 4778: 1987).

**Quality Management (QM):** That aspect of the overall management function that
determines and implements the quality policy. (BS 4778: 1987).

The umbrella term for approaches to quality.
(McCabe, 1998, p.1)

The systematic management process aimed at
achieving a client's requirements. (Baverstock,
1992, p.11).

**Quality System:** The organisational structure, responsibilities,
procedures, processes and resources for

**Repair:** The process of restoring a non-conforming characteristic to an acceptable condition even though the item may still not conform to the original requirement. (BS 5882: 1980).

**Rework:** The process by which an item made to conform to the original requirement by completion or correction. (BS 5882: 1980).

**Specification:** The document that prescribes the requirements with which the product or service has to conform. (BS 4778: 1987).

People often use the term Quality Management when they mean Quality Assurance and Quality Assurance when they mean Quality Management. Barrett (1994, p.211), noted the distinction between QM and QA as follows:

"QM is concerned with internal management of quality, whereas QA is interested in being able to demonstrate externally that systems and procedures have been followed".
1.5.1 Author's Own Definitions of Principal Terms Stated in The Research

**Quality:** Degree of excellence of the contractor's services and finished products as perceived by the customer.

**QA Systems:** What is meant by QA Systems throughout the research, unless otherwise indicated, is namely the ISO 9000 series.

**Objectivity:** The words 'objectivity' and 'objective measure' are repeated frequently throughout this research. For the purpose of this research what is meant by 'objectivity' is not the absolute objectivity that may be achieved in laboratory-like conditions. In this research 'objectivity' relates to reliable data based on evidence gathered from reliable sources with minimum bias and, where possible, based on hard evidence backed by relevant documentation.

**Effectiveness:** The ability of the QA System to meet its specified requirements and prescribed objectives. This term is used repeatedly throughout this research. The reasoning behind this definition is amplified in Chapter Three.
1.6 THESIS STRUCTURE AND CONTENT

A brief introduction of each chapter is given in this section in order to outline the logical progression of the thesis.

Chapter One

This is the introduction chapter. It provides background to the concept of quality and discusses its importance in the construction industry. The chapter also provides useful definitions of quality related terms used in the thesis. The overall aim of this research is introduced in this chapter.

Chapter Two

This chapter reviews the evolution and development of Quality Management. It starts by discussing early records of Quality Management throughout different periods until the development of modern ideas.

Chapter Three

This chapter discusses effectiveness of Quality Assurance Systems. The chapter outlines advantages and disadvantages of QA Systems and investigates the objectivity of available data. The chapter also highlights the need for the research, by identifying a gap in knowledge.
Chapter Four
Various research methodologies; their advantages and disadvantages are discussed in this chapter. The chapter outlines the research methodology adopted in this research and justifies its use. Precise statements of aims of the research are also provided in this chapter.

Chapter Five
This chapter outlines sources of data used in this research and how this data was collected. Sample size of the main research survey and the response rate are also discussed in detail.

Chapter Six
This chapter presents and discusses results of data collected for this research. The chapter shows that in addition to reviewing various literatures, results were collected from three main sources: Construction companies, experts in the field of Quality Management, and clients of the industry. Therefore, results are presented and discussed in the same order they were collected.

Chapter Seven
This is the final chapter of this thesis. The chapter discusses the implications of the research findings and states final conclusions. The chapter also outlines the original contribution, of this research, to knowledge and provides recommendations for further research.
The following diagram outlines the thesis structure.

Chapter One - Introduction
Introduction to the concept of quality and its importance in the construction industry. Structure and content of the thesis.

Chapter Two - Literature Review
Evolution and development of Quality Management

Chapter Three - Effectiveness of QA Systems

Chapter Four - Research Methodology
Research aims. Research tools adopted and reasons for using them.

Chapter Five - Data Collection
Sources of data used in the research. Approach used to collected data. Response Rate.

Chapter Six - Results and Discussion
Presentation of results collected from various sources. Discussion of results.

Chapter Seven - Conclusions and Recommendations
Original contribution to knowledge. Implications of results and findings. Recommendations for future research. Limitations.
1.7 SUMMARY

This chapter introduced the concept of quality and its importance in all industries.
It has been stated that the construction industry loses hundreds of millions of pounds each year due to bad quality.

Various quality related definitions were also discussed and the distinction between Quality Management and Quality Assurance was outlined.

The overall aim of the research was also stated in this chapter. The research aims to establish whether effectiveness of QA Systems, in construction industry, can be assessed in an objective reliable manner. The research also aims to establish what types of measures are being used, by construction companies, to assess the effectiveness of their QA Systems.

The following chapter discusses the evolution and development of modern quality management and standards.
REFERENCES


Chapter One

Introduction


CHAPTER TWO

Historical Background
2.1 INTRODUCTION

This chapter describes the evolution of Quality Management starting with the earliest records and ending with modern Quality Management Systems. It is important to be familiar with the origins of ISO 9000 as this issue becomes relevant in following chapters. This chapter describes how the origins of ISO 9000 were in industries other than construction.

2.2 EARLY RECORDS OF QUALITY MANAGEMENT

Early civilisations were formed alongside the banks of the Niles, Tigris and the Euphrates. Some of the structures built during these ancient times still stand today thousands of years later.

The earliest legal code known in its entirety was found in Babylon (Iraq) by French archaeologists in 1901. According to Larue (1969), the most notable cultural contribution of the Babylonian King Hammurabi (1792-1750 B.C.) was the development and documentation of a body of laws. Hammurabi claimed to have received his famous code of laws by divine providence from the sun God.
Chapter Two

Historical Background

The laws were inscribed upon a stele of black diorite nearly eight feet high and it is now displayed at the Louvre in Paris.

One of the laws in Hammurabi’s famous code stated the following:

“If a builder constructed a faulty structure which subsequently collapsed, causing the loss of an aristocrat’s life, the builder might be put to death” (Larue, 1969, p.28).

The ancient law above introduces very important concepts. It necessitates that the house is built to minimum standards to prevent collapse and, therefore, sets the minimum level of quality acceptable.

2.3 THE INDUSTRIAL REVOLUTION

Since the early times of the Babylonians, quality management as a concept did not advance very far until the years of the Industrial Revolution. In fact, according to Johnson and Kaplan (1987), many recognisably modern ideas of quality only originated in the nineteenth century. Before this time, business was organised around a single process and product and used economic exchanges to obtain raw material and sell finished goods.

The Industrial Revolution of the eighteenth century had the most important impact on industrialisation in the world. Following the invention of the steam engine and
its further perfection by James Watt for industrial use, most processes were adapted to mechanisation. Wren and Voich (1984), describe the transition from pre-mechanisation to production management as "a spirit of innovation led to inventions, inventions led to factories, factories led to a need for management and organisation".

This transition from pre-mechanisation to production management did not happen overnight. According to Lawrence and Lee (1989), over a period of 50 years from the mid-eighteenth century, the British economy was transformed from predominantly agricultural based to predominantly industrial. Therefore, major industrial sectors developed such as cotton, glass, coal, iron, copper, paper and building.

2.4 DEVELOPMENT OF MODERN IDEAS OF QUALITY

The real quality revolution, according to Bird (1990), started with the Allied and NATO military purchasing during and after the World War II. The various procurement procedures of the US, Ministry of Defence, and NATO generally provided specifications against which tenders were sought, and quality conformed by inspection with reference to it.

Khan and Hashim, (1983) also noted that it was the defence organisations of Britain and America that were initially involved in documenting standards for
their ordnance products. The reason for this was to provide products that agreed to certain specifications and that were interchangeable at reduced costs.

It is obvious, therefore, that military organisations’ obsession with standardisation brought a new impetus in the generation of standards, which were mainly product oriented.

The British Standards Institution (BSI) issued its first standards on statistical quality control in 1935 entitled BS 600: ‘The Application of Statistical Methods to Industrial Standardisation and Quality Control’. The outbreak of World War II impelled BSI to publish a number of emergency standards in order to cope with the urgent requirement for weapons. In 1942, BS 1008: ‘War Emergency Quality Control’ was published.

In December 1963, the United States’ Department of Defence issued a standard entitled ‘Military Specification: Quality Programme Requirements’. This, according to Groocock (1986), was to replace an earlier version issued in 1959.

In May 1967, the British Government published a white paper entitled ‘Public Purchasing and Industrial Efficiency’. The paper incorporated the following opening statement: “It is the Government’s policy to help make British industry more efficient and competitive”. This paper made several significant recommendations which main points can be summarised as follows:
• A scheme should be developed which provides quality control and ensures that the whole production of a particular product conforms to agreed requirements and, therefore, removes the need for further inspection and testing by the purchaser.

• British Standards should be developed to specify product types and the provision for technical assessment.

• Support for greater use of quality assurance schemes and, in particular, in cases where no standards exist.

In May 1968, according to Ashford (1989), the North Atlantic Treaty Organisation (NATO) issued the first edition of an Allied Quality Assurance Publication entitled AQAP-1: ‘Quality Control System Requirements for Industry’. This document specified NATO requirements for Quality Control Systems to be operated by their contractors. To assist contractors and manufacturers to comply with its provisions and to guide those responsible for evaluating Quality Systems, NATO issued a further document known as AQAP-2 in September 1968.

According to Hoyle (1994), in response to NATO requirements the British Ministry of Defence published its own equivalents of AQAP documents for use in Britain. The first of these documents was Defence Standard (DEF STAN): 05-08, issued in March 1970, followed by a more definitive document, DEF STAN 05-21
which was published in January 1973. Ashford (1989), noted that unlike many subsequent standards, DEF STAN 05-21 was a model of clarity.

It seems that the introduction of concepts of quality management into defence contracts prompted the British Standards Institution to take action to provide guidance and information on the subject to various industries. In 1971 they published BS 4778: Glossary of Terms used in quality assurance and followed it, in 1972, with BS 4891: A Guide to Quality Assurance. Ashford (1989), stated that although these documents were only advisory, they served a useful purpose in interpreting the requirements of defence procurement standards in a more general context.

The British Standards Institution in 1974 issued BS 5179 to complement the UK MOD standards. BS 5179 introduced guidelines for organisations producing their own quality assurance documentation. Hoyle (1994), noted that this standard was heavily based on the Defence Standards but was aimed at the non-military market. Hoyle further stated that BS 5179 is still an excellent guide to the subject as it gives review and evaluation guidance for each recommendation but not in detail.

The next significant stage in the development of the modern Quality Assurance Standards was the Warner Report.

The British Government invited Sir Frederick Warner in 1976 to put forward his recommendations to the National Economic Development Office.

According to Sherwood (1990), as a direct result of the Warner Report the publication of a national 'Standard' became reality. The British Standards Institution, in 1979, issued the BS 5750 series entitled 'Quality Systems'.

BS 5750 was prepared in three parts, for contractual purposes, to help small and large organisations across a wide spectrum of diversity to establish documented quality management systems. In fact, according to Ashford (1989), the BS 5750 series introduced the words 'quality systems' into the language of management. They established that a quality system has to achieve two objectives. First it has to control what is produced to make sure it meets the requirements of the purchaser and, secondly, it has to provide confidence or assurance that compliance has been achieved.

Three years after the publication of the first edition of BS 5750 series, the British Government published an influential White Paper entitled 'Standards, Quality and International Competitiveness'. This paper was presented to Parliament by the Secretary of State in July 1982. The paper emphasised the Government's recognition of the importance of national and international standards which can provide customers with required quality and how this could be accomplished through the use of Quality Assurance Systems.
By the mid 1980's many countries, such as, Australia, Canada and the USA published their own quality assurance standards. In the interest of international trade, standards had to be harmonised.

In 1987, according to Duncan, *et al* (1990), the International Organisation for Standardisation (ISO), under the chairmanship of the Canadians, prepared a series of documents, ISO 9000 to ISO 9004, ISO 9000 and ISO 9004 being guideline documents and ISO 9001 to ISO 9003 quality system specifications, using BS 5750 parts 1 to 3 as basis for the standard. After consideration of ISO 9001 - 9003, the committee of BSI adopted the ISO standard and has since re-issued BS 5750 as dual standards.

Over 26 countries were involved in the development of ISO 9000, as stated by Hoyle (1994), and while the standard still bears evidence of its military pedigree, it did break the mould and set a new world standard for quality management.

ISO protocols require that all standards be reviewed at least every five years to determine whether they should be confirmed, revised or withdrawn. The 1994 versions of the ISO 9000 family are currently being revised by ISO’S Technical Committee TC 176, for publication in December 2000.

According to the International Organisation for Standardisation (2000a), the two most important objectives in the revision of the ISO 9000 series of standards have been:
1- To develop a simplified format that will address small as well as medium and large organisations, and

2- For the amount and detail of documentation required to be more relevant to the desired results of the organisation's process activities.

In order to develop a simplified structure the number of standards within the family has been reduced. This has been achieved by the replacement of ISO 9001:1994, ISO 90002:1994 and ISO 9003:1994 by a single quality management system requirements standard, ISO 9001:2000.

ISO 9001:2000, according to the International Organisation for Standardisation (2000b), is intended to be generic and applicable to all organisations, regardless of type, size, and product category. It is recognised, however, that not all the requirements of this new standard will necessarily be relevant to all organisations. Under certain circumstances, an organisation may be able to justify the exclusion of some specific requirements from its Quality Management System.

2.4.1 Quality Gurus

It is inappropriate to discuss the development of quality standards and the quality revolution without discussing, at least briefly, the contribution of the Quality Gurus.
"From the early 1950's a small group of American quality experts or gurus have been advising industry throughout the world on how it should manage quality. The most notable of these are Deming, Juran and Crosby. They have all formed highly successful consultancies, and the one thing in common with all of their philosophies and methods is that there are no short cuts to quality, no quick fixes" (Manning, 1994, p.159).

Professor Toney Bendell prepared a publication for the Department of Trade and Industry, in 1991, entitled The Quality Gurus: What can they do for your company? The publication highlighted the significant contribution of the Quality Gurus. This publication also divided the Gurus across three time periods as follows:

**Early 1950s, the Americans:** W. Edwards Deming, J. M. Juran and Feigenbaum.

**Late 1950s, the Japanese:** Kaoru Ishikawa, G. Taguchi and Shigeo Shingo.

**The new Western Wave:** Philip Crosby, Tom Peters and Claus Moller.

The table below shows the differences and similarities between three well known Quality Gurus.
## The American quality gurus compared (adapted from Oakland 1995)

<table>
<thead>
<tr>
<th></th>
<th>Crosby</th>
<th>Deming</th>
<th>Juran</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition of quality</strong></td>
<td>Conformance to requirements</td>
<td>A predictable degree of uniformity and dependability at low cost and suited to the market</td>
<td>Fitness for use</td>
</tr>
<tr>
<td><strong>Degree of senior management responsibility</strong></td>
<td>Responsible for quality</td>
<td>Responsible for 94% of quality problems</td>
<td>Less than 20% of quality problems are due to workers</td>
</tr>
<tr>
<td><strong>Performance standard/Motivation</strong></td>
<td>Zero defects</td>
<td>Quality has many scales. Use statistics to measure performance in all areas.</td>
<td>Avoid campaigns to do perfect work</td>
</tr>
<tr>
<td><strong>General Approach</strong></td>
<td>Prevention, not inspection</td>
<td>Reduce variability by continuous improvement</td>
<td>General management approach to quality – especially 'human' elements</td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td>Fourteen steps to quality improvement</td>
<td>Fourteen points for management</td>
<td>Ten steps to quality improvement</td>
</tr>
<tr>
<td><strong>Improvement basis</strong></td>
<td>A 'process', not a programme. Improvement goals</td>
<td>Continuous to reduce variation. Eliminate goals without methods</td>
<td>Project-by-project team approach. Set goals</td>
</tr>
<tr>
<td><strong>Teamwork</strong></td>
<td>Quality improvement teams. Quality councils</td>
<td>Employee participation in decision making. Break down barriers between departments</td>
<td>Team and quality circle approach.</td>
</tr>
<tr>
<td><strong>Costs of quality</strong></td>
<td>Cost of non-conformance. Quality is free</td>
<td>No optimum - continuous improvement</td>
<td>Quality is not free - there is an optimum</td>
</tr>
</tbody>
</table>
2.5 QUALITY MANAGEMENT AND THE CONSTRUCTION INDUSTRY

With regard to modern Quality Systems, Griffith, in 1990, noted that within the construction industry, the application of Quality Assurance has been slow to emerge. Whilst construction must formally conform to planning and building approvals set by local authority building control, there is no compulsory requirement for design practices, manufacturers, contractors, or consultants to conform to the requirements of BS 5750: Quality Systems.

Tyler and Frost (1993) stated that Quality assurance is a subject that has only been taken seriously in the construction industry in Great Britain in recent years.

"The large construction companies have introduced QA systems into their organisations but a Loughborough University survey showed that none of the medium-sized construction companies surveyed had introduced such a system" (Tyler and Frost, 1993, p.9).

According to Duncan, et al (1990), since 1979, mainly due to the requirements of nuclear power stations, the construction industry has gradually adopted BS 5750 for use by the main construction contractors and suppliers.

In 1994, an important Government initiative, 'Constructing the Team' (Latham report), emphasised the importance of quality aspects in construction. In fact, the
report stated that Quality Assurance certification should continue to be encouraged within the construction industry as a potentially useful tool for improving corporate management systems.

Another important Government initiative was a report entitled ‘Constructing Quality’. This report was prepared by the Quality Liaison Group and launched by the Construction Minister on 21st November 1995. The report sets out a quality strategy for the construction industry through a series of recommendations in the areas of procurement, standards, small firms and education and training.

2.6 SUMMARY

Since the times of the Babylonians, quality management as a concept did not advance much until the Industrial Revolution. The true evolution of management systems came about as a result of the military organisations’ obsession with product standardisation.

Within the construction industry the application of Quality Management has been slow to emerge. However, despite the manufacturing origins of BS 5750 / ISO 9000 it was soon implemented by the majority of large construction companies.

Reasons for the implementation of BS 5750 / ISO 9000 in construction companies as well as its advantages and disadvantages are discussed, in detail, in the following chapter.
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CHAPTER THREE

Effectiveness of Quality Assurance Systems
3.2 REASONS FOR IMPLEMENTING QA SYSTEMS

Before the term 'effectiveness', for the purpose of this research, can be defined, the reasons for implementing QA Systems have to be explored. This is because the definition is directly linked to the reasons for implementation. This will become apparent in the following sections.

Watling (1989), suspects that many organisations first became acquainted with the words 'Quality Assurance' when informed by a potential client that in order to be eligible to participate in a certain project they had to be able to demonstrate that their quality management system complied with an appropriate British Standard.

Al-Nakeeb (1993), based on a survey of forty-one large construction companies in the UK, determined that the two main reasons that led construction companies to implement QA Systems were client pressure, and to gain competitive advantage.

Client pressure was also mentioned by McCabe (1998, p. 185) as he stated:

"For many construction organisations the introduction of 'formal QA' using a quality system such as ISO 9000 was not voluntary. Most organisations implemented QA because they read newspaper predictions that the government, through its agencies, would in future demand that contractors tendering for work should be accredited to the British Standard for quality management BS 5750".
Rayner and Porter (1991) who surveyed twenty firms, using in-depth interviews, found that the main reason for seeking certification to ISO 9000 was customer pressure. In fact, 35% of the surveyed firms reported client pressure as the main reason for implementing a QA System. Other reasons were as follows: anticipated customer pressure 15%; gain market advantage 15%; access new markets 15%; improve quality 10%; and other 10%.

Furthermore, research by Shammas-Toma et al. (1996) indicated that client requirement is the main reason for the adoption of QA Systems by construction firms in the UK rather than a belief in the value of such systems.

It seems that client pressure is not limited to companies in the UK only. For example, Brown and Van der Wiele's (1995) survey of ISO 9000 accredited companies in Western Australia revealed that customer pressure was the main motivation for achieving accreditation.

Thirty-five construction companies in the UK were interviewed in a major study carried out by the Construction Industry Research and Information Association (CIRIA 1996), and results show that thirty out of the thirty-five firms implemented QA Systems because they wished to improve the standing of their business in the market place and / or increase opportunities for increased business. Only two firms confirmed that they had installed their QA System in response to client pressure. However, this is the only major survey to find that client pressure was not the primary reason for implementing QA Systems amongst respondents.
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Literature, therefore, shows that although there are various reasons for the implementation of QA Systems client pressure seems to be the primary motive. However, research evidence suggests that the 'client pressure' is in fact perceived rather than actual.

According to Barrett (1994), and Barrett and Grover (1998), the perceived client demand for third-party certification is often more apparent than real.

"Drawing from a wide range of in-depth interviews, there is no doubt that for most if not all firms their interest in quality issues is driven by perceived client demand, or a fear of future demand from clients for QA registration to BS 5750" (Barrett, 1994, p.207).

Barrett reinforced his argument above by surveying fifty-one clients, as part of a major survey. According to the survey (Barrett and Holling, 1998), ISO 9000 has the lowest preference rating of all criteria given as choices. Clients prefer to have worked with the relevant firm and people before, when making a choice to employ a consultant.

Barrett's view that the client pressure is likely to be more apparent than real is supported by a research carried out by Moatazed-Keivani et al (1999, p113):

"While many clients increasingly require ISO certification, it is by no means a universal or mandatory requirement. Practically
all managers confirmed that the requirement for ISO
certification varies according to the type of client. Thus although
the Ministry of Defence, the London Underground, and the
nuclear industry require certification, many other private or
public clients do not”.

Hutchins (1992, p.36), recognised the dangers of implementing ISO 9000 for the
wrong reasons and stated that:

“There is a very high risk that a company will introduce ISO
9000, not because it believes in the concept, but because it is
forced to do so. This is the very worst reason. The company in
this case, will almost certainly end up with two systems, the one
they show the auditors, and the one they actually use”.

Hutchins’s views are supported by Pateman (1994, p.207) who also recognised
the danger of implementing a QA System for the wrong reasons and stated:

“Implementing the standard solely because of market driven or
customer driven forces can be a recipe for disaster”.
3.3 ADVANTAGES OF QA SYSTEMS

This section highlights the advantages of QA Systems as reported by previous research and literature.

In 1988 the Federation of Civil Engineering Contractors published a report under the title: Quality Assurance for Contractors. The report listed nine benefits to the implementation of QA:

- The client receives assurance that the structure he ordered has been constructed in accordance with established work procedures, using materials of specified quality.

- The contractor's procedures become more efficient, wasteful practices are eliminated and the communications within the company improve because the responsibilities of people involved in construction are better defined.

- Communications between the parties to the construction work (i.e., the contractor, architects, engineers, sub-contractors, etc) improve through the use of more formal channels of communication.

- More work is produced "right first time", and cost savings are made because less remedial work is required.
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- Less time is lost because of poor materials supply, and the costs of replacing rejected materials are reduced.

- Project information, drawings, specifications etc are supplied by the client's representatives more systematically. Specifications should also be clearer.

- The contractor has a better chance of meeting his budget and completing the project to time. Any disputes which arise should be settled more easily by reference to the project quality records.

- Where there is staff turnover on site, new incumbents find it easier to check that parts of the works completed before their arrival have been carried out correctly. Equally, young engineers gain experience with greater confidence, since the written procedures they are asked to apply have been prepared by engineers more experienced than themselves.

- The contractor obtains assurance through audits and corrective actions that his project management is operating correctly. (The Federation of Civil Engineering Contractors, 1988, p.6).
The same report stated that,

"As with all new management techniques which are of value in theory, quality assurance must become cost effective in practice. The savings gained from its benefits must more than offset any additional costs incurred". (The Federation of Civil Engineering Contractors, 1988, p.7).

According to Ritter (1989) the immediate benefits of the certified, BS 5750 Quality Assurance System are predominantly ones internal to the certified firm. They are chiefly the following:

- A sounder defensive position against claims is likely to be maintained.

- Marketing may be improved to clients who are 'risk-averse' and apply special care in the pre-qualification of their consultants, or the suppliers of goods and services.

- Clearer records and other elements of the system may lead to savings of time and cost when changes take place in the course of a project.

- Impetus to standards of service and greater job satisfaction for staff can come from better recognition of
their efforts and the stimulus of external audits (Ritter 1989, p.24).

Advantages of a systems approach were also highlighted by Hughes and Williams (1991, p.7) as they stated that:

"Advantages derived from available research data are:
- Improved communications and efficiency.
- Checking of work and avoidance of unnecessary and costly errors, failures and expensive remedial work.
- Documented proof that work has been executed in compliance with document and specifications.
- Easier implementation of client changes.
- Precise clarification and quantification of the effects of such changes.
- Easier identification and quantification of delays and claims.
- Completion on time.
- Reduced maintenance period remedial works.
- Provision of as-built records.
- Possible reduction of insurance premiums.
- Improved competitiveness and marketability of services".
Twenty appropriately sized firms, from different industries, were surveyed by Rayner and Porter (1991). Results of their survey reveal that 40% of companies felt that the most valuable benefit actually achieved had been the retention of existing customers. A further 20% of the surveyed companies felt that the most valuable benefit was the gaining of new customers. Overall, 70% of respondents indicated that the principal benefits are related to marketing; 25% perceived the principal benefits to be related to discipline and control and only 5% felt that the principal benefit was directly related to the cost of quality, in the form of less scrap and rework.

Pheng and Yeo (1997) surveyed twenty-one construction firms and reported that 100% of the firms approached stated that ISO 9000 improved documentation. Other advantages to the implementation of ISO 9000 were also highlighted. Enhanced company communications was reported by 57.1%, improved methods of working and improved quality of work done were also reported by 52.4% of firms surveyed.

Results of research carried out by Moatazed-Keivani et al (1999), show that the most important outcome of ISO 9000 certification, amongst twelve construction companies interviewed, has been the improvement in management practices and structure. Moreover, the majority of managers interviewed added that a major result of the certification process, was the raising of consciousness on quality issues among personnel, particularly at management level. Increased customer satisfaction and improved management and service provision were also reported.
The advantages stated above are based on literature and research findings. Later sections in this chapter will discuss the objectivity of these advantages.

3.4 DISADVANTAGES AND PROBLEMS OF QA SYSTEMS

The advantages outlined in the previous section may give the impression that the implementation of a QA System is an opportunity not to be missed. This section however, highlights reported disadvantages and problems with QA Systems. This section also discusses some of the concerns regarding the suitability and applicability of QA Systems in the construction industry.

According to Gunning (1996), many quality systems have failed to provide the necessary assurance because they are based on procedures which do not fully address the problem of achieving full product conformity. Instead, they concentrate on a paper exercise which is dominated by form-filling and observation of documented procedures, regardless of whether these procedures actually ensure product conformity.

A report by the Federation of Civil Engineering Contractors (1988), recognised the concerns that have been expressed by the construction industry. According to the report, quality assurance involves excessive paperwork and too much formality, which together serve to increase overhead costs and reduce flexibility of operations on site to an extent which can cause delay.
Results of a survey of forty-one large construction companies, carried out by Al-Nakeeb (1993), show that 73% of the surveyed companies found the implementation of a QA System time consuming. Other disadvantages were also identified, including concerns that the QA Systems are too costly and can cause resistance and conflict within the organisation.

According to Lee (1998), one of the biggest limitations of ISO 9000 was that it focused on systematic process management with little emphasis on the use of technology. As a result, it was reported that the certification exercise brought limited improvement on the lead time.

Seymour and McCabe (1994, p.457) researched six construction companies and stated that:

"Much of the experience of QA amongst site managers, we have found, is that their dilemma is exacerbated. Because of the paperwork, they have even less time to supervise and the checking they do becomes even less effective."

A report by Bristol Quality Centre (1991) listed three major disadvantages to the implementation of ISO 9000. These advantages are:

- Because it is a “pass” type of approval it can become the peak, and only, achievement on quality — i.e. “we have the approval therefore we must be a good company”.

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The costs of ISO 9000 achievement and maintenance are significant and consume resources which are limited. If no, or few, gains to the competitiveness of the company are perceived then this may prevent further senior executive interest in the subject of quality.

ISO 9000's emphasis on the importance of established procedures could inhibit the rate of change for improvement in an organisation.

Criticisms associated with applying ISO 9000, according to Quality Liaison Group (1995), tend to major on bureaucracy, administrative cost, loss of innovative opportunity and limitation to conformity rather than improvement.

Barrett and Grover (1998, p28), stated three main problem areas with ISO 9000. These are:

- The ISO 9000 standard does not deal well with the people-oriented and informal aspects of an organisation's operations.

- The ISO standard does not give sufficient emphasis to managing a responsive/dynamic relationship with the firm's clients.
Third party certification tends to compound the above two problem areas by creating an emphasis on a written manual to the virtual exclusion of informal aspects coupled with a perspective that, once certification is achieved the process is ended.

Barrett’s view, on the post-certification syndrome, is also shared by Holmes (1987) and Develin and Partners (1989) and they stated that:

“Many individuals were, from the outset, apprehensive of a third party QA registration scheme because of the danger of the subject becoming regarded as an end in its own right”. (Holmes, 1987, p.26).

“The risk of using a standard is that companies relax after accreditation”. (Develin and Partners, 1989, p.21).

Many authors have criticised the internal auditing procedure, which is a requirement of ISO 9000. People don’t like someone looking over their shoulder. Whether the audit is internal or external it seems to make people feel that they are not being trusted.

Concerns over the auditing procedure are expressed by Duncan et al (1990) who stated that:
"Unfortunately, auditing is too frequently seen as a criticizing exercise. Many auditors seem to find satisfaction in recording trivia to justify the thoroughness of their audit. The good things found during an audit are often not acknowledged, while problems are exaggerated unnecessarily; as a result, the final report is unbalanced". (Duncan et al, 1990, p.55).

Conti (1991), also expressed concerns about the auditing procedures, and according to him, by their very nature, external assessments (like traditional internal audits) foster a defensive mentality, and 'examination syndrome', rather than a pro-active attitude.

A number of authors have expressed their concerns as to the suitability and applicability of ISO 9000 to the construction industry because of the manufacturing-industry-roots of the standard.

By nature the construction industry is very 'people-oriented' and human interaction much more intensive than in the manufacturing industry. Unlike the manufacturing industry, construction has not got a fixed site. Construction sites are unique with different teams working on each site.

Furthermore, the life-cycle of construction projects are longer than those of most manufactured products. Therefore, the period of human interaction between members of individual project teams on one side, and between the construction
company and its clients on the other, is much longer than that of most manufacturing organisations.

The culture of the construction industry, as stated by Tyler and Frost (1993), differs substantially from that found in many manufacturing organisations. Individual site managers, who compare with line managers in manufacturing terms, are far more autonomous in day-to-day activities.

It is rather obvious that the construction industry is a 'people industry'. Therefore, those responsible for the implementation of QA Systems should be aware of the importance of the human aspects and avoid treating people like robots. A mechanistic approach to quality systems must be avoided at all cost. This may seem obvious but, according to Hellard (1994), even experienced QA consultants and certification bodies with limited experience of the building industry have a tendency to adopt a mechanistic approach in applying the principles of ISO 9000 to the construction process.

"Trying to control people through systems and treating people as robots causes two things to happen: - people will get round the system, - it will seem that the system is working. Of course we need systems, but they will work only if people make them work". (Mortiboy and Oakland, 1991, p.3).
In fact, some professionals such as Barrett and Grover (1998) are encouraging the creation of separate standards, suitable for services that don’t fall in the manufacturing category.

“The RICS should use its contacts and members to provide a strong lead by lobbying for the creation of flexible QA/QM standards suitable for services, such as surveying, and designed to support an integrated approach to health and safety, training and environmental management issues as well as quality. In parallel the RICS should work with clients to break through the cycle of misunderstanding about QA-certification as a major selection criterion”. (Barrett and Grover, 1998, p.2).

Barrett and Grover also express concern about the applicability of ISO 9000 in non-manufacturing industries, and stated that:

“For surveyors, and the service industries in general, there is the potential problem that the origin of ISO 9000 lies in the process manufacturing industries. The language used and the approach adopted is not always easily translated into the requirements of a different type of business.” (Barrett and Grover, 1998, p.11).
The Quality Liaison Group (1995), also emphasised the problem of the manufacturing language used in the ISO 9000 standard and stated that:

"A failure of BS EN ISO 9000 lies in its vulnerability to superficial and variable interpretation, which can lead to inappropriate application. This means that compliance with the relevant standard may not directly affect the quality of the product. Unwieldy bureaucratic documented quality systems may secure certification but do not necessarily improve performance. Neither do they reflect the nature of the construction industry and its organisations particularly in the case of small firms" (Quality Liaison Group, 1995, p.17).

Hellard (1993, p.58), is another author who is critical of the applicability of ISO 9000 to the construction industry. Hellard presented nine primary characteristics of the construction industry to demonstrate its uniqueness. The nine characteristics are summarised below:

- **Uniqueness of a construction project.** A construction project is not even a prototype. It is a single product run. It has a unique production location.

- **Length of project.** Amendments to the project requirement must be permitted both as the design develops and even later during production on site, as the end product has a very long life cycle.
- **Difficulty in defining quality standards.** These will relate not only to the quality of the building but also to the quality of its various parts.

- **Uniqueness of people-relationships.** Many of the various contractors involved may never have worked with or alongside other firms. Some project teams will be present throughout the project, others will come and go.

- **Feedback.** This is difficult. The construction cycle is long; the feedback cycle is much longer.

- **Difficulties in establishing cost in use.** The design criteria for a capital project should be based on the costs in use of the building services, systems and finishes. However, their establishment and collection has defied many endeavours in the industry since the 1950s when their implication was appreciated.

- **Consumer conflict.** There is frequently conflict between the requirements of the purchaser and those of the product user: the building client, who commissions the project, is generally concerned with different aspects of cost (and their taxation implications) than the lessee or tenant, who by his lease arrangements may be responsible for the costs of maintenance.
Effectiveness of Quality Assurance Systems

- *Lack of experience of client.* The briefing operation is generally further complicated because the client is an amateur in the sense that he is rarely concerned with the commissioning of more than one building and so could consider that there is little incentive to become adequately expert in making what are the top-management decision for his project.

- *Nature and form of the building contract.* The nature and form of the building contract is vital, and perhaps the primary education that a building client should be given. There are in the UK ninety-four different standard variations (i.e. printed forms), which have been developed and created by the various groups in the construction industry.

The unique characteristics of the construction industry, according to Hellard, significantly differentiates it from the manufacturing industry that the ISO 9000 was originally intended for. Hellard argues that because of the nature of the construction industry a third party certification is irrelevant and without added value.
However, some authors seem to disagree with the opinions above and argue that ISO 9000 is a standard suitable for all industries. For example, Ashford (1989, p.8) stated that:

"The early development work on quality management took place in a manufacturing environment and so it is hardly surprising that most literature on the subject is written in the vernacular of the factory. This is unfortunate as it creates a mistaken impression in the minds of those engaged in activities other than manufacturing that the tenets of quality management hold no benefits for them. Nothing could be further from the truth".

Now that the advantages and disadvantages of ISO 9000 have been discussed, the following section will examine the foundations that some of the above mentioned statements are based on. In other words, what measurements were applied in order to determine the stated advantages and disadvantages.

3.5 OBJECTIVITY OF AVAILABLE DATA

The previous two sections listed the advantages and disadvantages of ISO 9000. Some claims made indicate that ISO 9000 is too good to be missed. Other claims indicate that ISO 9000 has many drawbacks. Indeed, some authors even question the suitability of ISO 9000 in the construction industry. What are the bases of the
statements made? And how objective is the available data? This section attempts to answer these two questions.

As mentioned in previous chapters, a large number of literature and research data have been reviewed for this research. All available literature seems to be based on personal views and opinions. This leads to an important question: Are conclusions, based on personal views and opinions, reliable enough to be considered as objective evidence?

The individuals quoted and referred to, in previous sections of this chapter, are highly respectable in their fields of expertise and their views and opinions hold great credibility. Therefore, it is the author's view that, while the perceptions and opinions of one individual may be deemed as biased and subjective, the aggregate outcome of personal views and opinions of such highly credible individuals may be considered as highly reliable evidence and carries a considerable degree of objectivity.

For example, although the advantages of ISO 9000, as stated in section 3.4, according to The Federation of Civil Engineering Contractors (1988), Ritter (1989), and Hughes and Williams (1991), are all based on the perceptions and opinions of these authors without any direct reference to any empirical data, the aggregate outcome is reliable enough to be deemed as objective.

Similarly, the disadvantages, stated in section 3.5, according to Bristol Quality Centre (1991), Quality Liaison Group (1995), Duncan et al (1990), are anecdotal
and based on the authors' views and perceptions. However, the accumulative outcome of the views and opinions of such credible experts cannot be dismissed as purely subjective.

The rest of the authors referred to in sections 3.4 and 3.5 above have based their statements on the results of surveys they carried out. Some of these surveys were related specifically to the construction industry, for example Al-Nakeeb (1993) and Moatazed-Keivani et al (1999). Other surveys involved various industries, including construction, for example Develin and Partners (1989) and Lee (1998).

The methodologies adopted for the surveys were either postal questionnaires or interviews with QA Managers, with exception of Shammas-Toma et al (1996) who used the observation technique.

All the above mentioned research and studies are highly credible and not to be undermined. However, regarding the objectivity of data, it can be argued that while postal questionnaires and interviews, used to assess the effectiveness of a QA system, can provide valuable empirical data they remain prone to a certain degree of subjectivity. The data collected is largely based on the perceptions and feelings of the respondents and interviewees, mainly QA Managers. The degree of this subjectivity (or objectivity) in this case, in the author's opinion, depend on how experienced those QA managers are and the degree of prejudice involved. Some QA Managers may be biased when answering certain questions, in order to reflect a better image of their companies. Therefore, any conclusions based on such data are ultimately the compilation of feelings and perceptions of individuals.
who, unlike experts, may be biased and inexperienced, and therefore, remain prone to a great deal of subjectivity.

The observation technique used by Shammas-Toma et al was based on investigation of twenty-five sites, where a sample of structural elements on each site was selected for defect observation. The finished elements were tested with a cover meter and minimum readings were recorded. It was then possible to establish the quality of the finished product. Defects were traced to sources of their origins and were put into two categories, management-controllable defects and operative-controllable defects. To examine the latter type of defects, formal quality controls were investigated as follows; on each site the check-list used by site personnel were examined and the site engineers were asked about the items they check. The check-lists, completed by site staff, and claims about what had been checked were then compared with the actual condition of what had been checked or allegedly checked. A ‘quality performance score’ was awarded for each item and on the basis of these scores the effectiveness of the Quality Management System, intended to control operative-controllable defects, was assessed.

It can be argued that the results achieved by Shammas-Toma et al couldn’t reflect the effectiveness of the entire Quality Management System used, nor could the methodology, adopted in their study, be used to assess the effectiveness of a Quality Assurance System. The methodology used did provide objective measures as to how effective a certain Quality Control process was, namely the check-list, but this does not reflect in any way the true effectiveness of the whole QA
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System. In fact if check-lists were used in absence of any QA System, the results achieved would have probably been the same.

3.6 DEFINITION OF QA SYSTEM EFFECTIVENESS

A definition of QA System’s effectiveness can be formed now that the reasons that led construction companies to implement QA Systems, the advantages and disadvantages have been discussed.

Effectiveness of the system is dependent upon what the company defined as its purpose. In other words, if you don’t define what the system is set to achieve, by precisely defining its objective, you can’t measure the effectiveness or the impact of the system.

“The measure of how effective a system is lies in the ability to meet its objectives”. CIRIA (1996, p59).

Therefore, throughout the research, ‘effectiveness’ of the system is defined as:

The ability of the QA System to meet its specified requirements and prescribed objectives.

For example, if the company has implemented a QA System in order to reduce rework on site then the effectiveness of the system is judged by how well it achieves this objective.
3.7 PROBLEM IDENTIFICATION – FINDING THE GAP IN KNOWLEDGE

As it has been mentioned in Chapter One, the adoption of ISO 9000 in the construction industry has been slow to emerge. However, during the last decade and up to date there has been a great interest within the construction industry in the area of QA Systems. In fact, it is difficult today to find a large construction company that has not implemented a QA System.

The author has carried out a previous research, at a Master’s degree level, in the area of QA Systems in the construction industry. The author found that there was a great and genuine interest and a notable confusion, within the construction industry, regarding the subject of the effectiveness of QA Systems. The lack of knowledge in the area of the effectiveness of QA Systems prompted the author to carry out further, more detailed investigation at a PhD level.

Furthermore, results of literature review identified a serious problem, namely, *there seems to be a great deal of confusion and diverse conflicting reports regarding the effectiveness of QA Systems in the construction industry.*

These gaps in the knowledge shaped the bases from which this research developed and formed the reasoning behind the main concepts evolved. This lack of knowledge leads to very important questions: *How do construction companies measure the effectiveness of their QA Systems? Can the effectiveness of QA Systems be measured objectively?* If the answer is yes then this leads to another...
question: *How so?* And if the answer is no, then it also leads to another question:

*Why not?*

### 3.8 IMPORTANCE OF RELIABLE MEASURES

Decades have passed since BS 5750 first appeared yet the effectiveness of these systems in the construction industry remains a matter of great controversy and uncertainty.

Constructing the Team (Latham 1994, p.80), often referred to as *The Latham Report*, also highlighted the issue surrounding the uncertainty of the effectiveness of Quality Assurance Systems. It stated that:

"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".

The need for measures is also emphasised by Hoyle (1994, p415), who stated that:

"having established a quality system it is necessary to install measures that will inform management whether the system is
being effective. Installing any system without some means of verifying whether it is doing the job it is intended to do, is a waste of time and effort”.

According to Develin and Partners (1989), without quantifiable, measurable results, people will remain sceptical of the value of the process and will not retain enthusiasm. They also stated that:

“People don’t participate enthusiastically just to satisfy a textbook dogma. They will expect evidence that the effort is worthwhile” (Develin and Partners, 1989, p.49).

The two quotations above sum up the essence of the importance of providing hard evidence that a certain process or system is working effectively. Many construction companies are spending large amounts of money and human resources on the implementation and maintenance of their systems. These companies need to know more about the effectiveness of QA Systems in order to decide if it is worth continuing with the implementation or not.

3.9 SUMMARY

This chapter started out by highlighting the reasons that led construction companies to implement ISO 9000. Many reasons were stated, however, the primary reason seems to be client’s pressure.
Advantages and disadvantages of the implementation of ISO 9000 in construction were discussed. Opinions were clearly divided as to whether ISO 9000 is suitable and applicable to the construction industry or not. The objectivity of statements made by various authors, regarding the advantages and disadvantages of ISO 9000, was assessed.

The literature review of the effectiveness of QA Systems identified that there is a great deal of confusion regarding the effectiveness of QA Systems. The identification of this problem led to serious questions that shaped the basis of this research.

Finally, the importance of reliable measurements was also highlighted. Installing any system without being able to measure its benefits is a waste of valuable resources.

The following chapter discusses the research methodologies adopted for this research and justifies their use.
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CHAPTER FOUR
Research Methodology
4.1 INTRODUCTION

In this chapter the research aims are stated and the research methodology is explained and evaluated.

The chapter reviews the various research methodologies which are considered relevant to this study and describes the rationale for adopting a particular research methodology.

The advantages and disadvantages of methodologies used in this research are also highlighted.

4.2 RESEARCH AIMS

According to Yin (1991) in order to select an appropriate methodology, the first and most important condition for differentiating among various research strategies is to identify the type of research question being asked.
The following research aims evolved as the core of this study:

- To determine measures taken, by construction companies and experts in the field of Quality Management, to assess the effectiveness of Quality Assurance System, namely ISO 9000, when implemented in Construction Companies in the UK.

- To examine the objectivity of available data on the effectiveness of QA Systems.

- To determine how the effectiveness of such systems can be measured objectively and whether it can be assessed objectively at all.

These aims require research to find answers to a series of how, why and what questions. Therefore, the aims of any study will, inevitably, structure the nature, design and style of the research tools.

4.3 RESEARCH APPROACH

Prior to deciding on a research approach, there was a need for an extensive literature review. The main objective of the literature review was to develop a
knowledge and understanding of previous work and activity in the area of this research.

Electronic bibliographies (CD ROM format), electronic journals and databases such as BIDS and Emerald Online were utilised, in addition to conventional approaches, to find related literature.

Various types of related publications were reviewed. They included books, quality related journals, Quality Standards, Conference proceedings, theses and published research in related subjects.

The author also attended a wide range of seminars, and participated in national and international conferences. This contributed significantly to gaining a better understanding of the research area.

Related literature was reviewed and periodically updated throughout the research period.

Having decided on a specific focus for the research, the next decision is to choose a research approach. Oliver (1997), argues that a traditional way of distinguishing between types of approaches to research is to think of them as involving either a quantitative or qualitative approach. This view is supported by Creswell (1994), who also provided the same two choices for the researcher, i.e. quantitative or qualitative.
It is not within the scope of this thesis to dwell on the debate of quantitative versus qualitative research. However, it is important to provide a brief overview of these two approaches in order to justify their use in this research.

4.3.1 Qualitative Research

Researchers adopting a qualitative perspective, according to Bell (1993), are more concerned to understand individuals' perceptions of the world. Such researchers tend to seek insight rather than statistical analysis.

Mills (1959) noted that qualitative research is interested in how humans behave under different circumstances and conditions, how they use information supplied to them, and when, and if, they act on it. Mills also argues that if this human behaviour is studied in a symbolically reduced fashion, such as employing a 'yes' or 'no' questionnaire and statistically testing the data, there is a risk that conclusions may fail to fit reality.

According to Walker (1985), qualitative methods tend to produce 'rich' data relating to small numbers of people and tend to provide more contextual data which adds value to other data. In short, qualitative research tends to reach those parts that other techniques do not.

Quite recently, increasing recognition of the value and appropriateness of qualitative studies has emerged. This may perhaps be in acknowledgement of the
potential for such methodologies to get beneath the manifestations of problems and issues which are the subject of quantitative studies, and thereby, to facilitate appreciation and understanding of basic causes and principles, notably, behaviours (Fellows and Liu, 1997).

Easterby-Smith et al (1991), argue that among the various techniques primarily associated with qualitative methods, the most fundamental of all is that of in-depth interviewing.

4.3.2 Quantitative Research

Quantitative researchers gather facts and study the relationship of one set of facts to another. They use scientific techniques that are likely to produce quantified and, if possible, generalisable conclusions (Bell, 1987).

Essentially, quantitative approaches involve making measurements by collecting data. According to Fellows and Liu (1997), the quantitative approach is built upon previous work which has developed principles, laws and theories to help decide the data requirements of the particular research project.

The distinction between quantitative and qualitative research methods was made by Oliver (1997) on the basis that quantitative methods seek data in a numerical format, which can then be analysed and presented in a number of ways, including charts, tables and graphs.
Furthermore, according to Creswell (1994), quantitative research is considered to be a more “scientific approach” as it offers some numeric description of a population. Creswell also noted that quantitative techniques are generally used to test or verify a theory, rather than to develop one.

In conducting quantitative research, three main approaches are employed. As noted by Fellows and Liu (1997), these approaches are: asking questions of respondents by questionnaires and interviews; carrying out experiments; and ‘desk research’ using data collected by others.

### 4.3.3 Triangulation

The use of multiple, but independent, measures is known as triangulation, a term borrowed from navigation and surveying where a minimum of three reference points are taken to check an object’s location (Smith, 1975).

Therefore, triangulation, as seen by many authors (e.g. Fellows and Liu, 1997; Creswell, 1994; Bryman, 1988), is the use of qualitative as well as quantitative research approaches together to study a topic.

Triangulation can be very powerful to gain insights and results to assist in researching a certain topic. The advantages of triangulation are discussed in more detail in the next section.
4.4 OUTLINE OF RESEARCH METHODS ADOPTED

This section outlines the research methods adopted and provides justification for employing them.

Fellows and Liu (1997), argue that by employing qualitative and quantitative approaches together it is possible to reduce or even eliminate the disadvantages of each individual approach whilst gaining the advantages of each and, due to the combination, a multi-dimensional view of the subject is gained.

There are good reasons for using different approaches in the same research for triangulation, as pointed out by Abrahamson (1983), this prevents the research becoming method-bound. The strength of almost every measure is flawed in some way or other, according to Abrahamson, and therefore, research design and strategies can be offset by counterbalancing strengths from one to another.

Triangulation seems to find widespread acceptance and many authors (e.g. Bryman, 1988; Creswell, 1994; Oliver, 1997) agree that triangulation can provide a general picture and enhance the validity of findings because one method may complement another.

After an extensive review of research methodology literature, it was decided that triangulation would be the best approach for this particular research, especially as the aims of the research do not provide for the use of one single method of research. Therefore, the use of the qualitative approach can help to provide
background information on contexts and subjects, whereas the quantitative approach can help to structure and generalise the findings. However, emphasis is placed on the qualitative methods, through in-depth interviews, in providing the detailed information imperative to this research.

It can be seen that the decision-making process, to select an appropriate research approach, was in various stages. Each stage was planned by the researcher and then discussed and approved by the supervisory team.

The process started with an intensive literature review of various research approaches and methodologies then, for the reasons stated in the previous section, a decision was made to use triangulation as the most suitable approach for this research.

The following decision was to select an appropriate methodology, for the chosen approach, to collect required data. The survey method, using postal questionnaires and in depth interviews, was then chosen in preference of other methods such as case studies and experimental methods.

According to Denzin (1978), a survey is a methodological technique that requires the systematic collection of data from populations or samples through the use of interview or self-administered questionnaires. The investigator approaches a sample of persons who have been exposed to a set of events or experiences and interviews them with respect to these experiences.
The decision regarding the best research approach and its associated methodologies and tools was driven and governed by the nature of data required from the chosen samples.

In order to justify the use of the survey methodology, alternative research approaches and methodologies, and how they compare with the chosen methodology for this research, are discussed later in this chapter.

The following section outlines and justifies the choice of tools used to collect the data for this research.

4.4.1 Mail Questionnaire

This section provides an overview of mail questionnaires and outlines their advantages and disadvantages.

Questionnaires are very widely used in large scale investigations. Much has been written about the use of questionnaires as a tool for surveying a large sample and a wide range of literature is available, for example, the classic books by Oppenheim (1966) and Moser and Kalton (1975).

A questionnaire is a highly structured data collection technique whereby each respondent is asked much the same set of questions (de Vaus, 1990).
The most notable advantages of mail questionnaires are:

- It is normally difficult, if not impossible, to survey distant locations using personal interviews as the travel costs may be prohibitive. Mail questionnaires enable the researcher to target respondents precisely even at distant locations (Oliver, 1997).

- A chief advantage of the mail questionnaires is cheapness. All that is required is the cost of the planning and pilot work, printing expenses, addressing, mailing, and providing stamped, self-addressed envelopes for the returns (Oppenheim, 1966).

- Avoidance, to a degree, of interviewer bias. The fact that no interviewer is present means that there will be no interviewer bias (Oppenheim, 1966).

There are some inherent weaknesses of mail questionnaires. According to many authors such as Oppenheim (1966), Brenner et al (1985), de Vaus (1990), the most noticeable of the drawbacks of mail questionnaires are:

- The largest disadvantage of mail questionnaires is the fact that they usually produce a very poor response rate.
• In comparison with the interview technique, mail questionnaires lack personal introduction of the research and the chance to explain and elaborate on questions. However, a good covering letter and well designed unambiguous questions may overcome these weaknesses.

• Respondents may unintentionally skip a question or may tend not to answer questions which may show them or their company in a negative way.

• No opportunity to make assessments based on observations.

When designing a questionnaire there are two types of questions available. They are, according to Fellows and Liu (1997), open and closed questions. Open questions are designed to enable the respondent to answer in full; to reply in whatever form, with whatever content and to whatever extent the respondent wishes. Closed questions, on the other hand, have a set number or responses as determined by the researcher where the respondent may be asked to tick boxes or choose a number on a scale such as the Likert scale.

Oppenheim (1966) noted that the chief advantage of open questions is the freedom that they give to the respondent. Once he has understood the intent of the question, he can let his thoughts roam freely, unencumbered by personal replies. The respondent, therefore, may provide his ideas in his own language. However, open questions, in general, are not as easily analysed as closed ones.
According to de Vaus (1990), where the questionnaire is long or the respondent’s motivation is not high, closed questions are useful since they are quick to answer. Furthermore, closed questions are easier to code, and therefore, simplify the analysis.

Closed questions are easier and quicker to answer; they require no writing; and quantification is straightforward. This often means that more questions can be asked within a given length of time (Oppenheim, 1966).

However, closed questions also have their drawbacks. A major disadvantage, as noted by de Vaus (1990), is that sometimes closed questions may create false opinions either by giving an insufficient range of alternatives from which to choose or by prompting respondents with ‘acceptable’ answers.

Further disadvantages of closed questions are the loss of spontaneity and expressiveness. Oppenheim (1966) argues that in the case of closed questions it is never known what the respondent said or thought of his own accord. Also, there is the risk of the introduction of bias by “forcing” the respondent to choose between given alternatives and by making him think of alternatives that might not have occurred to him.

The types of questions forming the questionnaires in this research were an intentional mix of open and closed questions. Closed questions were used where respondents were expected to provide repeated answers of a definitive nature and where there was no fear of leading respondents towards a certain answer, for
example, when the answer can either be 'yes' or 'no'. Open questions were utilised where maximum information was required from respondents without having to guide them towards a certain answer. In other words, open questions were used in order to allow respondents to freely express their views without being influenced by a list of pre stated answers.

Questionnaires used in this research provided the basis for interviews. In other words, questions used in the interviews were based on the results of the questionnaires.

Detailed discussions of the questionnaires used for this research, their design and types of questions will follow in the next chapter.

4.4.2 Interviews

It has been stated earlier in this chapter that among the various techniques primarily associated with qualitative methods, the most fundamental of all is that of interviewing.

The qualitative research interview is a construction site for knowledge. An interview is literally an inter view, an interchange of views between two persons conversing about a theme of mutual interest (Kvale, 1996).
According to Oppenheim (1966), the greatest advantage of interviews, in the hands of a skilled interviewer, is their flexibility. The interviewer can make sure that the respondent has understood the question and the purpose of the research. Oppenheim also argues that the undisputed advantage of interviews is that the richness and spontaneity of information collected is higher than that which a mailed questionnaire can hope to obtain.

Naturally there are also several disadvantages with interviews. Oliver (1997) noted that the process is quite time-consuming when compared to mail questionnaires. Furthermore, interviews can be rather costly if one is to interview a large number of people who are geographically widely dispersed.

Oppenheim (1966), noted that one of the disadvantages of interviews is the possibility of bias. The interviewer may give an inkling of his own opinion or expectations by his tone of voice, the way in which he reads the questions, or even by his appearances and accent. Oppenheim argues that the interviewer may unintentionally influence the respondent by pausing expectantly at certain points, by probing with leading questions, and by agreeing with the respondent in an effort to maintain rapport.

Interviews vary in their nature, they can be: structured (formal), unstructured (informal) or semi-structured. The major differences lie in the constraints placed on the respondent and the interviewer.
In the *structured* interview, the researcher deliberately tries to retain considerable control over the content of the conversation. According to Moser and Kalton (1975), structured interviews involve asking all the respondents the same questions, in the same manner and in the same order without deviating from the plan.

Although structured interviews ensure some degree of consistency in the different interviews, they lack flexibility and tend to impose the researcher's views of events upon the respondents and do not allow them to provide their own interpretations of the research topic (Oliver, 1997).

*Unstructured* interviews, however, in contrast to the inflexibility of the *structured* ones, do not utilise schedules of questions. In the unstructured interviews, according to Fellows and Liu (1997), the researcher introduces the topic briefly and then records the replies of the respondent. This may be almost a monologue with some prompts to ensure completion of the statements.

Easterby-Smith *et al* (1991), warns against assuming that an unstructured interview, where the respondent talks freely without interruption or intervention, is the way to achieve a clear picture of the respondent's perspective. This is far from the truth according to Easterby-Smith *et al* as it is more likely to produce no clear picture in the mind of the respondent as to what questions or issues the researcher is interested in.
The preferred interview technique for this research is the *semi-structured* interview. This technique fills the spectrum between the two above described extremes. Here the researcher has a sequence of themes to be covered, and a number of planned questions to ask, however, there is flexibility in the process to change the order of events, or questions to follow-up events as they arise during the interview (Kvale, 1996).

Details of the interviews utilised in this research, their design, and samples chosen, will be fully discussed in the following chapter.

**4.5 ALTERNATIVE METHODOLOGIES**

Alternative research methodologies and their associated data collection tools were considered before finally deciding on the methodology described earlier in this chapter.

It is not within the scope of this thesis to discuss every known research methodology. However, this section provides reasons for dismissing some alternative research methodologies, that were initially considered for this research, as less effective.

Action research was initially considered for this research. After a careful consideration this approach was thought to be less effective for this particular research.
According to Bell (1993), action research is an on-the-spot procedure designed to deal with a concrete problem located in an immediate situation. The primary aim of action research is to understand, evaluate and solve this problem.

Furthermore, McNeill (1990), argues that in action research the researcher is actively involved in planning and introducing some change in policy, and then using their research experience to monitor and possibly to evaluate its effect.

Therefore, without dwelling on advantages and disadvantages of action research, it is obvious that it is not an appropriate approach for this particular research. The research aims to determine how construction companies are measuring the effectiveness of their QA Systems and whether this effectiveness can be evaluated objectively. This research is not of a problem-solving nature, it is of an exploratory investigative nature and, therefore, the problem-solving approach of action research makes it less suitable in this case.

Case studies were also considered as a possible alternative methodology. According to Fellows and Liu (1997), case studies usually employ interviews, of key actors in the subject of study, coupled with documentary data.

From experience, and through informal contacts with various construction companies, it was clear that access to quality related documents and records would be very difficult for an ‘outsider’ due to confidentiality and other reasons. The accessibility issue alone makes the case study methodology a less favourable option in comparison with the chosen research methodology.
Furthermore, even if some organisations agreed to the case study approach the number of case studies would have very been limited. Taking into account the nature of data required, the survey methodology was chosen, in preference to case studies, for its ability to provide the required data but from a much wider and a more representative sample.

Experimental studies were also considered for this research. According to literature, for example, Rummel and Ballaine (1963), Fellows and Liu (1997), the major objective of experimental studies is to describe the effect of certain known variables upon a particular characteristic of a group, population or organisation.

Therefore, according to literature, experimental studies are ideal for establishing causal connections among variables. The objective of the research is to evaluate existing methods to measure the effectiveness of QA Systems rather than actually find the impact of such systems on organisations. Moreover, the accessibility issue mentioned earlier in this section would have been amplified in this case. Using experimental studies would have required access to certain documentations and information that construction companies seem to be unwilling to share.

Longitudinal studies have also been considered for this research. According to Fellows and Liu (1997), longitudinal studies are observations made at multiple time points. There are three types of longitudinal studies: trend studies, those that examine changes within some general population over time; cohort studies, those that examine more specific subpopulations as they change over time; and panel studies, those that examine the same set of people over time.
Therefore, the primary objective of longitudinal studies is to study ‘changes’ over a period of time rather than give the snapshot picture that is usually achieved through surveys. If the aim of a research was, for example, to study the impact of QA Systems on organisations, then a longitudinal study (particularly, trend studies) would have been very useful. However, since the primary objective of this research is to identify and evaluate methods to assess the effectiveness of their QA Systems rather than study the ‘change’ caused by such systems, longitudinal studies in this case seem unsuitable. In fact, the type of data required for this research is indeed of a snapshot nature, which makes the survey methodology a much preferred option.

Furthermore, McNeill (1990), amplifies a major disadvantage with longitudinal studies which is cost. In fact, McNeill argues that longitudinal studies often struggle to remain solvent. Due to the limited funds associated with PhD studies the high costs of longitudinal studies make them unpopular.

It has been mentioned earlier in this chapter that the chosen data collection techniques or tools, within the survey methodology, are semi-structured interviews and postal questionnaires. Other data collection tools were explored before making the final decision.

For example, the use of group interviews or expert panels was considered. However, the researcher, in agreement with the supervisory team, decided that the use of group interviews for this research is unsuitable. The task of getting the chosen sample of experts all at the same time and place is extremely difficult.
Furthermore, the researcher felt that in using group interviews the results may be affected by dominant individuals who can take over the discussion or try to influence the opinions of others. According to Easterby-Smith et al (1991), social pressure can condition the responses gained and it may well be that people are not willing to air their views publicly. Easterby-Smith et al also warn that the problems of group interviews can sometimes outweigh the advantages.

Finally, the old Delphi Process to collect the required data was also considered for this research.

"The Delphi Process is a unique method of eliciting and refining group judgment, based on the rationale that $n$ heads are better than one when exact knowledge is not available. Delphi uses a panel of experts and repeated measurement and controlled feedback and replaces direct confrontation and debate with a planned program of sequential, individual interrogation usually conducted by questionnaire" (Jolson and Rossow, 1971, p.444).

It will be seen in Chapter Five that the selected group of experts is composed of individuals who are considered to be leading experts in their relevant subjects with various commitments and very busy schedules and, therefore, it was feared that the chosen experts may decline participation in the Delphi Process which requires them to commit more time than that taken by one in-depth interview with each of them.
Chapter Four
Research Methodology

4.6 SUMMARY

Different research methodologies have been discussed. It was felt that the best approach for this research was triangulation, which is seen as combination of both the qualitative and quantitative approaches. The choice of triangulation for this research has been justified.

Different means of collecting data have been discussed. It was felt that the best techniques to collect data for this research would be through the utilisation of mail questionnaires and in-depth semi-structured interviews. Justifications for using these techniques have been offered.

The following chapter will discuss, in detail, the process of Data Collection. It will outline the design of questionnaires and interviews used for this research.
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CHAPTER FIVE

Data Collection
5.1 INTRODUCTION

In the previous chapter the chosen research methodology has been discussed and justified. This chapter outlines the process of data collection and shows how each step was adapted depending on the results of the previous steps. It discusses how the data was actually collected, who supplied the information, how the surveyed sample was chosen and how participating individuals were approached.

Three main tools were used to obtain information. These were: literature review, questionnaires and interviews. This chapter discusses the process of data collection using each of these tools and outlines the aims of the questionnaires and interviews used in this research and how they were designed.

5.2 SOURCES OF LITERATURE AND INFORMATION USED

The first phase of the research involved a thorough review of ‘quality’ related literature. A large number of books and quality related journals available at the University’s library were reviewed. Several electronic databases were utilised in
order to find relevant literature. Inter-library loan requests were completed in
order to obtain literature not available locally.

Various organisations were approached at the initial stages of the research to
obtain advice and information that might not have been available in the public
domain. Organisations approached include; Department of The Environment
(DoE), Department of Trade and Industry (DTI), British Property Foundation
(Quality Liaison Group), National Accreditation for Certification Bodies
(NACCB), Institute of Quality Assurance (IQA), Construction Quality Assurance
Ltd, British Quality Foundation, Building Research Establishment (BRE),
Construction Industry Research and Information Association (CIRIA), Chartered
Institute of Building (CIoB), Federation of Civil Engineering Contractors, and
The British Standards Institution, which is the collaborating body for this
research, (See Appendix A).

The above organisations were approached in various ways. Some were
approached by telephone calls while others were approached by letter. Many of
these organisations have home pages on the Internet and were approached by e-
mails.

Almost all the organisations approached provided some useful literature and
information. Some of them simply sent a list of their latest publications while
others offered advice or suggested additional organisations to contact.
The author also collected literature and information when participating in national and international conferences, symposium and seminars. The author's participation in these large-scale gatherings was also useful in establishing contact and rapport with many academics and practitioners involved in the area of Quality Management.

5.3 SOURCES OF DATA COLLECTED

It has been stated in the previous chapter that the nature of the aims of the research did not provide for the use of one single methodology. Triangulation was decided to be the most appropriate approach for this research due to the nature of data required. Having decided on the best approach for this research the next decision to be made was from whom to collect the data?

After reviewing a large number of literature and previous research projects, approaching construction companies was an obvious and a natural decision in order to gain an insight into how they assess the effectiveness of their QA Systems.

Up on deciding on the first two phases (literature review and approaching construction companies) a decision was made to collect data from “experts” in the subject of Quality Management, particularly, those involved in the construction industry, in order to discuss with them the results gathered from literature and the
contraction companies and to seek their views regarding the effectiveness of QA Systems.

Furthermore, during the second phase of the research, in addition to approaching construction companies, attempts were also made to approach clients of the construction industry as an additional source for data. Justification for choosing these particular groups, as the main sources for data, will be given in the relevant sections below.

The diagram below illustrates the various phases of data collection:
The next sections will provide specific details as to how data was collected from each of the above three mentioned groups.

5.4 DATA COLLECTION - CONSTRUCTION COMPANIES

Data collection from construction companies was in two phases:

1- Data collected for the preliminary investigation.

2- Data collected for the main study by mail questionnaire.

5.4.1 Preliminary Investigation / Pilot Study

5.4.1.1 Aim of Pilot Study

The pilot study was conducted in order to form the basis of the main study survey. Moser and Kalton (1975), refer to the pilot survey as the ‘dress rehearsal’ for the main study survey and note that they are a standard practice with professional survey bodies and are widely used in research surveys.

The main aims of the pilot interviews were:

- To determine how construction companies would respond to the research topic: would they show any interest? This
would be useful in predicting a response rate for the main survey - mail questionnaire.

- To provide guidance as to the adequacy of the questionnaire by noting important points such as: the ease of handling the questionnaire, the efficiency of its layout and the clarity and adequacy of the questions themselves. This would help in refining ambiguous or unclear questions.

- To assess the suitability of targeting QA Managers, as respondents, rather than other senior managers. By noting the fluency in the way these managers answer the questions, and whether they have the necessary information readily at hand, it would be possible to make an assessment as to their suitability as respondents.

5.4.1.2 Pilot Interview Design

It has been mentioned earlier in this chapter that the pilot interviews form the basis of the main study survey. In other words, the pilot interviews in this research do not form the basis of further interviews, instead they form the basis of the mail questionnaire. Therefore, the questions were designed as if they were intended for a mail questionnaire rather than for an interview.
The development of the questions asked was based on the results of the literature review and findings of previous research. Naturally, the main aims of the research have a significant bearing on the choice of questions asked.

The first five questions were designed to determine the general description of the company and its historical experience. The remaining questions were more specific to the research and aimed to determine whether construction companies have developed some means to objectively measure the effectiveness of their QA Systems. If a company had developed such means, it was asked to describe them. If a company had not developed any means to objectively assess its QA System, it was asked why not?

In designing the questions many issues were taken into account. According to Zeisel (1995) the most important three issues to be considered when designing the questions were:

1- Is the question simple to understand?
2- Is the question precise enough?
3- Is the question neutral enough in order not to influence direction?

In addition to the three important issues above, Czaja and Blair (1996) noted some key decisions that should be considered when designing questions. Some of these decisions are:
• Does the question provide information needed?

• Will most respondents understand the question in the same way?

• Will most respondents have the information to answer it?

• Will most respondents be willing to answer it?

• Is other information needed to analyse this question?

All the above-mentioned issues and recommendations were considered prior to designing the questions.

The questions were an intentional mix of open and closed ones. The advantages and disadvantages of these two types of questions were discussed in the previous chapter.

5.4.1.3 Sample Size and Access to Companies

Six, large, well known construction companies were approached for the pilot study. All these companies had been running a QA system for at least one year and had been certified against ISO 9000 by recognised certification bodies. Telephone calls were made to each of these companies in order to obtain the names of their Quality Assurance Managers.

The decision to approach QA Managers, rather than other senior managers in the company, was based on the assumption that a QA Manager would have a first
hand experience of the system and would be more likely to have details and information readily at hand than other managers. The author also assumed that QA Managers would be enthusiastic about the subject of investigation and, therefore, might be more willing to be interviewed than other senior managers in the company.

Having obtained the names of the QA Managers in these six construction companies, a letter requesting an interview was sent to each one of them.

The letter, printed on University headed paper, gave a brief description of the study and informed the addressee that this was a PhD research project carried out in collaboration with the British Standards Institution (BSI). The letter also emphasised the fact that all information supplied would be treated with strict confidentiality. It was felt that the promise of confidentiality might help to gain a more favourable response.

The letter also stated that QA Managers who agreed to take part would receive a summary of the research findings upon completion. It was felt that this might act as an incentive, encouraging a better response.

The QA Managers were also informed that the author would attempt to contact them by telephone shortly after the receipt of the letter in order to arrange a convenient time for an interview, should they agree to it. It was felt that this would be a better approach than asking the QA Managers to confirm their decision in writing. It is the author's view that QA Managers might take a long
time to respond if they were asked to confirm their decision in writing. Furthermore, it was also felt that by contacting the Managers by telephone reluctant ones might be persuaded to be interviewed, where an unfavourable decision in writing would have been final.

All six QA Managers were contacted by telephone three to four days after sending the letter. Despite their workload and time constraints, all of the QA Managers were very enthusiastic about the research topic and stated that they were happy to be interviewed. A mutually convenient date for an interview was agreed with each QA Manager.

Samples of the letter sent to the QA Managers as well as a copy of the pilot interview schedule are shown in the following pages.
Dear Mr (Name),

I am carrying out a PhD research project at the University of Glamorgan with the BSI acting as a collaborating establishment. The research investigates the effectiveness of Quality Assurance Systems in the construction industry.

I would be very grateful if you could spare me an hour of your time for an interview.

If you agree to participate in my research I would be happy to make a summary of the results available to you on completion of my thesis.

Any provided information will be treated in the strictest confidence. Your name and the name of your organisations will remain anonymous.

Over the next few days I will be endeavouring to contact you by phone to arrange a date.

I thank you in advance for your co-operation and look forward to contacting you.

Yours sincerely,

A. A. R. Al-Nakeeb, BEng, DBA, MBA
Chapter Five

Data Collection

1- Name of company ............................................................................................................

2- Name and position of person answering the questionnaire

........................................................................................................................................
........................................................................................................................................

3- How long has this company been in business? ...... years.

4- Type of work: (You may tick more than one box)
   Building construction      ☐
   Civil Engineering construction ☐
   Repair and maintenance ☐
   Other (please specify) ☐

5- How long has it been since you acquired a third-party QA certification?
   ☐ years and ☐ months

6- How do you objectively assess the effectiveness of your system QA System?
Chapter Five

Data Collection

7- How often do you carry out the assessment?

8- Who is responsible for carrying out this assessment?

9- How long does it take to objectively assess the effectiveness of your QA System?

10- What are the costs involved in carrying out this assessment?

11- In your view, how objective are the results of this assessment?

12- What are the usual results of such assessments and what are their implications?
5.4.1.4 Pilot Interview Process

All of the pilot interviews were carried out face-to-face at the QA Managers’ private offices. The interviewees were reminded that any information supplied would be treated with strict confidentiality. The issue of confidentiality was emphasised in an effort to reduce ‘prestige’ bias as respondents may try to impress the interviewer by giving false or exaggerated answers in order to put themselves and their company in a better light.

After the customary personal introductions the interviewer gave a brief description of the research and handed the interviewee a copy of the questionnaire while keeping another copy for himself to read from.

The interviewer asked the questions and noted the answers on his copy of the questionnaire. Pilot interviews were meant to form the basis for the mail questionnaire, where tape recording is impossible. Therefore, there was no point in tape recording the pilot interviews.

The interviewees were very eager to answer the questions put to them and gave the impression that they found the research investigation very interesting. Although, on average, questionnaires were completed in thirty to forty minutes, the interviewees were so enthusiastic about the subject that they provided additional information. The average interview time, therefore, was ninety minutes with the exception of one interviewee who was particularly interested in the research and entered into a three-hour in-depth discussion with the interviewer.
Following each interview, the author sent a corporate 'thank you' card to the QA Manager, as a matter of courtesy.

Results and analysis of the Pilot Interviews will be discussed in the following chapter.

5.4.2 Mail Questionnaire

Having successfully carried out the pilot study the mail questionnaire for the main study was developed from the analysis of the pilot investigation.

During the pilot investigation it was noticed that most questions seemed to be clear and did not need further elaboration. However, it was felt that the questionnaire was too long and the questions were too broad. The author had expected construction companies to have some means to measure the effectiveness of their QA Systems and, therefore, many of the questions were designed to examine how this was carried out.

Consequently, questions were refined and the final version of the mail questionnaire was much shorter and more focused.
5.4.2.1 Aims of Mail Questionnaire

Upon completing the pilot investigation successfully the following step was to construct a mail questionnaire.

The main aims of the mail questionnaire used in this research were:

- To determine whether large construction companies in the UK have developed any means to measure objectively the effectiveness of their QA Systems.

- To discuss these objective measures, if there were any.

- To find out whether companies, that had not tried to assess their QA Systems in an objective way, believed that they can actually do so.

Clearly, the main aims of this research, as stated in the previous chapter, have a significant bearing on the aims of the mail questionnaire.
5.4.2.2 Sampling Method

It was decided to approach construction companies in the UK fitting the following criteria:

- The company should be nationally well known.
- Considered to be a large company with an annual turnover of not less than one million pounds.
- have been running a QA System for at least one year and certified by a recognised Certification Body.

It was felt that data collected from well known companies rather than from newly established ones might be seen as more credible, and according to Develin and Partners (1989), leading companies are far more concerned with increasing the effectiveness of their overhead resources and gaining cost saving and efficiency improvement than other companies. Furthermore, due to the high cost associated with implementation of QA Systems it was thought that large companies were more likely to have implemented such systems rather than smaller firms. The third criterion is rather obvious. It was felt that the construction companies should have a minimum of one year of experience with QA Systems in order to be able to answer the questions in a meaningful manner.

The British Standards Institution provided an electronic copy of BSI Register of Licensees, which listed construction companies registered under Quality Assurance and Product Certification schemes.
Furthermore, The Chartered Institute of Building (CIOB) provided the author with Chartered Building Company Directory, which listed a large number of construction companies along with some details, including, contact details.

Having consulted the two sources above, one hundred and two construction companies were identified that fitted the criteria discussed above and it was decided to send the mail questionnaire to all of them.

5.4.2.3 Mail Questionnaire Processing

After refining some questions, as a result of the pilot study, the questionnaire was printed on good quality paper and every effort was made to make it look professional and attractive. A desk-top publishing software was used to produce an attractive front cover for the questionnaire. The contact address of the author was also included in the questionnaire in case some respondents lost or disposed of the cover letter by mistake.

A cover letter, addressed to the QA Manager in each of the chosen companies, was prepared, giving a brief description of the research and its objectives. The letter also stated that this research was being carried out in collaboration with the British Standard Institution. Moser and Kalton (1975) emphasised the importance of providing respected sponsorship of the research and suggested that this makes the questionnaire more appealing to the respondents.
On the assumption that construction companies might be inundated with requests from undergraduate students to complete questionnaires, the cover letter clearly stated that this questionnaire was part of a PhD research project.

Furthermore, the letter also included a promise to share the research findings with the respondents on completion together with another promise to keep all information supplied strictly confidential.

QA Managers were requested to complete the questionnaires and send them back within two weeks. An envelope carrying the University’s freepost address was attached to every questionnaire in order to provide an added incentive to return the completed questionnaire without any cost being incurred by the respondents, other than time.

A three-week period was allowed for the questionnaires to be returned. After this period, a reminder letter was dispatched to the non-respondents and a further three-week period was allowed for.

Copies of the questionnaire cover letter, the mail questionnaire, and the reminder letter are shown in the following pages.
Dear Mr (Name),

I am carrying out a PhD research project at the University of Glamorgan with the BSI acting as a collaborating establishment. The research investigates the effectiveness of Quality Assurance Systems in the construction industry.

The enclosed short questionnaire forms part of the study. The objective of the questionnaire is to investigate if any of the construction companies approached has developed a model to objectively measure the effectiveness of its Quality Assurance System.

The questionnaire will be treated in the strictest confidence. I am aware of the pressure under which you operate and the time constraints on your work, but I very much hope that you will spare a little of your time to complete the enclosed short questionnaire and post it to the Director of my studies Mr Trefor Williams using the enclosed stamped addressed envelope.

I thank you in advance for your co-operation and look forward to receiving the completed questionnaire as soon as possible.

Yours faithfully

A. Al-Nakeeb  BEng., DBA, MBA

Please return the questionnaire to:
Mr Trefor Williams
FREEPOST
School of the Built Environment
University of Glamorgan
Pontypridd
CF37 1BR

Vice-Chancellor - Professor Adrian Webb
Quality Assurance in Construction

Questionnaire

A. A. R. AL-NAKEEB
UNIVERSITY OF GLAMORGAN
1- Name of company ........................................................................................................

2- Name **and** position of person answering the questionnaire

..............................................................................................................................
..............................................................................................................................

3- How long has this company been in business? ...... years.

4- Type of work: (You may tick more than one box)
   - Building construction
   - Civil Engineering construction
   - Repair and maintenance
   - Other (please specify)

5- How long has it been since you acquired a third-party QA certification?
   - years and months

6- Have you developed some sort of a model to **objectively** measure the effectiveness of your ISO 9000?
   - Yes □ No □
7- If you have answered YES to question 6, please indicate how do you objectively measure the effectiveness of your ISO 9000 and how does your model work? You may use the reverse side of this page or attach a separate page.

8- If you have answered NO to question 6, do you think the effectiveness of ISO 9000 can be quantified and measured in an objective way?

Yes ☐ How so? ........................................................................................................................................

No ☐ Why not? ......................................................................................................................................
Dear Mr (Name),

I wrote to you on (Date) asking if you would kindly take part in my research and complete a questionnaire. I am enclosing the questionnaire again in case you have lost it or have not received it for some reason.

I would like to remind you that the questionnaire will be treated in the strictest confidence. I am aware of the pressure under which you operate and the time constraints on your work, but I very much hope that you will spare a little of your time to complete the enclosed short questionnaire and post it to the Director of my studies Mr Trefor Williams using the enclosed stamped addressed envelope.

I thank you in advance for your co-operation and look forward to receiving the completed questionnaire as soon as possible.

Yours faithfully

A. Al-Nakeeb  BEng., DBA, MBA

Please return the questionnaire to:
Mr Trefor Williams
FREEPOST
School of the Built Environment
University of Glamorgan
Pontypridd
CF37 1RR
5.4.2.4 Response Rate

Response rate, according to Czaja and Blair (1996), is the number of eligible sample members who complete a questionnaire divided by the total number of eligible sample members.

Out of the one hundred and two questionnaires sent, twenty completed questionnaires were received in the first week, fourteen in the second week, and seven were received after sending the reminder letter, bringing the total of completed questionnaires to forty-one. Therefore, the mail questionnaire survey resulted in a 40% response rate.

This response rate is considered very good and acceptable when compared with other response rates of mail questionnaires in the area of construction management. For example, when Proverbs et al (1999), distributed questionnaires to 150 construction companies in the UK, to 75 companies in France, and to 55 companies in Germany, they yielded response rates of 21%, 17% and 18% respectively. Another example is that of a survey carried out by Shash and Abdul-Hadi (1993), when they surveyed 300 contractors, and yielded a response rate of 24%.

In comparison with the surveys mentioned above, the response rate of 40% seems to be well above average and very encouraging.
Results and analyses of the mail questionnaires will be discussed in detail in the following chapter.

5.5 DATA COLLECTION – EXPERTS

Upon receiving the completed mail questionnaires from the construction companies and analysing the results the following step was to interview experts in the area of Quality Management.

In this section the method of collection data from experts is discussed in detail. The term 'experts' will be explained and the chosen sample justified.

For the purpose of this research, the term 'expert' refers to a professional with a long time experience in Quality Management or an academic recognised for their work in the subject of Quality Management and who is well published. Occasionally, an 'expert' can be a professional and an academic at the same time.

5.5.1 Aims of Experts' Interviews

Results and analysis of the construction companies' mail questionnaire formed the basis for the aims of the experts' interviews. These aims were:
• To determine whether the experts believe that the effectiveness of QA Systems can be measured objectively.

• If experts believe such measures are possible, the aim was to determine what they are and how they work.

5.5.2 Expert Interview Design

Semi-structured interviews were chosen to collect data from experts participating in this research. Reasons for choosing semi-structured interviews in preference to other techniques were explained in the previous chapter.

Personal one-to-one interviews were chosen in preference to group interviews. It was felt that some individuals may become influenced by the opinions of others and, therefore, their judgment may be biased or distorted. There was also a concern that some charismatic and more talkative individuals may dominate the discussion and, unintentionally, push others to take a back seat. Hoinville et al (1978), noted that group discussions do not produce nearly as much detailed information as separate interviews. Hoinville also noted that it is not easy to get a group together, for not everyone invited may be able to attend at the specified time and place.

Questions asked were short and precise yet designed to obtain the information and details required to meet the aims stated above. A decision was made not to pilot
the expert's interviews in an effort to include as many experts as possible in the main study.

5.5.3 Sampling Method

The sampling method needed careful and prudent planning, in order to justify the choice of the experts' group. Initially, it was considered approaching individuals who were well published in the area of Quality Management selected from various publications covered during the literature review. However, this meant that professionals involved in Quality Management with valuable experience and knowledge would be left out just because they may have had no publications.

A decision was made to approach individuals who, in the author's view, were considered as experts, based on their reputation and quality publications. It was also hoped that such individuals might be able to nominate and suggest other experts to approach. This decision proved to be fruitful.

One of the experts initially interviewed was Mr Richard Grover who is well published and, indeed, well renowned for his involvement in quality-related professional and academic circles. Mr Grover suggested that the best possible method to select quality experts was to approach Mr Alan Taylor, who is the Chairman of the British Quality Foundation Construction Group, and ask him to identify suitable experts to interview. This way, the experts' group would be
chosen by a person who, by his own position, could be regarded as an expert and who was knowledgeable about expertise in the industry.

It is appropriate at this point to mention that the British Quality Foundation was formerly the British Quality Association (affiliated to the Institute for Quality Assurance). The construction group was formed in 1983 and is one of the most established of such groups in the UK. It has been around through all the major changes in quality affecting the construction industry.

Consequently, Mr Alan Taylor was approached and asked to nominate a group of leading experts in the area of Quality Management. Subsequently, Mr Taylor identified seven individuals as the leading experts in the UK. These nominated experts, in alphabetical order, were: Professor Peter Barrett, Mr Philip Brown, Mr Ronald Baden Hellard, Mr Peter Jones, Mr Chris O'Donnell, Mr Richard Smith, and Mr John Theophilus.

In addition to the seven nominated leading experts, another six individuals were chosen, based on their publications and work experience. These six experts were: Mr Michael Board, Mr Richard Grover, Mr Tom Harland, Dr Jeff Jones, Mr David Phillips, and Mr Alan Taylor.

The supervisory team suggested that at least one of the thirteen above listed experts should not be approached as there would be need, at some future date, to appoint an expert to the role of external examiner. Thus, twelve experts were
approached. Synopses of the experts' work experience and credentials are listed in Appendix B.

5.5.4 Experts Interview Process

All the above listed UK based experts were initially approached by letter. The letter provided a brief description of the research and its aims and explained that it was being carried out with the British Standards Institution acting as a collaborating establishment. Six of the experts were informed that they had been nominated by the chairman of the British Quality Foundation. All the experts were asked to be interviewed and were informed that they would be contacted by telephone in order to arrange a suitable date. All letters were printed on University headed paper and sent by first class post.

All twelve experts were contacted by telephone three days after sending the letter and mutually suitable dates for interviews were arranged. None of the experts approached declined to be interviewed. Only one expert, Mr Peter Jones, due to his busy schedule and time constraint, asked to be interviewed over the telephone. All experts asked to keep the interview short due to various commitments and busy schedules.

Immediately after each telephone call arranging an interview date, a confirmation letter, confirming the time, date and place agreed for the interview, was
dispatched. The letter also requested the experts to make available a summary of their professional experience and credentials.

All the experts (apart from Mr Peter Jones who requested a telephone interview) were interviewed at their place of work. The interviewer commenced the interview by assuring the interviewee that all information provided was to be treated as strictly confidential. The interviewer then asked for permission to record the interview (including the telephone one). None of the interviewees declined this request. Audio taping proved to be very useful as it allowed the interviewer to concentrate on the responses of the interviewee rather than concentrate on writing notes, this benefit was emphasised by Kvale (1996) as well as by Moser and Kalton (1975).

The interviewer provided a brief description of the research and its aims then started reading the questions listed in the interview schedule one by one. The interviewee had the chance to interrupt at any time in order to ask for clarification or to ask a question.

The questions listed in the interview schedule acted only as a framework for the interview without restricting the interviewer to a rigid routine. The interviewer was able to ask additional questions during the flow of conversation, this way the interviewers utilised the flexibility offered by the semi-structured interview technique. All questions were brief and precise in order to meet the experts' requests to keep the interview short.
Following each interview, the interviewer sent a corporate thank you card to the interviewee thanking him for the time he provided and expressing appreciation.

Therefore, the total number of experts who participated in this research was twelve. The average time for the interview was one hour, and as mentioned above, none of the experts approached declined to take part in the research. This excellent response rate can only reflect the interest of these experts in the topic of this research.

Results and analyses of the expert’s interviews will be discussed in detail in the following chapter.

Samples of letters sent to experts and a copy of the interview schedule are shown in the following pages.
Dear Mr (Name),

I have recently had a meeting with Mr Alan Taylor, of Bovis / British Quality Foundation who spoke very highly of you and strongly advised me to contact you.

I am carrying out a PhD research project at the University of Glamorgan with the BSI acting as a collaborating establishment. The research investigates the effectiveness of Quality Assurance Systems in the construction industry.

I am now at the final stages of data collection where I need to discuss the findings with quality experts such as yourself.

I would be very grateful if you could spare me 30 minutes of you time for an interview. If you agree to participate in my research I would be happy to make a summary of the results available to you on completion of my thesis.

Over the next few days I will be endeavouring to contact you by phone to arrange a date.

I thank you in advance for your co-operation and look forward to contacting you.

Yours sincerely

A. Al-Nakeeb
B.Fng.. DBA. MBA
Dear Mr (Name),

Thank you very much for agreeing to see me on (Date). Mr Alan Taylor spoke very highly of you and I have no doubt that your contribution to my research will be valuable.

I am required to justify to the examiners why I have selected the experts I am interviewing and I would really appreciate it if you could make available your CV (in relation to your publications and experience with Quality Systems).

I thank you for your co-operation and I look forward to meeting you this Friday.

Yours sincerely

A. Al-Nakeeb  B.Eng., DBA, MBA
Interview Schedule

Date of interview ............... Place of interview ................. Time taken ..........

1- Name of expert and current position.

2- Related work experience in the field of QA (CV if possible).

3- Do you believe that the effectiveness of ISO 9000 can be measured in an objective meaningful way?

4- If you have answered YES to the question above, how can the effectiveness be measured in an objective manner that goes beyond peoples’ perceptions and personal views?

5- If you have answered NO to question 3, why don’t you believe the effectiveness can be measured?
5.6 DATA COLLECTION – CLIENTS

A decision was made at an early stage of the research to approach a number of clients of the construction industry. Literature such as Street (1992), Al-Nakeeb (1993), and Shammas-Toma (1996), show that client pressure was the main reason that led companies to implement QA Systems.

It was felt that it might be beneficial to determine if clients of the construction industry have made any objective assessment of the QA Systems implemented by the construction companies they were dealing with. Three major clients were approached, the Ministry of Defence (MOD), the Welsh Development Agency (WDA), and Cardiff County Council (Property Services Department).

The main reason for choosing the Welsh Development Agency and the Cardiff County Council for the pilot study of client's organisations was ease of accessibility. Furthermore, in Wales, these two organisations are considered to be large repetitive clients of the construction industry. The MOD was chosen in the pilot sample for its well-known emphases on Quality Assurance.

The MOD was approached by a letter giving a summary of the research and its aims and asking if the MOD prefers dealing with quality assured contractors rather than dealing with contractors who were not registered to ISO 9000, and why.
The MOD sent a letter replying to the queries and stating its views regarding the QA Systems. Full details and assessment of this reply will be given in the following chapter.

Informal interviews were arranged with Senior Managers at the WDA and the Cardiff Council Property Services Department. Both interviews were arranged informally through personal contacts. Both interviewees were asked similar questions to determine whether they had developed any means to assess the effectiveness of QA systems implemented by the construction companies they deal with.

The results of these interviews will be discussed and assessed in the following chapter, along with the analyses of other data collected.

It is important to mention at this point that data collected from clients were considered as a pilot for a possible main survey. After analysing the data collected from the clients it became clear that the focus of the research would be more beneficial if directed towards the construction companies and the experts, rather than clients. The system's effectiveness has already been defined in section 3.6 and it was based on the construction organisation's objectives for implementing a QA system. It was felt that although clients' satisfaction was the ultimate measure of quality, they were not in a position to comment on the contractor's QA Systems, as they were not directly involved in them. Therefore, plans to approach additional clients were abandoned.
5.7 SUMMARY

Sources for data used in this research have been discussed in detail. Apart from data collected through the literature review, three other sources of data for this research were identified: data collected from construction companies, data collected from experts, and data collected from clients of the construction companies.

A survey using a mail questionnaire was carried out to gather data from construction companies. This proved to be very successful and resulted in a good response rate.

A group of experts in the area of Quality Management was approached. This group consisted of a well-balanced mix of professionals and academics. Justification was offered for choosing the sample. None of the experts approached declined to be interviewed, something that can only reflect their interest in the topic of this research.

The following chapter provides analysis and discussions of the data gathered for the research.
REFERENCES


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CHAPTER SIX

Results and Analysis
6.1 INTRODUCTION

The processes of data collection were discussed in the previous chapter. This chapter presents and discusses the results of data collected for this research.

As outlined in the previous chapter in section 5.3, data was collected from three main groups: construction companies, experts, and clients. Therefore, this chapter follows the same order and presents the results in three main categories:

- Results of data collected from construction companies
  - Pilot study data.
  - Main study data.

- Results of data collected from experts.

- Additional results – Results of data collected from pilot study of clients.
6.2 RESULTS OF DATA FROM CONSTRUCTION COMPANIES

Results in this section are divided into two subsections:

1- Results of data collected for the preliminary investigation – pilot study
2- Results of data collected for the main study – mail questionnaires.

6.2.1 Results of data collected for the preliminary investigation – pilot study

The aims of the pilot study were defined and discussed in section 5.4.1.1. The QA Managers in six large, well-known construction companies were approached. The main results of the pilot study are as follows:

- The QA Managers approached reacted favourably when they were asked for an interview. All the QA Managers approached agreed to be interviewed. This excellent response could be taken as a good indication that reflects companies’ interest in the research subject.

- One of the aims of the pilot study, as stated in section 5.4.1.1, was to assess whether the QA Manager was the right person to approach and, thereafter, to complete the questionnaire.
All the QA Managers approached were involved in their QA Systems from the initial stages and were able to answer all questions without hesitation. Also, it was noted that all managers had all necessary information and documentation readily at hand. Therefore, it was concluded that QA Managers were the appropriate persons to approach and involve in this part of the research.

- The most significant result of the pilot study was that none of the companies approached measured the effectiveness of their QA systems in an objective manner. In fact, five of the six companies indicated that they had not attempted to measure the effectiveness of their QA System in any way. One company indicated that it measured the effectiveness of its QA System, and provided a copy of a questionnaire and a document summarising results of questionnaires sent to its staff (see Appendix C). The results are, clearly, subjective and based on the perceptions of respondents who could be new to the organisation or biased. The respondents were asked to express their agreement or disagreement to a series of statements. For example, the first item on the list was *Image of the company* and respondents were asked to indicate the possible effect of ISO 9000 by circling one of the following pre-stated options; *Better, Worse, No change*. According to Stevens *et al* (1994), this type
of measurement is usually subjective and relies on the conviction of the individual scorer.

QA Managers of the five remaining companies were very keen to find out whether it is possible to measure the effectiveness of their QA Systems in a meaningful reliable manner and asked the researcher to share the research findings upon completion.

- During the in-depth discussions with the QA Managers it became clear that none of the companies interviewed had kept accurate records of defects and non-conformances prior to the implementation of ISO 9000, and whatever record they had they refused to share it with researchers because of client confidentiality.

- On average, the interviews took two hours to conduct. As a result, it was felt that the questionnaire was too long and the questions were too broad. The author had anticipated that construction companies would have measured the effectiveness of their QA Systems and therefore, many of the questions were designed to examine how this was carried out.

Consequently, the questions were modified and refined. The length of the questionnaire was reduced considerably. This resulted in a final version of the mail questionnaire, with questions that are short and focused.
6.2.2 Results of data collected for the main study – mail questionnaires

The aims of the mail questionnaire, its design and processing were discussed in detail in the previous chapter. The questions were designed to be precise, short, simple to understand, and meet the stated aims of the questionnaire planned for this research.

The previous chapter also discussed the method of sampling, the total population, and the response rate. Therefore, the results and discussions of the mail questionnaires are based on forty-one completed questionnaires, representing a 40% response rate.

The results are presented in Tables 1, 2 and 3 in the following pages. Since participating companies were promised strict confidentiality and anonymity, numbers substitute their names.

Furthermore, the type of information gathered by the questionnaire did not require the use of complex statistical analysis, such as correlation analysis for example. Therefore, there was no demand for the use of a statistical package to analyse the results. The results are now discussed on a question by question basis as follows:
### Results and Analysis

<table>
<thead>
<tr>
<th>Company Number</th>
<th>Question 3</th>
<th>Question 4</th>
<th>Question 5</th>
<th>Question 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28 years</td>
<td>Building construction</td>
<td>4 years and 1 month</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>130 years</td>
<td>Building construction</td>
<td>2 years and 6 months</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>50 years</td>
<td>Building construction, Civil engineering, Property development, Residential development, Utilities management, International development and construction.</td>
<td>9 years</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>50+ years</td>
<td>Building construction, civil engineering construction, repair and maintenance</td>
<td>5 years</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>135 years</td>
<td>Civil engineering construction, Repair and maintenance</td>
<td>12 years</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>135 years</td>
<td>Building construction, Civil engineering construction, Repair and maintenance</td>
<td>2 years</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>45 years</td>
<td>Building construction, Civil engineering construction, fit-out work</td>
<td>3 years and 2 months</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>130 years</td>
<td>Building construction, Housing</td>
<td>6 years</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>64 years</td>
<td>Building construction, Civil engineering construction, Repair and maintenance, Mining, Development.</td>
<td>6 years and 9 months</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>30 years</td>
<td>Building construction</td>
<td>6 years and 9 months</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>75+ years</td>
<td>Building construction, Civil engineering construction, Repair and maintenance, Design.</td>
<td>10 years</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>80 years</td>
<td>Building construction, Repair and maintenance</td>
<td>4 years and 10 months</td>
<td>No</td>
</tr>
<tr>
<td>13</td>
<td>110 years</td>
<td>Building construction, Civil engineering, Repair and maintenance</td>
<td>5 years</td>
<td>No</td>
</tr>
<tr>
<td>14</td>
<td>100 years</td>
<td>Building construction, Construction management and design.</td>
<td>9 years</td>
<td>No</td>
</tr>
<tr>
<td>15</td>
<td>64 years</td>
<td>Building construction, repair and maintenance</td>
<td>8 years and 2 months</td>
<td>No</td>
</tr>
<tr>
<td>16</td>
<td>100 years</td>
<td>Building construction</td>
<td>8 years</td>
<td>No</td>
</tr>
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<td>17</td>
<td>71 years</td>
<td>Building construction, Civil engineering construction</td>
<td>3 years and 8 months</td>
<td>No</td>
</tr>
<tr>
<td>18</td>
<td>90 years</td>
<td>Building construction, repair and maintenance</td>
<td>4 years</td>
<td>No</td>
</tr>
<tr>
<td>19</td>
<td>70 years</td>
<td>Civil engineering construction</td>
<td>4 years 11 months</td>
<td>No</td>
</tr>
<tr>
<td>20</td>
<td>405 years</td>
<td>Building construction</td>
<td>1 year and 10 months</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 1 (Companies 1 – 20)
<table>
<thead>
<tr>
<th>Company Number</th>
<th>Question 3</th>
<th>Question 4</th>
<th>Question 5</th>
<th>Question 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>90 years</td>
<td>Building construction, repair and maintenance.</td>
<td>2 years and 5 months</td>
<td>No</td>
</tr>
<tr>
<td>22</td>
<td>50 years</td>
<td>Building construction</td>
<td>7 years</td>
<td>No</td>
</tr>
<tr>
<td>23</td>
<td>76 years</td>
<td>Building and civil engineering construction, repair and maintenance</td>
<td>3 years and 3 months</td>
<td>No</td>
</tr>
<tr>
<td>24</td>
<td>90 years</td>
<td>Building and civil engineering construction, repair and maintenance</td>
<td>3 years</td>
<td>No</td>
</tr>
<tr>
<td>25</td>
<td>Not available</td>
<td>Building construction, Design and construction management</td>
<td>7 years</td>
<td>No</td>
</tr>
<tr>
<td>26</td>
<td>50 years</td>
<td>Building and civil engineering construction</td>
<td>3 years and 6 months</td>
<td>No</td>
</tr>
<tr>
<td>27</td>
<td>10 years</td>
<td>Building construction, Repair and maintenance</td>
<td>4 years and 2 months</td>
<td>No</td>
</tr>
<tr>
<td>28</td>
<td>90 years</td>
<td>Building construction, Repair and maintenance, fit-out</td>
<td>5 years and 6 months</td>
<td>No</td>
</tr>
<tr>
<td>29</td>
<td>150 years</td>
<td>Building and civil engineering construction</td>
<td>8 years</td>
<td>No</td>
</tr>
<tr>
<td>30</td>
<td>44 years</td>
<td>Building construction, Repair and maintenance</td>
<td>2 years and 6 months</td>
<td>No</td>
</tr>
<tr>
<td>31</td>
<td>125 years</td>
<td>Building construction, Repair and maintenance</td>
<td>5 years</td>
<td>No</td>
</tr>
<tr>
<td>32</td>
<td>100 years</td>
<td>Building construction</td>
<td>2 years and 3 months</td>
<td>No</td>
</tr>
<tr>
<td>33</td>
<td>145 years</td>
<td>Building construction, Repair and maintenance</td>
<td>3 years and 10 months</td>
<td>No</td>
</tr>
<tr>
<td>34</td>
<td>50 years</td>
<td>Building construction, Repair and maintenance</td>
<td>4 years</td>
<td>No</td>
</tr>
<tr>
<td>35</td>
<td>14 years</td>
<td>Building construction</td>
<td>5 years</td>
<td>No</td>
</tr>
<tr>
<td>36</td>
<td>130 years</td>
<td>Building and civil engineering construction</td>
<td>6 years</td>
<td>No</td>
</tr>
<tr>
<td>37</td>
<td>51 years</td>
<td>Building and civil engineering construction, Repair and maintenance</td>
<td>5 years and 11 months</td>
<td>No</td>
</tr>
<tr>
<td>38</td>
<td>37 years</td>
<td>Building construction</td>
<td>4 years and 11 months</td>
<td>No</td>
</tr>
<tr>
<td>39</td>
<td>26 years</td>
<td>Building and civil engineering construction, Repair and maintenance</td>
<td>8 years and 8 months</td>
<td>No</td>
</tr>
<tr>
<td>40</td>
<td>60 years</td>
<td>Building construction, Repair and maintenance</td>
<td>3 years and 3 months</td>
<td>No</td>
</tr>
<tr>
<td>41</td>
<td>40 years</td>
<td>Building and civil engineering construction</td>
<td>2 years and 5 months</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 1 (Companies 21 – 41)
### Results and Analysis

#### Company Question 7

<table>
<thead>
<tr>
<th>Company Number</th>
<th>Question 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Increase the scope of work open to tender (M.O.D. requires ISO 9001). Reviewing subcontractors/suppliers at end of contract. All sites operate same procedures allowing staff interchange. Auditing deviation from the norm. Control of quality of materials on site resolves in cost savings. Preventative action always discussed at the end of each audit. Annual review with directors including chairman shows commitment from top down.</td>
</tr>
<tr>
<td>2</td>
<td>All audits are given a percentage</td>
</tr>
<tr>
<td>4</td>
<td>We have considered a variety of measures i.e. audits, and non conformance costing. We are also using the Business Excellence Model and self assessment as means to measure improvement.</td>
</tr>
<tr>
<td>5</td>
<td>By sample recording a project for periods of 2-3 months. But this expense isn’t justifiable beyond the initial stage when the results are used to validate the decision to implement a QMS.</td>
</tr>
<tr>
<td>6</td>
<td>Departmental auditing of procedures</td>
</tr>
<tr>
<td>7</td>
<td>We use Q-Pulse software to measure the performance of our system. This highlights deficiencies with our system which we then focus on using continuous improvement techniques to improve our processes and systems.</td>
</tr>
<tr>
<td>8</td>
<td>By asking out clients. By having an independent audit. By internal audits. By measuring client repeat orders. By measuring quantities of snags at handover.</td>
</tr>
<tr>
<td>10</td>
<td>None-conformances reports are used to identify or measure trends.</td>
</tr>
<tr>
<td>11</td>
<td>N/A</td>
</tr>
<tr>
<td>12</td>
<td>N/A</td>
</tr>
<tr>
<td>13</td>
<td>N/A</td>
</tr>
<tr>
<td>14</td>
<td>N/A</td>
</tr>
<tr>
<td>15</td>
<td>N/A</td>
</tr>
<tr>
<td>16</td>
<td>N/A</td>
</tr>
<tr>
<td>17</td>
<td>N/A</td>
</tr>
<tr>
<td>18</td>
<td>N/A</td>
</tr>
<tr>
<td>19</td>
<td>N/A</td>
</tr>
<tr>
<td>20</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2 (Companies 1 – 20)
## Results and Analysis

<table>
<thead>
<tr>
<th>Company Number</th>
<th>Question 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>N/A</td>
</tr>
<tr>
<td>22</td>
<td>N/A</td>
</tr>
<tr>
<td>23</td>
<td>N/A</td>
</tr>
<tr>
<td>24</td>
<td>N/A</td>
</tr>
<tr>
<td>25</td>
<td>N/A</td>
</tr>
<tr>
<td>26</td>
<td>N/A</td>
</tr>
<tr>
<td>27</td>
<td>N/A</td>
</tr>
<tr>
<td>28</td>
<td>N/A</td>
</tr>
<tr>
<td>29</td>
<td>N/A</td>
</tr>
<tr>
<td>30</td>
<td>N/A</td>
</tr>
<tr>
<td>31</td>
<td>N/A</td>
</tr>
<tr>
<td>32</td>
<td>N/A</td>
</tr>
<tr>
<td>33</td>
<td>N/A</td>
</tr>
<tr>
<td>34</td>
<td>N/A</td>
</tr>
<tr>
<td>35</td>
<td>N/A</td>
</tr>
<tr>
<td>36</td>
<td>N/A</td>
</tr>
<tr>
<td>37</td>
<td>N/A</td>
</tr>
<tr>
<td>38</td>
<td>N/A</td>
</tr>
<tr>
<td>39</td>
<td>N/A</td>
</tr>
<tr>
<td>40</td>
<td>N/A</td>
</tr>
<tr>
<td>41</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2 (Companies 21 – 41)
### Results and Analysis

<table>
<thead>
<tr>
<th>Company Number</th>
<th>Question 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>7</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>N/A</td>
</tr>
<tr>
<td>9</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>N/A</td>
</tr>
<tr>
<td>11</td>
<td>YES. Need to develop a no-blame culture whereby mistakes/errors can be identified. Need to cost these mistakes/errors and plot trend of costs as system is developed, perhaps as a percentage of turnover – not an easy task.</td>
</tr>
<tr>
<td>12</td>
<td>NO. Because within the construction industry there are too many variables. Every contract is different to all previous contracts. Clients expectations vary, even with the same specification. The performance of subcontractors varies. A high level of staff turnover in this industry. Fluctuations of work load have a major effect on quality and quantity of resources available. The industry is generally subject to the changes in elements. Client’s designers vary considerably in ability, significantly affecting performance. It is therefore, only possible to measure compliance with the system, e.g. how many non-conformities at audits for instance, not how well have we achieved client requirements.</td>
</tr>
<tr>
<td>13</td>
<td>Probably</td>
</tr>
<tr>
<td>14</td>
<td>YES. Measurement of business processes and their effectiveness via the Business Excellence Models. There is however, a large degree of subjectivity in the assessment.</td>
</tr>
<tr>
<td>15</td>
<td>YES. Customer response. Internal criteria. We already have few defects/complaints. The ISO 9001 customer complaints log is a control in itself.</td>
</tr>
<tr>
<td>16</td>
<td>YES. Audits. Cost or rectification. Length of snagging lists. Number of contracts won where certification was mandatory.</td>
</tr>
<tr>
<td>17</td>
<td>NO. A quantity of errors or inefficiency practices which have not occurred cannot be valued.</td>
</tr>
<tr>
<td>18</td>
<td>NO. Effectiveness of a constantly moving, changing and various outputs cannot be measured and give meaningful results. We are however, an increasingly successful business and achieving/maintaining ISO 9000 costs little; therefore, it is successful. I would be very interested in the results of your studies.</td>
</tr>
<tr>
<td>19</td>
<td>NO. Difficult to measure improvement in efficiency and “getting it right”.</td>
</tr>
<tr>
<td>20</td>
<td>NO. To do this we would need to know the costs we have incurred prior to certification. A company of our pedigree had quality control and procedures but were only necessary to be included on restricted tender lists.</td>
</tr>
</tbody>
</table>

Table 3 (Companies 1 – 20)
<table>
<thead>
<tr>
<th>Company Number</th>
<th>Question 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>NO. Due to the far reaching effects of ISO 9000 the benefits cannot be quantified in many cases. Yes, we can say we can now tender for such and such a client whereas we couldn’t before. Yes we can say that wastage and rework is down by x%. But what exactly is a direct benefit of the system rather than coincidence, due to other relevant factors, etc. we can only estimate.</td>
</tr>
<tr>
<td>22</td>
<td>YES. Monitoring the number of mistakes within the office over a period of time and the time and cost spent on snagging over a period of time.</td>
</tr>
<tr>
<td>23</td>
<td>NO. ISO 9000 was imposed upon us by our market clients. The company has traded successfully for many years and the system was developed to reflect company operating procedures. How we operate is continually reviewed by senior management and any necessary changes to reflect market needs are actioned, and our Quality System is amended if necessary to suit.</td>
</tr>
<tr>
<td>24</td>
<td>NO. Because the work we undertake is too varied to produce reliable statistics economically.</td>
</tr>
<tr>
<td>25</td>
<td>NO. No objective measure of quality performance prior to introduction of ISO 9000 for comparison. Too many variables affecting outcomes – not possible to measure impact of ISO 9000. Competitive tendering of construction services is a major risk taking business. The joint implementation of QA and risk taking is ambivalent and inconsistent and defies any objective measures.</td>
</tr>
<tr>
<td>26</td>
<td>NO. System implementation can be monitored for both compliance and effectiveness. If the system is functioning as designed, quantifiable cost benefits cannot readily be established. E.g. if a new client is won, how big an influence can be quantified? Costs of defect can be more readily assessed.</td>
</tr>
<tr>
<td>27</td>
<td>NO. Many of the benefits are cultural or intangible. Some things are measurable such as cost of non-conformities, speed of processing orders etc, however, ISO 9000 is only one of many influencing factors. It is also very difficult to establish a reference point to measure against due to the fluctuating market (varied workload) and the unique nature of every project within construction.</td>
</tr>
<tr>
<td>28</td>
<td>YES. Continuous improvement against benchmarks.</td>
</tr>
<tr>
<td>29</td>
<td>Concentration on “the system” takes the eye of the real ball and we are attempting to build quality into the culture of all involved in the process.</td>
</tr>
<tr>
<td>30</td>
<td>A method of measurement would be very useful, but there are so many possible indicators that it is unlikely to be very precise. The major problem is that we only decide to try and measure effectiveness once the system is in place. Without a benchmark before change the full improvement cannot be assessed.</td>
</tr>
<tr>
<td>31</td>
<td>NO. We have not seen any increase in business margins or quality. We have always produced quality work and have worked to our agreed systems. When put in place we had been advised QA would be generally required. This is not the case.</td>
</tr>
<tr>
<td>32</td>
<td>NO.</td>
</tr>
<tr>
<td>33</td>
<td>NO. Difficult to obtain comparative data. We have always been a quality conscious company. ISO 9000 has only formalised checks we have always carried out.</td>
</tr>
<tr>
<td>34</td>
<td>YES. Reduction in the cost of customer complaints following occupation. Identification of troublesome materials or details.</td>
</tr>
<tr>
<td>35</td>
<td>YES. Cost of work carried out after project completion as a % of the turnover. Value of negotiated work as % of turnover. No contracts completed on program as a % of total. I would very much appreciate a copy of your conclusion/recommendation of your report.</td>
</tr>
<tr>
<td>36</td>
<td>YES. Reduction in defects. Improved control of the process. Ease of pre-qualification.</td>
</tr>
<tr>
<td>37</td>
<td>NO.</td>
</tr>
<tr>
<td>38</td>
<td>NO. A number of elements are intangible.</td>
</tr>
<tr>
<td>39</td>
<td>NO. All projects are different and it is not possible to re-run to see what the outcome would have been under a different system. Subjectively, an assessment is and can be made.</td>
</tr>
<tr>
<td>40</td>
<td>YES. By recording the amount of rework. Customer questionnaires. In 1996 we obtained £15 million of contracts that would not have been awarded if we were not registered.</td>
</tr>
<tr>
<td>41</td>
<td>YES. This question is often raised in our company. We are interested to know what your own research comes up with as to how the effectiveness of ISO 9000 can best be quantified and measured.</td>
</tr>
</tbody>
</table>

Table 3 (Companies 21 – 41)
Questions 1 and 2 are company and respondent related. Obtaining the name of the respondent proved to be useful when it was necessary to make follow up telephone calls in order to elaborate on some points made by some respondents. The results of the follow up calls are dealt with in another section, when results of question 7 are discussed.

Business Experience - Results of Question 3 show that the average business experience (age) of the companies approached is 74 years. It has already been stated in section 5.4.2.2, that according to Develin and Partners (1989), leading companies are far more concerned with increasing the effectiveness of their overhead resources and gaining cost saving and efficiency improvement than other companies. Therefore, the results of question 3 affirm that all the approached companies are well established and, therefore, widely known, at least, nationally.

Type of Work - Results of Question 4 show that the companies approached are involved in various types of work. The bar chart (fig 6.1) indicates that more than 95% of these companies are involved in building construction, 44% are involved in civil engineering construction and 49% are involved in repair and maintenance work.
Other types of work were indicated by 22% of the companies and they range from demolition to design and construction management. Table 1 lists the companies' answers to this question.

**QA Experience** - The companies were asked how long it had been since they had acquired their ISO 9000 certification. The results show that 1 year and 10 months is the minimum experience indicated by one company, and 12 years is the maximum indicated by another company. The average experience of the forty-one companies is 5.2 years.

The results, therefore, indicate that these companies are expected to be experienced enough in the area of QA and should be able to answer all related questions. If a company has been running a QA System for 6 months for example, the credibility of their answers, in the author's view, would be questionable as the experience of the company with the QA System would be too brief to reflect the full impact of the system.
As stated above, the average experience with QA Systems of the forty-one companies surveyed is 5.2 years. This shows that such systems can be considered relatively new to the construction industry when compared with manufacturing industry. This has also been identified ten years ago by Griffith (1990), as he noted that within the construction industry the application of quality assurance has been slow to emerge.

Measuring the effectiveness of QA Systems - Questions 6 – 8 are related to the effectiveness of the QA System. The aim of these questions was to determine if the companies had developed any models to measure objectively the effectiveness of their system. If such models were available, the companies were asked to explain how they worked.

The results reveal that thirty-one companies (75.6 %) answered ‘NO’ to question 6, indicating they had not measured the effectiveness of their QA Systems in an objective manner. The remaining ten companies (24.4 %), answered ‘YES’ to question 6, indicating that they had managed to measure objectively the effectiveness of their QA Systems and attempted to explain how they achieved this.

Upon examining statements made by the companies when they answered question number 7, it was noted that all methods suggested to measure the effectiveness of QA Systems were, in fact, either very subjective or inaccurate measures and could not be considered as reliable indications of the effectiveness of the QA Systems.
Answers to question 7, as stated on the returned questionnaires, are listed in Table 2 above, and discussed below.

- Using Internal Quality Audits to measure effectiveness

Six out of the ten companies who answered yes to question 7, suggesting that they had objectively measured the effectiveness of their QA System, mentioned 'internal auditing' as a mean to assess the system’s effectiveness.

“The contractor obtains assurance through audits and corrective actions that his project management is operating correctly”. (The Federation of Civil Engineering Contractors, 1988, p.6).

Discussing the objectives of quality audits, Duncan et al (1990, p.54), stated three basic purposes:

1- To confirm that there is an adequate management system in place.
2- To confirm that it is available to and understood by those performing the tasks.
3- To confirm that it is being properly adhered to in practice.

According to Evans and Lindsay (1996), auditors typically ask such questions as: Does a documented policy on quality exist? Have management objectives for quality been defined? Have the policy and objectives been transmitted and explained to all levels of the organisation? Have job descriptions for people who
manage or perform work affecting quality been documented? Are job descriptions of functions that affect quality available? Has management designated a person or group with the authority to prevent nonconformities in products, identify and record quality problems, and recommend solutions? What means are used to verify the solutions? While these questions might find the deficiencies, the corrective action required, and so on, they remain audits on the planned and systematic actions and do not actually measure the quality improvement or the impact of the implementation of the QA System on the organisation.

Internal Quality Audits (a requirement of the ISO 9000), therefore, are systematic and independent examinations of the QA System to determine whether the activities are carried out as stated in the documentation and to ensure that the requirements of ISO 9000 are met. Quality Audits therefore, reflect the effectiveness of the QA system in relation to the requirements of the standard. In other words, Quality Audits show how effective the QA System is in meeting the specified requirements of the ISO 9000. They do not, however, reflect the impact and effectiveness of implementing a QA System in an organisation because they do not convey the effectiveness of the system in meeting its specified objectives.

For example, if a company decided to implement a QA System in order to reduce or eliminate defects on construction sites, the internal Quality Audit will not show how effective the system is in achieving this objective nor will it reflect the 'quality' of the finished product. Quality Audits will only verify whether quality activities are being performed as planned and in accordance with the requirements of the standards.
Hersan (1990), criticised the International Standards Organisation (ISO) for causing confusion by using the term ‘quality’ when they actually mean ‘quality assurance’.

“It is a truism to state that the two terms ‘quality assurance’ and ‘quality’ cannot and must not be used one for the other: the first one is the cause and the second one is the effect. The use of ‘quality’ instead of ‘quality assurance’ is creating confusion and misunderstanding. It is a common intellectual process to associate a new concept with a traditional and familiar one. Here the new concept is quality assurance and the familiar concept is inspection or quality verification. To be specific, it seems that ‘quality’ has been used instead of ‘quality assurance’ in the following expressions: quality system, quality audit, quality requirements, quality manual, quality plan, and quality records. A ‘quality audit’ is an audit on the quality, i.e. an audit on the product or service conformity. A ‘quality assurance audit’ is an audit on ‘all those planned and systematic actions ...’—in other words, a verification of the system” (Hersan, 1990, p.62).

According to ISO 9002 : 1994, Clause 4.17:

“The supplier shall establish and maintain documented procedures for planning and implementing internal quality audits to verify whether quality activities and related results
comply with planned arrangements and to determine the effectiveness of the quality system".

It seems that those six companies, who suggested that they used Quality Audits to measure the effectiveness of their QA System, were misled by the wording of the ISO standard in relation to the word ‘effectiveness’ as stated above.

Four of those six companies were contacted by telephone in order to clarify their answers. The remaining two companies were not available for comment. During the short telephone conversations all four QA Managers agreed that the wording of ISO standards in relation to the effectiveness of the system is misleading. All four managers also confirmed that they actually use Internal Quality Audits, which is a requirement of the ISO 9000, to validate that the planned system procedures are complying with the requirements of the standards. They agreed that Internal Quality Audits do not reflect the quality of the finished product nor determine the effectiveness of the QA System in meeting its objectives.

It is, perhaps, appropriate at this point to mention that the author was invited by the BSI, to its Construction Industry User Forum, on 29th September 1998, to share the results of his research and to comment on the ISO 9000 draft of the revised standards in order to contribute toward the ISO 9000 : 2000 which is due for release in November / December 2000. The author expressed his concerns that the current ISO 9000 standards are being ambiguous, confusing, and misleading when referring to the effectiveness of the system. The author argued that current standards refer to Management Review and Internal Quality Audit (both are
requirements of ISO 9000) as means to measure the effectiveness of the QA System where, in fact, as argued above, they do not reflect the effectiveness of the system in meeting its specified objectives in any way.

The author also argued that Internal Quality Audits can, for example, show that documented procedures are being performed as planned and, therefore, the system is being ‘effective’ in meeting the requirements of the standards without it necessarily being effective in meeting the company’s objectives that led to the implementation of the system. In other words, one can have a QA System that meets the requirements of the ISO standard in every way without having any positive impact on the quality of finished products or services for example.

The argument above is put in context by Barrett and Grover (1998, p.10), as they stated that:

"The aim of a quality system is to achieve consistency in the supply of a service. This does not mean that the standard of the service is acceptable to the client but rather that the client can be assured that the service standard will be consistent. If the service is rubbish, all a quality system can do is to ensure that the rubbish will be delivered consistently"."
Chapter Six

Results and Analysis

- Using customer satisfaction surveys to measure effectiveness

Answers to question seven also included customer satisfaction surveys. Three companies indicated that they used customer satisfaction surveys as an objective measure to assess the effectiveness of their QA system.

ISO 9004-2 (1991) recognises the importance of customer assessment and states the following in clause 6.3.3:

"Customer assessment is the ultimate measure of the quality of a service. Customer reaction may be immediate, or it may be delayed and retrospective. Often subjective evaluation will be the sole factor in a customer's assessment of the service provided".

However, customer surveys are not enough to reflect the full extent of the quality trend in a construction company nor the effectiveness of the company's QA System. Many of the clients are ‘a one off’ type and have very limited experience, also some clients might have unreasonable expectations of what the contractor's QA System can offer them. Furthermore, when customers express their satisfaction or dissatisfaction, they are referring to the service provided to them and the finished products, not the QA System, after all, the customers are not directly involved with the contractor's QA System and, therefore, they are not in a position to evaluate it.
Chapter Six
Results and Analysis

- Using non-conformances cost and quantities of snags to measure effectiveness

Three companies, 4, 8, and 10 (see Table 2), indicated that they used non-conformances cost and quantities of snags as measures to assess objectively the effectiveness of their QA Systems. All three companies were contacted by telephone for further clarification.

It became clear during the follow-up telephone conversations that while the data collected of defects or non-conformities may indeed be objective, it does not reflect the effectiveness of the QA System. The three QA Managers, contacted by telephone, agreed that although non-conformities data is a good measure of a product’s quality, which can then be used to plot quality trends, it does not reflect the effectiveness of their QA Systems. In other words, the QA Managers agreed that while quality trends, based on non-conformities data, can indicate if quality is improving or not, the results cannot be attributed solely to the QA system in the presence of other factors. This identifies the problem of causality, which will be dealt with later in this chapter.

- Using numbers of repeat orders / business to measure effectiveness

Two companies, in answering question 7, stated that they used repeat orders / business as an objective assessment of the effectiveness of their QA Systems. This assessment is questionable. The author argues that repeat orders may reflect the effectiveness of having certification but does not convey the effectiveness of the QA System. For example, a company can run a QA System that complies with the requirements of ISO 9000 and therefore, achieve a third party certification, yet still have a system that does not meet its stated objectives.
One can also argue that a customer, if impressed with the contractor's quality of work, may come back only for this reason regardless of whether the company's QA System is effective or not. In this case the repeat business is not directly related to the effectiveness of the system in any way.

Company 1 listed what seem to be 'advantages' of their system rather than means of measuring those advantages (see Table 2). Company 1 was contacted by telephone and a short conversation was initiated with the respondent of the questionnaire, who was the company's QA Manager. It became clear, during the conversation, that the statements made, as an answer to question 7, were based on the perception of the manager and that the company had not developed any means to measure the effectiveness of their QA System.

- Using Business Excellence Model to measure effectiveness

Business Excellence Model was one of the measures, stated by company 4 (see Table), to assess the effectiveness of their QA System.

The Business Excellence Model, according to the British Quality Foundation (1997), was in part derived from the Malcolm Baldrige National Quality Award and developed by the European Foundation for Quality (EFQM) in 1991. The model is promoted in the UK by the British Quality Foundation, which works closely with the EFQM.
The Business Excellence Model shown in Fig. 6.2 is divided into *Enablers* and *Results*. According to the British Quality Foundation (1997), the enablers are concerned with how the organisation approaches each criteria. These are scored according to the excellence of the approach used and the extent of use within the organisation, its deployment through the levels of the organisation and across all areas. The results criteria, on the other hand, measures what the organisation is achieving in terms of the organisation's actual performance, the organisation's own targets, and wherever possible the performance of competitors and similar organisations.

The British Quality Foundation claims that self assessment against this model can be used by all types and sizes of organisations to assess current performance and identify opportunities for improvement and development. Through the scoring process, it provides a basis for comparison, both internally and externally, and
shows the progress that has been made over time. Each criterion is assigned a weighting in accordance with its perceived importance.

Therefore, a company can use the Business Excellence Model to self assess itself, regardless of whether it is implementing a QA System or not. If a company is implementing a QA System then the system will only be a part of the organisation's processes. Therefore, the results of the self assessment against the Business Excellence Model will reflect the performance of the business as whole, of which ISO 9000 is only a small part.

Company 5 answered question 7 in an ambiguous way. The statement made was unclear (see Table 2). Consequently, the company was contacted by telephone. The original respondent was not available to elaborate on the statement but his assistant was happy to explain that the company uses internal benchmarking and comparing non-conformities records every 2-3 months in order to measure improvement. The Assistant QA Manager also explained that their measures reflect trends of improvement, due to a combination of various processes, and do not necessarily reflect the effectiveness of their QA System.

- Using computer software to measure effectiveness

Company 7 was also contacted by telephone for further clarification. It appears that the company uses special software that highlights deficiencies in their QA System. In other words, the software is used to audit their system against the requirements of ISO 9000, therefore, like Internal Quality Auditing, the software
does not measure the effectiveness of the QA System in meeting its stated objectives.

**Using Benchmarking to measure the effectiveness**

Company 9 stated that they use inter-divisional comparison in order to objectively assess the effectiveness of their QA System. In other words the company uses internal benchmarking as a way to measure the effectiveness of their QA System.

"Benchmarking is the comparison of measured process parameters against internal and external performance"  

Benchmarking, according to McGeorge and Palmer (1997), is a concept of aiming at improving the competitiveness of organisations through the examination and refinement of its business processes.

According to Rossiter (1996), there are four categories of benchmarking. These are: Internal Benchmarking, External Benchmarking, Functional Benchmarking, and Generic Benchmarking.

Internal Benchmarking, which is what company 7 referred to, is defined as:

"The comparison of different processes within the same organisation" (McGeorge and Palmer, 1997, p.87).
An example of Internal Benchmarking, as demonstrated by McGeorge and Palmer ibid, would be a construction company comprising a major work division, a housing division and a refurbishment division, comparing the way the three divisions deal with the hiring of plant.

Internal Benchmarking, therefore, allows the organisation to compare different divisions and departments and facilitates better understanding of its own performance level and allows the best practice that exists within the organisation to be identified and installed company wide, it is not a measure to assess the effectiveness of a QA System. For example, if a construction company has two regional offices, one that implements ISO 9000 and one that does not. Internal Benchmarking may be used to compare the two offices. This may allow the best practice to be identified and then installed company wide. This 'best practice' may or may not be the ISO 9000, after all, each regional office has a different set of employees, deals with unique projects and has different customers. The causality problem in this case is amplified and pinpointing ISO 9000 as the 'cause' for best practice would be questionable in the presence of a vast number of variables.

Furthermore, the author could find no reference, in any of the literature covered, to suggest that Benchmarking can be used to measure the effectiveness of QA Systems.

Therefore, to recapitulate the results of question 7, ten companies indicated that they have managed to objectively measure the effectiveness of their QA Systems.
Different methods were highlighted. Some of the statements made were ambiguous and therefore, further clarifications were needed.

Consequently, seven companies were contacted by telephone. Upon further investigation, it became clear that none of the companies have actually measured the effectiveness of their QA System in a manner that can be considered objective. Some have attempted to measure the effectiveness subjectively. Others, misled by the wording of the ISO 9000 standard, used Internal Audits in an effort to measure the effectiveness of their QA Systems. As argued above, none of the methods used by the ten companies are suitable or credible enough to, objectively, reflect the effectiveness of their QA Systems.

**Further Views on Measuring the Effectiveness of QA Systems** - The final question of the mail questionnaire asked companies, who answered NO to question 6, to indicate whether they believed that the effectiveness of QA Systems can be measured objectively or not, and to indicate a reason for their answer.

Answers to question 8, as stated by the respondent companies, are listed in Table 3. Question 8 concerns the thirty-one companies that indicated they have not measured the effectiveness of their QA Systems. The results show that, out of the thirty-one companies who answered question 8, eleven companies (35.5%) indicated that although they have not attempted to measure the effectiveness of their QA Systems they believe it can be measured. Seventeen companies (54.8%) indicated that they do not believe it possible to objectively measure the
effectiveness of their QA Systems, and provided their reasons. One company answered with the word 'possible' without further elaboration. Two companies did not answer 'YES' or 'NO', but made short statements (see answerers of companies 29 and 30 in Table 3).

The following sections discuss the companies’ suggested methods to objectively assess the effectiveness of their QA systems. The discussion also includes statements that suggested it is impossible to measure the effectiveness in a meaningful manner.

- Suggestion of using cost of non-conformities, cost of rework, and length of snagging lists to measure effectiveness.

Five companies suggested cost of non-conformities, cost of rework, and length of snagging lists, as means to objectively measure the effectiveness of ISO 9000.

According to Willis and Willis (1996), quality costs are classified conventionally in three major categories: prevention costs, appraisal costs and failure costs. Where prevention costs are the cost of all activities associated with the planning and controlling of a quality assurance programme and system, appraisal costs are the costs of activities necessary to determine the actual level of quality achieved relative to the desired levels of customer satisfaction and organisational quality standards, and failure costs are incurred when it is necessary to correct products or services which fail to satisfy the customer or do not meet company quality specifications.
It is important to measure quality costs, according to the Department of Trade and Industry (1992), because they are very large as various studies and information volunteered by companies have shown that quality-related costs commonly range from 5 to 25 per cent of companies' sales turnover.

Much has been written about different approaches to collect quality costs in all industries, including construction. For example, Davis et al (1989), Gibson et al (1991), and Von der Geest et al (1994).

However, Bowen and Edwards (1994, p.385), questioned the objectivity of quality costs collected on construction sites and stated:

"Data, by their nature, purport to be objective. However, subjectivity distorts the data in two important ways. Firstly, during the recording of the procedures on site and, secondly, during subsequent transformations of the data to produce 'information' for various procedural requirements".

Therefore, despite the doubts about the objectivity of quality costs they remain, in the author's view a very useful tool to monitor quality performance and, when used as part of benchmarking, may even reflect organisational performance by providing useful quality trends. However, the use of quality cost as a method to objectively assess the effectiveness of QA Systems is questionable.
The problem, with using quality cost to measure the effectiveness of ISO 9000, is three fold. Firstly, during the in-depth interviews with QA Managers, it became clear that most construction companies did not keep accurate defect records prior to the implementation of ISO 9000, and whatever defect records they had they refused to share with researchers because of confidentiality issues. Therefore, in the absence of accurate historical quality records, it is almost impossible to benchmark or compare the trends of quality improvement before and after the implementation of ISO 9000.

Secondly, there is the issue of causality. Assuming that a company has indeed kept accurate quality records before it implemented ISO 9000, this company would be in a position to compare quality trends and performance before and after the implementation. However, in the presence of various influencing factors and variables, some of which are unique to the construction industry, it would be impossible to attribute any improvement in quality trends solely to the system.

In other words, for a meaningful comparison, quality trends may need to be taken for periods of years rather than months. During this time many variables would change. It is a fact of life, particularly in the construction industry, that staff come and go, organisational structure changes, each project is unique in its own rights, different sets of people work on each project, including designers, engineers, foremen, labourers, and many other variables. These ever changing variables, according to experience and logic, would inevitably have a big impact on the quality of finished products, which make the task of pinpointing any success solely to the ISO 9000 an impossible one.
Thirdly, as it has been stated above, Bowen and Edwards (1994) argues that subjectivity can distort the quality costs' data which implies that the objectivity of such data may be questionable.

Company 14 (see Table 3), suggested that it might be possible to objectively measure the effectiveness of ISO 9000 using the *Business Excellence Model*. The company also stated "There is however, a large degree of subjectivity in the assessment". Using the Business Excellence Model as a mean to measure the effectiveness of QA Systems has already been discussed above, during the discussion of the results of question 7, and reasons for its unsuitability for this task were given.

All other suggested methods to objectively assess the effectiveness of QA Systems have already been stated by other companies when they answered question 7 and therefore, have already been discussed. These include:

- *Customer complaints, customer response.*

It has already been stated that this is a subjective measure that reflects customers satisfaction or dissatisfaction with the products and services offered to them rather than reflecting views about the contractors QA Systems.
Chapter Six

Results and Analysis

- **Internal Quality Audits.**

This has also been discussed and it was concluded that companies seem to be misled by the wording of the ISO 9000 standards as it suggests Internal Quality Audits as a mean to evaluate the effectiveness of the QA System.

- **Number of contracts won / Ease of qualification.**

As highlighted previously, when results of question 7 were discussed, the number of contracts won, where certification was mandatory, reflects the impact of possessing a certification. It does not reflect the effectiveness or the impact of the system itself.

- **Benchmarking.**

This has already been mentioned above and the difficulties with this approach have been discussed.

Therefore, all the suggestions made by the respondent companies, on how it might be possible to objectively measure the effectiveness of ISO 9000, are either unrealistic, unsuitable, or very subjective. Statements made by companies suggesting it is not possible to measure the effectiveness of QA Systems will now be examined.

As stated earlier in this section, 54.8% of the surveyed companies indicated that they do not believe it is possible to measure the effectiveness of QA Systems. Statements were made giving their reasons and reflecting their beliefs. (see Table 3).
- Too many variables and influencing factors

The uniqueness of the construction industry, its nature of being people oriented and its variables have been discussed in various parts in Chapter Three.

When answering question 8, respondents echoed the different elements of the nature of the construction industry. Seven respondents indicated that it is not possible to objectively measure the effectiveness of ISO 9000 due to the vast number of ever changing variables and influencing factors.

Examples of typical statements made by the respondents are:

The effectiveness of QA Systems cannot be measured objectively because,

"... within the construction industry there are too many variables. Every contract is different to all previous contracts. Clients expectations vary, even with the same specification. The performance of subcontractors varies. A high level of staff turnover in this industry. Fluctuations of work load have a major effect on quality and quantity of resources available. The industry is generally subject to the changes in elements. Client’s designers vary considerably in ability, significantly affecting performance. It is, therefore, only possible to measure compliance with the system, e.g. how many non-conformities at audits for instance, not how well have we achieved client requirements" (Company 12).
“...the work we undertake is too varied to produce reliable statistics economically” (Company 24).

“All projects are different and it is not possible to re-run to see what the outcome would have been under a different system. Subjectively, an assessment is and can be made” (Company 39).

From the typical statements above, it can be seen that the unique nature of the construction industry can thwart and hamper efforts to measure the effectiveness of ISO 9000 in a manner that goes beyond people’s personal views and perceptions.

Statements made by respondents were logical and valid arguments. All the variables they mentioned are bound to have significant impacts on the quality of the finished construction. The uniqueness of construction projects makes comparisons of similar projects very difficult. This is particularly true as a rerun on the same project under exact conditions and variables is a virtual impossibility.

A valid objective comparison between projects is not the only difficulty. Pinpointing the ‘cause’ of success or failure, as the respondents’ statements imply, in the presence of various influencing factors is another problem. The causality problem seem to be very significant in this case and hinders efforts to reliably attribute results to a single cause, namely the implementation of a QA System.
For example, take a company that has implemented a QA System in order to improve quality of finished construction projects. The ultimate judge of quality in this case, according to Galloway (1996), is customers' satisfaction. Therefore, the system is effective if it meets its objective, which is improved quality, hence customer's satisfaction. It is not difficult to assess customers' satisfaction via face-to-face meetings or questionnaires, for example. The problem is how to attribute any quality improvement and increased customer satisfaction solely to the QA System in the presence of other influencing factors? Changing the subcontractors or suppliers may have been the cause. Also, the presence of clients' agents on site, for example, could have been a more influencing factor than the implementation of ISO 9000.

- Lack of accurate historical records of defects and quality

Four companies indicated that it is hard to measure the effectiveness of QA Systems in the absence of accurate quality records prior to the implementation of ISO 9000.

Typical examples of statements made are:

"...No objective measure of quality performance prior to introduction of ISO 9000 for comparison ...” (Company 25).

"The major problem is that we only decide to try and measure effectiveness once the system is in place. Without a benchmark
before change the full improvement cannot be assessed”

(Company 30).

It has already been mentioned, in section 6.2.1, that companies do not seem to hold accurate defects and quality records prior to the implementation of their QA Systems. The lack of such historical data hinders any possible comparison of finished constructions quality before and after the implementation of ISO 9000.

Therefore, a major comparative study on a significant scale, of quality improvement, in the eras before and after the implementation of ISO 9000 is abstruse and onerous for two main reasons. Firstly, as stated above, not many companies have kept accurate historical records of quality. Secondly, those few companies that might have kept such records are not willing to share them with others, as the author experienced, due to client confidentiality.

-Difficulty in measuring improvement

One reason of why effectiveness of QA Systems cannot be measured objectively was given by company 19 as:

“Difficult to measure improvement in efficiency and ‘getting it right’ ”

It is hard to agree with the statement above. There are many ways to measure improvement, the Business Excellence Model and benchmarking are typical examples. Various publications deal with performance measurements, for
example see McCamus (1991), Berry and Otley (1996), and Fitzgerald and Moon (1996).

Methods to assess business performance or quality improvement, therefore, do exist. The problem, as discussed above, is how to attribute the change in performance to the QA System in the presence of other factors.

Companies' interest in the 'effectiveness' subject - Three companies included additional notes on the returned questionnaires asking for a copy of the research's final conclusion and recommendation.

The author also received a significant number of telephone calls, from individuals who responded to the questionnaire and other interested parties who had heard about the research, enquiring whether a method to objectively assess the effectiveness of QA Systems has been developed.

A letter was also sent by a respondent, almost a year after he completed and returned the questionnaire, asking if a method has been found to measure the effectiveness of QA Systems. See Appendix D for a copy of this letter.

The interest of so many individuals in this research subject is, on its own, a significant result. It reflects enthusiasm in the research subject and eagerness, of interested parties, to fine hard evidence regarding the effectiveness of their systems.
6.3 RESULTS OF DATA COLLECTED FROM EXPERTS

As mentioned in the previous chapter, twelve experts were approached to participate in this research and none of them declined. The Aims of the experts' interviews were discussed in section 5.5.1.

This section discusses results of the experts' interviews. The results are analysed on interview-by-interview basis. Each interview is examined for the following information:

- Does the interviewee think it is possible to objectively measure the effectiveness of QA Systems?

- Does the interviewee suggest methods to measure the effectiveness?

- Interesting arguments and comments, related to QA Systems.

Experts were promised strict confidentiality, therefore, numbers substitute their names to secure anonymity.
Expert 1

The expert believes that most QA Systems were implemented due to client pressure, echoing the discussion made in Chapter Three.

The expert also believes that the external auditing of the system, by a third party, is an important characteristic that gives ISO 9000 much strength. However, the expert argues that the fact that a company is certified means that they have made an effort to get certified and made an effort to maintain the certification but this does not mean that a certified company is necessarily a good company.

The expert indicates that he is not sure whether the effectiveness of QA Systems can be measured beyond people's views and perceptions and states that he is not aware of any company, whether construction or not, that has developed a model to measure the effectiveness of their QA System objectively. The expert, in fact, suggests that a lot of people have moved on from ISO 9000 to self-assessment models, such as the Business Excellence Model.

This begs the question why are companies moving on from ISO 9000 to self-assessment models? Perhaps, one can argue that companies are moving on to self-assessment models because, in the absence of reliable measures of the effectiveness of QA Systems, they are not sure if ISO 9000 is the best way to meet their quality objectives. Where a self-assessment model, such as the Business Excellence Model discussed earlier in this chapter, can offer them a way to assess their business performance as well as possible quality improvement.
Considering a possible measure of system effectiveness, the expert states:

“I wonder if such a situation exists where say a twin separated at birth, whereby in one country an organisation runs under ISO 9000 where in another country it runs without it!”.

However, this expert acknowledges that important and influencing factors cannot be isolated, hence acknowledging the causality problem. For example, each company would have its own group of staff and local management, which is bound to influence the performance of the two businesses.

In other words, if company A, which has an ISO 9000, performed better than its ‘twin’ company that has no ISO 9000 it would be unfair, in the expert’s view, to suggest that the QA System is the only cause. Countless factors, including ISO 9000, could have affected the results.

**Expert 2**

This expert is supportive of the implementation of ISO 9000 and believes that when a QA System is taken on board, one should look beyond compliance with the standards. It is important to gain positive quantifiable benefits for the company, to justify the existence of the system which is an overhead. The only way to gain maximum benefit out of the QA System, in the expert’s view, is to
build into the system means of monitoring performance. However, the expert does not explain those means.

The expert strongly believes that the strength of ISO 9000, in the construction industry, lies in its ability to identify problems which can then be put right by people.

A method is suggested, by the expert, to measure the effectiveness of ISO 9000:

".... the only way to do it is, I suppose, to note the performance of a company over a period of time".

However, the expert questions the reliability of such method because of the existence of a vast number of variables that have a significant impact on the organisational performance. The expert, therefore, acknowledges the problem of causality and the difficulty of looking at the QA System in isolation of other influencing factors.

Consequently, the expert suggests an alternative method, which he subsequently dismissed as impossible:

"The only way then, to objectively measure the effectiveness, is to have two similar companies, one that has introduced an ISO 9000 and one that hasn’t and that would be almost impossible".
Therefore, although the expert strongly believes that people should look at quantifiable improvements of the system, he does not offer any practical method to achieve this.

Furthermore, the expert also indicates that he is not aware of any company, construction or not, that has managed to measure the effectiveness of their QA Systems objectively.

**Expert 3**

The expert endorse the causality issue and believes that it is too easy to measure the effectiveness of the QA System in complying with the requirement of the standards but it is not easy to measure the impact of the system on organisational performance because it can depend up on people being better within the system which makes measurement of the results very difficult.

If the system is measuring non-conformance, the expert believes you can say the system is working better if it has no defects, but at the same time he sees no point of doing that. The expert argues that ISO 9000 is not even worth implementing in the construction industry since it accounts for no more than a very small percentage of what is needed to produce business excellence or good results.

While the expert believes that a system approach is very important, he does not feel that ISO 9000 is the right system to implement in the construction industry. In
the following statements the expert emphasises the importance of choosing the right system, and not just any system.

"You can have systems without good management but you can’t have good management without systems”

"...you can have perfect systems that comply in every last degree of appropriateness, applied to construction, but it won’t help you”.

"You can put in a QA System to get a tick but that won’t do very much to improve your performance”.

Reasons for the expert’s concerns regarding the suitability of ISO 9000 in the construction industry are clearly highlighted in his following statements:

"... more than 60% of all projects are one-off and, therefore, the client is not going to do it again. Therefore, the culture of the construction industry has grown up around what it needs to do to build a one-off building that is unique in location, in time, weather, people and so on. It is just basic commonsense. To try and convert a system, which was designed for mass production and repetition, like ISO 9000, is starting at the wrong end of the horse".
"To use the ISO 9000 system just doesn’t make any sense, and however you try to convert it is not designed to produce a one-off solution, it is designed to produce a million-off".

"The trouble is the construction industry instead of pursuing its own approach to quality and to improve performance of management, has been sold the puff of ISO 9000".

It is clear, from the statements above, that this expert does not believe it is even worth measuring the effectiveness of ISO 9000, because, in his view, it is the wrong system to implement in the construction industry.

Like expert 1, the expert here believes that people are moving on from ISO 9000 to self-assessment models. The expert, through his work with the British Quality Foundation, is trying to assess whether the Business Excellence Model is more suitable to implement in construction rather than ISO 9000.

"Am I campaigning still for a different model for the construction industry? The answer is yes, and we are currently working in the British Quality Foundation and trying to see whether that model can be adapted. You need a system that looks at the soft aspects of quality management as well as hard aspects. Why only look at the 5%?".
In order to demonstrate that people are moving away from ISO 9000 towards other models that take into account the soft aspects of quality management, the expert provided a copy of a report, by The Construction Clients’ Forum, entitled ‘Constructing Improvement: The Clients’ Proposals for a Pact With the Industry’, and pointed out that ISO 9000 is not mentioned in the report at all, suggesting that even clients of the construction industry are moving away from ISO 9000.

**Expert 4**

This expert believes that a QA System should enable the QC System to work better. This, according to the expert, may have contributed to defects reduction on site. However, the expert also acknowledges that the defects reduction might have still been achieved without a QA System, as he stated:

“The question is, would that have been achieved if it hadn’t been for the QA System? I don’t think we’ll ever know that”.

A main advantage of a QA System, according to this expert, is that people work in a combined way to achieve advantage. Furthermore, the expert believes that, because of the record-keeping requirement of the system, problems are easily identified and money lost on certain areas can be traced to a specified cause.
However, the expert states that he does not know how to measure the effects and advantages of the system, nor knows of a company that has managed to find means to objectively measure the effectiveness of QA Systems.

The expert, according to his statement below, also distinguishes between the effectiveness of implementation of the system (in meeting the standard’s requirements) and the effectiveness of the system itself in meeting the company’s stated objectives.

"If the model of a company is the ISO 9000 system, then the nearer you get to perfection to that system within that company is the only measure that you have of successful implementation, by audit or whatever you can test that".

This echoes what has been discussed, earlier in the chapter and in Chapter Three, regarding Internal Quality Auditing. It is possible, and easy enough, to measure the ‘perfection’ or effectiveness of the implementation of the system. This is done by the internal auditing procedure to measure the compliance of the system with the stated requirements of the standards. Internal Quality Audits, however, as it has been highlighted previously, do not reflect the effectiveness and impact of QA Systems on the organisation as a whole.

Regarding the suitability of ISO 9000 to the construction industry, the expert believes that the system is broad enough if one is willing to interpret it correctly and states that:
“ISO 9000 doesn’t require a great intellect in order to be translated into construction. It can do for any business”.

**Expert 5**

The expert believes that when a company defines its quality objectives, which is required by ISO 9000, it should ensure that those objectives are realistic and measurable. He is also critical of companies that set objectives that are difficult to measure against.

Another area is also criticised by the expert. The following statement, made by the expert, highlights the area of concern:

“... a major fault in the system at the moment is the inadequacy of the registration bodies. This is a major problem in this country. There is a lot of pressure being exerted at the moment by the Association of Quality Management Consultants. But the fact is that second party auditing, carried out by second party auditors, are much more severe, much more strict, much more detecting audits than the third party ones”.

This clearly contradicts the views of expert 1 who believes that the external auditing of the system, by a third party, is an important characteristic that gives ISO 9000 much strength.
Generally, the expert is very supportive of the implementation of ISO 9000 in the construction industry and does not doubt its suitability. This expert also believes that the main strength of the QA Systems lies in their ability to lead you to the origin of problems through the corrective action activity.

Factors that can indicate performance on site were discussed during the interview. The expert suggested that although performance indicators, such as waste, scrap and overtime, can easily be measured, the results are very difficult to attribute to a certain cause.

The expert suggests benchmarking, against other organisations, as a way to measure the effectiveness of QA Systems. However, he seems to dismiss this method’s validity by noting that, compared to manufacturing, there are far fewer constants in construction, which can make benchmarking an expensive process. This expert, therefore, also acknowledges the causality problem.

A company’s internal audit report, was presented by the expert during the interview. Referring to this document, the expert demonstrated how effective internal auditing could be in identifying problems with the implementation of the system. The document, for example, showed that auditing spotted one deficiency in document control, three deficiencies in corrective action, and that training records were two weeks behind. This expert then stated that:

"In that particular case, the report now goes into a management function and someone is going to ask the question 'why aren’t
those people following their procedures?’ Now, if in three months time you and I walk into that company and see that this information has gone nowhere and there are still people in that department not following the laid down procedures, there is an absolute measure of failure in that particular corner, of that particular business, of the effectiveness of the *implementation* of the ISO 9002. If this goes on for a year you have another measure. Because if it’s gone for a year and the likes of BSI haven’t looked at that and haven’t detected that then you have another measure, and that is the measurement of the effectiveness of the registration bodies”.

In the quoted statement above, there is a clear and direct acknowledgment that Internal Quality Audits reflect the effectiveness of the *implementation* method of the system. In other words, compliance of the system with the requirements of the ISO standard.

The expert believes that at the moment all evidence regarding the effectiveness of QA Systems are based on personal statements. However, the expert argues that the combination of such statements carry significant weight and cannot be dismissed as unreliable or purely subjective.
Expert 6

This expert is very supportive of the implementation of QA Systems in the construction industry and believes that ISO 9000 ensures that people work the way they are asked to work and do what they are asked to do.

"Systems are implemented to ensure that your employees are working the way you asked them to work. That is what they are, you don’t do it just to have an ISO 900 badge. Although, some people have used it as a marketing ploy. But the idea is that you are ensuring that your people work the way you tell them to .... . If that produces good results then it is great if it doesn’t then you still get poor output".

When it was put to the expert that some companies implement ISO 9000 for reasons other than to control their people, for example to reduce defects on site, the experts stated “this is not what it is for” and emphasised his belief that the purpose of the system is to ensure that people are working the way they are told to work.

However, the expert emphasised that having an ISO 9000 system does not mean one has a superior product or a superior service.

"A good company won’t be ignoring recurring problems any way, whether it has ISO 9000 or not. There are a lot of
companies that are providing very good products and very good services without implementing a QA System”.

When asked how the effectiveness of ISO 9000 can be measured in construction companies the expert answered, “You feel it”. The expert believes that ‘feelings’, ‘opinions’ and ‘perceptions’ of well experienced individuals cannot and should not be considered unreliable.

**Expert 7**

This expert believes that ISO 9000 is not a philosophy but it is a measure of a philosophy and states that:

“ISO 9000 can be used to measure or demonstrate the philosophy is being placed. You can easily adopt a system which complies with ISO 9000 yet does not demonstrate the philosophy whatsoever. You can do the whole thing by lip service. Some in the manufacturing industry have done that and I would say almost all of the construction industry has followed that. They don’t hold at their hearts the philosophy”.

The expert is very supportive of ISO 9000 and strongly rejects claims that it is not suitable for the construction industry because of its manufacturing roots. However, the expert describes the construction industry as “the most litigious
industry in the world” and notes that the industry spends twice as much on legal activities as its profit margins. The expert argues that the legal cost has risen “because of quality” and states that:

“... everybody knew that if you actually built something which failed you would probably be sued. This has had a very negative impact on Quality Systems because Quality Systems demand asking the client things like what is your perceptions of our quality and how can we improve it. Basically, you would be inviting a claim”.

Furthermore, confirming what has been stated previously, by experts 1 and 3, that many people are moving away from ISO 9000, this expert himself has moved from ISO 9000 systems to partnering. This expert argues that if one wants to see structures that are actually on cost and to the required quality and specifications more frequently then partnering is the answer, not ISO 9000. However, the expert doesn’t provide any evidence to support his argument.

The expert states that he is not aware of any company that has managed to measure the effectiveness of its QA System in a meaningful manner. However, the expert argues that the effectiveness could probably be measured and makes the following statement:

“I suggest that your objective measures could be made and the measure would be by researching pre ISO 9000 construction
industry broad performance and post ISO 9000 broad performance and say how has the industry on delivery on time, defects, cost control, customer satisfaction, how does it perform now compared with how it used to”.

It was, then, put to the expert that such comparison could be unfair, because many factors have changed during the transition period. Factors such as change in technology, macro environment, and microenvironments, for example. The expert’s answer was:

“If ... I am prepared to accept that. Yes under those circumstances your objective measure would be extremely flux”.

However, although the expert acknowledges the problems associated with causality, in making an objective assessment, he believes that personal judgments of experienced individuals can amount to ‘objective views’, and this, in the expert’s opinion, is a reliable measure.

**Expert 8**

This expert confirms, what has already been discussed in Chapter Three, that although most organisations have implemented QA Systems due to client pressure, this pressure is more perceived than actual. The expert states that:
“I think the client pressure is more apparent than real. I think it is because clients put things on their tender lists, like do you have ISO 9000? The impression I get, particularly through my work with some local authorities, is that they don’t analyse the information anyway. But it is the presence of that on the form that gives the impression that the client cares even if the client doesn’t really care. I have also done some workshops with institutional clients and the impression I get there is that they are not using that information because they have access to much better information”.

Despite the ISO 9000’s manufacturing elements, the expert does not believe that it cannot be implemented in the construction industry. According to the expert, this is because ultimately one is talking about a generic management structure.

With regard to the effectiveness of QA Systems, the expert believes it cannot be measured and that it could remain a grey area. To support his argument the expert states:

“The problem is to know where the starting point was of the organisation. What one suspects, an organisation that is keen to implement Quality Assurance, it is already very much a part of their culture and they didn’t have to undertake a huge cultural change, or probably that large of a change in terms of their organisational structure and systems. So they are really building
over an incremental fashion into something which is already there. So it is very difficult to say this is the situation before and this is the situation after because you are actually looking at something which is a logical progression”.

The expert suggests a longitudinal study, of a group of organisations that are at a stage pre QA, which observes the changes as the organisations implement QA Systems. However, the expert questions the practicality of such a study because it is difficult to set up. Furthermore, the expert also acknowledges the causality issue and believes that it would be impossible to attribute the results of such study solely to the system, in the presence of other factors and perhaps, other systems. The expert states:

“That isn’t altogether surprising, because when you actually start to analyse what other things organisations with Quality Assurance do, you tend to find they are also the same organisations who are involved in other management systems, they actually have proper health and safety and so on, so it would suggest that there is a culture of which Quality Assurance is a part”.
Expert 9

The expert is very supportive of ISO 9000 and believes that it can bring immense benefits to any organisation. The expert also believes that ISO is applicable and suitable to all types of businesses, including construction.

Internal Quality Auditing is highlighted, by the expert, as one of the elements of ISO 9000 that gives it the biggest benefits by identifying problems. The expert also states:

"I happen to believe that the internal audit, if applied correctly, can be of immense benefit. Because it actually links corrective actions, management review and the company direction".

The expert has not tried to measure the effectiveness of ISO 9000 nor knows of an organisation that has managed to measure it. However, the expert, who pointed out that he is from a manufacturing background, believes that the effectiveness can be measured reliably but there is a reluctance to do that for the following reasons:

- Information required to measure the effectiveness is "very very difficult to extract"

- People are reluctant to admit that their QA System has brought benefits to them in case it might imply that they were not good and
that they were making mistakes, "people don't want to wash their dirty linen in public".

People are not willing to share information that shows how good their system is, in order not to give competitors the advantage to follow their lead and build on their success.

The expert also acknowledges the fact that most companies have not kept accurate defect and performance records prior to the implementation of QA Systems.

Like experts 1, 3, and 7, this expert indicates that people are moving on from ISO 9000 to self-assessment means. In this case benchmarking was given as an example.

When the expert was asked how could one prove, beyond personal views and perceptions, that ISO 9000 is working to their advantage and bringing benefits? The expert indicated that there is a halfway between subjectivity and objectivity and one has to achieve a balance in order to reflect reliable assessments of the effectiveness. The expert stresses that one can achieve objectivity through subjectivity and reliable results.

Acknowledging the absence of hard evidence and recognising its importance, the expert suggests that this research may help in bringing recognition to this matter:
“Maybe that is what the conclusion of your thesis shall be, that there should be a mechanism of measurement .... May be you have actually hit the nail on the head and you have the opportunity to help with the creation of something to help the company measure effectiveness”.

**Expert 10**

The expert believes that ISO 9000 system is a framework around which actions are performed through a series of processes and that it can be interpreted to suit the construction industry.

“I always believed that ISO 9000 can be interpreted to suit any industry. The problem ISO 9000 had at its very beginnings is that it was initially written specifically around manufacturing industries. The terminology and everything related to it came over as being for manufacturing. The unfortunate side effect of that is that every industry that wasn’t manufacturing said ‘oh it wasn’t for us’ ”.

Regarding the question of QA Systems effectiveness, the expert declares that “there is a lot of work to be done in this area”, and points out that he is not aware of any measures that have been performed in any organisation to reflect the effectiveness of ISO 9000 objectively.
Furthermore, while the expert notes that "it is not an easy subject to deal with", he declares that he is not a "pessimist" and believes that objective measures could be achieved. However the expert states that he does not have any ready answers as to how this can be achieved.

The expert describes two problems that hinder efforts to objectively measure the effectiveness of QA Systems. The first problem is the causality issues:

"Half of the problem is that the raw data that one can collect so easily, by itself, does not reflect a measure of the effectiveness of the Quality System. It might reflect the effectiveness of individuals in monitoring what is going on, it may reflect some other hard issues like that, but they don’t necessarily reflect the effectiveness of the system as such”.

And the second problem is:

"getting the method of measurement of that level of improvement, beyond somebody’s perceptions, is the problem”.

However, the expert remains hopeful and maintains that it might be possible to measure the effectiveness of QA Systems in a reliable manner:
"From a personal point of view, I don’t want to say I don’t think it can’t be done. I still have an open mind that it, possibly, can be done, but I don’t know how”.

**Expert 11**

This expert believes that ISO 9000 is suitable for all kind of industries and argues that although construction projects are unique, processes involved are repeated in every project.

Regarding the measurement issue, the expert believes that ISO 9000 is only a very small part of the business and, therefore, its effect cannot be measured due to the presence of a huge number of variables. Therefore, this expert echoes the views of many other experts regarding the problem of causality.

Furthermore, like expert 9, this expert believes there is reluctance in the construction industry to measure results. He highlights a cultural problem:

“They are trying to do it in an organisation that doesn’t want to measure any thing. Because if you measure any thing and you find out that you have done a mistake they would chop your head off. So you have a culture problem”.
Moreover, this expert, like experts 1, 3, 7, and 9 above, seems to be more supportive of the Business Excellence Model than ISO 9000. He argues that it is "pointless" to lobby for a separate ISO 9000-like standard for the construction industry when The Business Excellence Model is more suitable and can work well without ISO 9000.

"Why not go for the Business Excellence Model which at least can deal with every part of the business?".

Talking of the success of his organisation in achieving improvement, the expert believes that this could have been achieved without ISO 9000. The expert agrees that a company with a QA System does not necessarily make it better than a company without such a system, he states that:

"...you could well document rubbish, quite easily".

**Expert 12**

This expert believes that in the construction industry there is a traditional communication problem between different departments, different management levels and different sites. He argues that putting a QA System in place forces people to address the communication problem.
The expert states that he is not aware of any company, including those in manufacturing industry, that has managed to objectively measure the effectiveness of ISO 9000. Furthermore, the expert states:

"I don’t think that you could come up with a model that could measure the effectiveness of ISO 9000 objectively".

The expert elaborates on the quoted statement above by expressing concerns that most companies have implemented QA Systems because of client pressure or perceived client demand and therefore did not mark a starting point in order to benchmark against later on:

"The worst thing about all this is that there are a few companies who put a stake in the ground before they started implementing ISO 9000 so that they could objectively measure the benefits of putting the system in place. There are organisations who embraced it quite fully and they decided well if we are going to do this we are going to get benefit out of it, but nobody put a stake in the ground to start with so they can objectively measure the effectiveness of their system later on".

The statement made above is very important. It states the expert’s reasons for lack of hard measures and also supports the results that have been discussed previously, in section 6.2.1, that companies did not keep accurate quality records prior to implementing ISO 9000.
Companies' reluctance to divulge information and fear of measurements has already been highlighted by experts 9 and 11. This expert also shares the same view and states that:

"In manufacturing industry where you get the same product time and time again, you can quantify it objectively, no doubt about that. But you will find that it is very difficult to find an organisation who would own up to this, because nobody wants to say yes we saved a huge amount of money doing this, because it means how badly you were before then".

Like expert 8, this expert suggests a longitudinal study of organisations which are about to embark on ISO 9000 to study the effect of the system. Drawbacks of such studies have already been discussed in Chapter Four (See section 4.5).

### 6.3.1 Summary of experts' views

All the approached experts gave the impression that they were very interested in the research subject and were very keen to discuss various related issues.

Eleven of the twelve experts who participated in this research believed that ISO 9000 is a system well worth implementing in the construction industry. Those eleven experts had no doubt regarding the suitability of such systems to the construction industry.
Most experts highlighted some benefits that ISO 9000 can bring to a construction organisation, if implemented correctly. Many experts believed that ISO 9000 can help to identify problems within the organisation and detect the cause through the corrective action activity. Some experts also believed that QA Systems can help in reducing defects on site and improve communication within the organisation.

However, experts recognised that a construction company that does not implement a QA System can still be very effective. The experts seemed to agree that the implementation of ISO 9000 does not necessarily guarantee superior products or services. According to the majority of the experts ISO 9000 provides assurances that the company is working the way it said it works and that people are doing what they are asked to do.

Many of the experts amplified the importance of the Internal Auditing requirement. However, experts supported the argument discussed earlier in section 6.2.2, and acknowledged that Internal Auditing reflects how effective the system is being in meeting the requirements of the standard, which is deferent from the effectiveness of the system in meeting its prescribed objectives.

Regarding measures of the effectiveness of QA Systems, most experts believed that such measures are very important because an organisation must justify the existence of such systems, which are considered as overheads. However, all experts declared that they are not aware of any construction company that has managed to assess the effectiveness of its ISO 9000 in any reliable manner.
Some of the experts suggested some methods to assess the effectiveness of QA Systems. For example, the comparison between ISO 9000 certified companies and non ISO 9000 certified companies. Another suggested example was to compare the pre ISO 9000 era to the post ISO 9000 era, within the same organisation. However, the same experts who made these suggestions questioned the reliability and objectivity of such measures, mainly due to the problem of causality, which seems to be more amplified in the construction industry as experts have noted.

According to various literature, for example, Hage and Meeker (1988) and Fellows and Liu (1997), *Causality* is the direction in relationships of known dependant and independent variables. All the approached experts believe that the presence of a large number of variables, within a construction organisation, makes the task of attributing the success or failure to a single cause immensely difficult.

Furthermore, in comparing the pre and post ISO 9000 eras many of the experts believed that, apart from the causality issue, there is another difficulty associated with this approach. Experts noted that due to the lack of accurate records of defects and other data in the pre ISO 9000 era makes any significant comparison with the post ISO 9000 era very difficult. This lack of accurate quality related records, in the pre ISO 9000 era, has already been identified during the interviews with the QA managers for the pilot study (see section 6.2.1).

Another area highlighted by many experts is the reluctance of construction organisation to make data available in the public domain. Experts believed that many construction organisations are reluctant to declare the benefits ISO 9000
brought to their organisation in case this reflects that they were not doing the right things previously. As one expert put it: "people don't want to wash their dirty linen in public".

Five of the interviewed experts noted that many construction organisations are moving towards self-assessment models, such as the Business Excellence Model, with or without the support of ISO 9000, in order to improve their organisational effectiveness.

Finally, many of the experts believed that although most of what is available to date, regarding the effectiveness of QA systems, is based on personal statements the combination of these statements is significant. Experts hold the view that the compilation of feelings, opinions, and perceptions of credible experienced individuals can form an anthology that carries a substantial weight and a certain degree of objectivity, which cannot be deemed as unreliable evidence. However, the experts agreed that there should be a reliable mechanism of measurement to justify the existence of such systems in an organisation.
6.4 RESULTS OF DATA COLLECTED FROM CLIENTS

In total, three construction industry clients' organisations have been approached. The aims of collecting data from clients and how they were approached have already been discussed in the previous chapter.

M.O.D.

The first client organisation to be approached was the M.O.D., namely, the Defence Works Services. The M.O.D. was asked why do they prefer to deal with ISO 9000 certified construction companies, and whether they have noticed any differences between ISO 9000 registered and non-registered companies.

The M.O.D. replied with a letter, (see Appendix E). The letter confirms that the M.O.D. prefers to deal with ISO 9000 certified companies and stated that:

"In September 1993 the Department introduced a policy of 'No Acceptable Certification – No Contract'. The objective of this departmental wide policy is to place contracts only with firms holding the appropriate BS 5750 (now BS EN ISO 9001/2: 1994) or equivalent".
However, the M.O.D. indicated that although they have no statistical data to suggest effectiveness of QA Systems, they feel more confident dealing with certified companies. In other words, certification gives them peace of mind.

“We do not hold statistics to demonstrate that firms with BS 5750 are ‘better’ than those who are without it. However, the Department can generally be confident that firms which have made the investment and commitment necessary to attain and operate a certified Quality Management System will be capable of fulfilling the responsibility for quality”.

**Welsh Development Agency**

The W.D.A., which is a major client of the construction industry in Wales, was approached in order to determine whether they have evaluated the effectiveness of their contractors’ QA System or not.

The answer was ‘No’. In fact it was made clear at the meeting that the W.D.A. has a list of contractors that they have been dealing with for a long time, and that they would usually chose a contractor from this list regardless of whether they were ISO 9000 certified or not.
Cardiff County Council (Property Services Department)

This organisation stated that although it is supportive of ISO 9000, it does not have any hard evidence related to the effectiveness of such systems. The organisation also praised the Business Excellence Model and indicated that the model is used to assess their own business performance.

Results of data collected from clients are limited. The three clients' organisations above were approached as part of a pilot study for a possible full survey. However, based on the results collected from the three organisations above, it was felt that a full survey of clients was not very useful in this research because it is likely to produce similar limited results, as demonstrated above.

Furthermore, as described in section 5.6, it was felt that although clients' satisfaction was the ultimate measure of quality, they were not in a position to comment on the contractor's QA Systems, as they were not directly involved in them. In other words, while clients are in a position to assess the quality of the finished products and the services provided to them, they are not qualified to assess QA Systems that are being implemented in the contractors' organisations.

Moreover, as described in Chapter Three, the definition of system 'effectiveness' was based on criteria internal to the contractor's organisation, namely the objectives of implementing the system. There it is only the contractor is in the position to assess the effectiveness of his system in relation to his objectives.
6.5 SUMMARY

In addition to reviewing various literatures, results were collected from three main sources: Construction companies, experts in the field of Quality Management, and clients of the industry.

Apart from forming the basis for the main survey, the pilot interviews with construction managers yielded some interesting findings. It was noted that most companies did not keep accurate quality records prior to the implementation of ISO 9000. Furthermore, whatever records companies had, they refused to share it with researchers because of client confidentiality. This makes the task of comparing performances, of companies before and after the implementation of QA Systems a very difficult task.

Results of the main survey revealed that the vast majority of construction companies surveyed had not attempted to measure the effectiveness of their QA Systems in any objective manner.

Those who indicated that they have managed to objectively measure the effectiveness of their QA Systems have made statements describing how they managed to achieve this. Upon examining their statements, and initiating further contact with them, it became clear that all measures used were very subjective or and did not hold much credibility.
Results of the main survey also revealed that some companies seem to be misled by the wording of ISO 9000 that refers to Internal Quality Audits as a mean to assess the effectiveness of QA Systems.

Interviews with experts also resulted in interesting outcomes. The vast majority of experts were very supportive of the implementation of ISO 9000 in construction organisations.

Some experts suggested methods that might be used to assess the effectiveness of ISO 9000. However, upon further discussions they acknowledged that these methods are either impractical or very subjective.

The causality problem was identified by all experts. For example, to attribute any reduction in defects to a single cause, namely, ISO 9000, is a very difficult task. Experts seem to agree that the causality problem is more amplified in construction organisations due to the presence of a vast amount of variables.

Moreover, many of the experts seem to believe that people are moving away from QA Systems in favour of self-assessment models, such as, the Business Excellence Model.

Results generated by approaching clients of the construction industry show that those clients have not taken any measures to assess the effectiveness of their contractors’ QA Systems nor used any statistical data to compare performances of those companies before and after they acquired certification.
The following chapter, the Conclusions and Recommendations, discusses the implications of the results of this research.


REFERENCES


Chapter Six

Results and Analysis


Results and Analysis

Chapter Six


CHAPTER SEVEN

Conclusions and Recommendations
CHAPTER SEVEN

Conclusions and recommendations

7.1 INTRODUCTION

This is the final chapter of this thesis and it aims to state what has been achieved by the research and draw conclusions from it. Conclusions regarding the methodologies used and their suitability to this research are provided in this chapter.

The chapter also states conclusions based on the results of the research and highlights the original contribution to knowledge.

Finally, limitations of the research and recommendations for further studies are listed in this chapter.

7.2 CONCLUSIONS OF METHODOLOGIES ADOPTED

It has been mentioned in Chapter Four that triangulation has been adopted as a research methodology. Mail questionnaires and interviews were the two main techniques used to collect necessary data.
The techniques used, to collect data, proved to be very efficient in meeting their stated objectives. It is, therefore, concluded that by employing qualitative and quantitative approaches it was possible to reduce or even eliminate disadvantages of each individual approach whilst gaining the advantages of each and, due to the combination, a multi-dimensional view of the subject was gained.

7.2.1 Reliability of Data Collected from Companies

One of the major methodological issues is often the reliability of data upon which the results are based on. When designing the questionnaire, questions that were purely based on respondents' perceptions have been avoided. All questions were direct and precise and did not ask respondents to mark their agreement or disagreement on a scale such as the Likert scale.

In fact, due to the nature of data required, the questions were designed to minimise subjectivity and bias. In other words, when respondents were asked if they had measured the effectiveness of their QA Systems objectively, the answer to the question could not be subjective, it was either 'yes' or 'no'.

It has also been mentioned in Chapter Four that the questionnaires were addressed and sent to Quality Assurance Managers despite the risk of bias. The pilot interviews, which formed the basis of the mail questionnaires, showed that all QA Managers had all necessary information and documentation readily at hand. If the questions were designed in a way that allowed the QA Managers to, for example,
indicate on a scale from 1 to 10 the impact of ISO 9000 on reducing defects on site, one could have argued then that there is room for bias and prejudice as those managers, due to their position in the company as being in charge of quality, could try to reflect a better image of their organisations. However, due to the type of questions asked, prejudice that could have influenced the data was successfully eliminated.

It is, therefore, concluded that data collected from QA Managers were indeed reliable and objective.

### 7.2.2 Reliability of Data Collected from Experts

Data was collected from twelve experts based in the United Kingdom. All the experts are considered to be credible and with extensive experience in quality management theory and practice. The fact that experts were nominated by the Chairman of the British Quality Foundation Construction Group suggests that they are considered authorities in the research subject.

As in the case of QA Managers, experts were asked questions that largely resulted in minimum prejudice. For example, when experts were asked whether they believed that the effectiveness of QA Systems could be measured objectively, there was not much room for bias. The answer would have been 'yes' or 'no', although it was felt that there was some reluctance to say no.
Therefore, it is concluded that data collected from experts were reliable and important. The same argument applies to the limited data collected from clients.

7.3 RESULTS' CONCLUSIONS

From the results of the survey of construction companies it is concluded that none of the approached companies had managed to measure the effectiveness of their QA Systems in a reliable manner.

Furthermore, the results suggest that those companies did not measure the effectiveness of their QA Systems objectively for the following reasons:

1- They were not interested to find out how effective their QA System was.

2- They did not know how to measure the effectiveness in an objective manner.

3- They thought they were measuring the effectiveness objectively where, in fact, they were not.

Judging by the tremendous interest shown by those companies, reflected by their response rate, and the frequent further contacts with the author, the first reason above can safely be dismissed as unrealistic.
It is, therefore, concluded that construction companies did not actually know how to measure the effectiveness of their QA Systems objectively although they were very interested to know how they could achieve this.

It is also concluded that most companies had not kept accurate quality records prior to the implementation of their QA Systems. The lack of such important records makes the task of comparing the organisational performance of the pre and post ISO 9000 eras very difficult.

Many companies have relied on internal audits in order to assess the effectiveness of their QA Systems. The author, supported by many of the approached experts, believe that companies are being mislead by the wording of ISO 9000 which suggests the possibility of measuring the effectiveness of the system using the internal auditing procedures. The author does not undermine the importance of internal audits but believes that the results of these audits reflect how effective the system is in meeting the requirement of the standards rather than show the effectiveness of the system in relation to the prescribed objectives that led to its implementation.

As mentioned in Chapter Five, the experts reacted favourably, when asked to be interviewed; showing great interest in the research subject. In fact, none of the experts declined to be interviewed.

Furthermore, as stated above, construction companies also reflected a remarkable interest in the research subject. Moreover, the BSI also expressed great interest in
the research subject and not only did they accept to act as a collaborating establishment, they invited the author to their head office to present his results.

It is, therefore, concluded that the construction industry’s professionals and quality related professionals are very interested in the research subject and keen to find reliable evidence regarding the effectiveness of QA Systems.

The results of the experts’ interviews show the vast majority of experts were supportive of the implementation of ISO 9000 in construction organisations and had no doubts regarding its suitability to the construction industry.

The experts stated that they were not aware of any existing models that measured the effectiveness of QA Systems nor were they aware of any organisation that had managed to achieve such measures. Many of the experts emphasised the importance of finding a reliable mechanism of measurement in order to justify the existence of QA Systems in an organisation. The experts, therefore, acknowledge that there is a gap in knowledge about the effectiveness of QA Systems in construction organisations and agree that this problem should be properly addressed.

It is, therefore, concluded that a great deal of research is required to explore the full impact of ISO 9000 on construction organisations, which is an area of immense controversy.
Some of the experts suggested methods in an effort to assess the effectiveness of ISO 9000 in an objective manner. However, the experts noted that their suggested methods are very hard to carry out and, indeed, in some case are impractical due to the presence of a large number of variables and influencing factors which makes the task of attributing any success to a single cause, namely the ISO 9000, onerous.

It is, therefore, concluded that it is important to address the causality issue which seem to hinder efforts to reliably measure the effectiveness of QA Systems. The causality problem is apparently more amplified in the construction industry probably because there are far less constants in this industry in comparison to other industries.

From the definition of effectiveness, as stated in Chapters One and Three, it is obvious that the effectiveness of ISO 9000 is closely related to the organisation's prescribed objectives that led it to implement the system. Depending on the nature of the prescribed objective or objectives, the effectiveness of QA Systems can sometimes be measured reliably.

For example, if a company implement a QA System in order to increase staff motivation then the system is deemed effective only if it achieves this task. Therefore, to measure the effectiveness of the QA System, in this case, employees may be surveyed by questionnaires or interviews in order to gain their feedback regarding the impact the system has on their motivation. In the author's view, one can expect good reliable results from such exercise since motivation is something
personal to those surveyed individuals and no one can reflect their feelings on
their behalf. Therefore, in this case, the perceptions and views of the employees,
regarding the impact the QA System has on their motivation, may be taken as
conclusive reliable evidence.

A further example is; if a construction company implement a QA System for
marketing reasons and in order to add credibility by using the appropriate logos,
of the certification bodies, on their letterhead, the organisation in this case
achieves its objective when the certification is awarded by the certification body
and, therefore, the system is being effective as long as this certification is
maintained.

In the two examples above the objectives of the system are well defined and can
be quantified. The causality issue plays no part in these cases, and the
effectiveness can be measured reliably.

It is, therefore, concluded that, depending on the company’s reasons for
implementing a QA System, the effectiveness can sometimes be measured in a
straightforward objective manner. However, if the objectives of the system are of
a more complicated nature, for example, to reduce defect on site, then the task of
assessing its effectiveness in meeting such objectives is very difficult. In this
particular case the causality problem is amplified and the task of attributing any
decrease in defects solely to one cause is complex.
Based on the results of the in-depth interviews with experts it is concluded that soft measures of the effectiveness of QA Systems should not be dismissed as unreliable all the time. The compilation of feelings, opinions, and perceptions of credible, unbiased, and experienced individuals can form results that carry a substantial weight and a certain degree of objectivity, which cannot be deemed as unreliable evidence.

Results based on data collected from clients of the construction industry were limited but nonetheless valuable. However, it was concluded at an early stage of the research that clients were not a suitable source of information required for this research and plans for further contacts with clients were abandoned. Therefore, in this case no general conclusion could be drawn.

Finally, it is concluded that the research has achieved all its stated aims. In fact, some of the findings achieved have gone beyond the original aims of the research.

7.4 ORIGINAL CONTRIBUTION TO KNOWLEDGE AND VALUE OF RESEARCH

Research in the area of effectiveness of QA Systems in the construction industry is limited. It has been demonstrated in previous chapters that most of the published work to date, on the impact of ISO 9000, reflected conflicting views and controversies.
This is the first study on a PhD level that investigates the objectiveness and reliability of measures currently used to assess the effectiveness of QA Systems. It is also the first study on this subject to use the research methodology adopted to collect reliable objective data.

A study using the approach and methodology of this research and aims to find objective data, in relation to the effectiveness of QA Systems, has not been carried out before.

This research is of a particular value to construction companies that are considering implementing an ISO 9000 as well as those companies that are currently implementing such systems.

According to Rayner and Porter (1991) and Gunning (1996), costs associated with ISO 9000 system’s implementation and maintenance is huge. Gunning estimated the costs of gaining certification to be £25,000 and the cost of maintaining the system is on average £14,700 per annum. The impact of such costs is certainly more significant in smaller organisations.

Therefore, taking into account the significant costs involved in implementing and maintaining the system, this research should assist organisations, that are embarking on such systems, in helping them realise that there is no hard evidence to suggest that such systems are effective.
Furthermore, the research offers those companies the opportunity to learn from the mistakes of other companies. For example, it has been shown in this research that companies could not compare their quality improvement before and after the implementation of ISO 9000 simply because they did not keep accurate historical records of quality prior to implementing the system. In this case, companies that are considering implementing a QA System are reminded that it is important to start keeping such records.

The research is also of benefit to construction organisations that have been implementing QA Systems. Such organisations are offered the opportunity to learn from mistakes of others and realise that it is perhaps a waste of time, effort, and money to attempt measuring the effectiveness of their QA Systems using the unsuitable methods discussed in the previous chapter.

Furthermore, the research brings awareness to such companies that many of their competitors are moving on to more supple systems and self assessment models that take into account the soft aspects of 'quality' in this people oriented industry.

The research also brings awareness to another important area, which is the importance of defining the QA System's objectives. A company must be clear about its objectives for establishing a QA System, otherwise it has no hope of ever assessing its effectiveness, not even subjectively.

Moreover, due to the lack of a comprehensive understanding of the full impact of ISO 9000, the research gives professionals, who are involved in revising current
standards, strong reasons to improve on those standards, perhaps, by building into the standards some kind of self-assessment mechanism.

Finally, consider the statements below:

BSI's advertisement of ISO 9000, printed in the Financial Times March 15th, 1996:

"It pays for itself ... 
It gives you a competitive edge ...
It improves productivity ..." (BSI advert).

"Everything I have learned about ISO 9000 leads me to assert with confidence that it is bad for business. Why should this be? ISO 9000 is no more than a (poor) method for controlling output. It was originally developed to prevent bombs going off in munitions factories and, despite being reviewed a number of times, it remains essentially the same". (John Seddon, in Property Week, September 19th, 1997, p.32)

Not only do these statements contradict each other, they are on the opposite ends of the spectrum. These statements were made with no direct reference to any evidence. The statements above are examples of frequent contradictory statements made about ISO 9000 in recent years. The research, therefore, provides interested parties with important conclusions, based on reliable data, that may assist concerned parties to make up their own minds and form their own opinions.
regarding ISO 9000, without being influenced by the statements of advocates and critics of the system. It makes them aware that, in fact, there is no hard evidence to support either group.

7.5 LIMITATIONS

The topic of Quality Assurance in construction is a subject open to varying interpretations and there are countless areas directly and indirectly related to the topic. It is totally unrealistic to assume that the research covers all areas pertaining to Quality Assurance Systems. However, it is important to point out limitations of any research.

The research was limited to the construction industry in the United Kingdom. Although many of the construction companies that took part in this research have subsidiaries and branches overseas, they are considered UK based companies.

All the experts who participated in this research were also based in the UK. Experts in the field of Quality Management overseas were not approached, therefore, limiting the results of the expert section to the UK only.

The research was also limited to large construction companies. No attempts were made to approach medium or small organisations. Furthermore, only QA Managers were approached in those organisations.
Results based on data collected from clients of the construction industry were discussed in this thesis. It was stated that only three clients organisations were approached, and reasons for the small sample were discussed and justified. Therefore, although the results of the client section are interesting and worth reporting, they remain limited and could not be considered representative of the construction industry clients’ organisations.

The above limitations are not considered as imposing a cautionary note on the value of the research findings and conclusions. They are only highlighted for readers to bear in mind when interpreting the research.

7.6 RECOMMENDATIONS FOR FURTHER RESEARCH

It been mentioned earlier in this chapter that it is possible sometimes to reliably measure the effectiveness of ISO 9000, depending on its prescribed objectives. An example of measuring the impact of ISO 9000 on employees’ motivation was given. This is a study worthy of further investigation. It would be rather interesting to find the impact of ISO 9000 on the ‘soft aspects’ of a construction organisation.

It has been concluded that some construction companies are moving on from ISO 9000 to self-assessment models. It is recommended that research is carried out to determine reasons that led organisations to perhaps concentrate less on ISO 9000 in favour of other models.
It had already been pointed out in the previous chapter that some experts suggested that there was an 'inherent' and an 'instinctive' reluctance to measure effectiveness of systems. Various reasons were given by the experts (see Chapter Six). This is another area worth investigating.

7.7 SUMMARY

This study is concluded, achieving its stated aims. Various methods, of varying degrees of objectivity, to assess the effectiveness of QA Systems have been considered and commented on. Several problems associated with such methods have been identified and further studies to address those problems have been recommended.
REFERENCES


Appendices

Appendix A: Letter from the Collaborating Establishment

Appendix B: Experts’ credentials

Appendix C: A construction company’s attempt to measure the effectiveness of its QA System

Appendix D: Letter from a company, interested in this research, inquiring about measures to assess the effectiveness of QA Systems

Appendix E: Response of the MOD

Appendix F: Author’s publications
APPENDIX A

Letter from the Collaborating Establishment
Dear Mr Al-Nakeeb,

Thank you for your letter of 13th May 1997.

I am very pleased to provide you with information to assist with your research. Please find enclosed a copy of the BSI Register of Licencees, with our compliments, which contains a database of all the organisations we have registered under Quality Assurance and Product Certification schemes. This information is all within the public domain.

BSI would be pleased to be listed as a collaborating organisation within any future publications.

Should you require any further information please do not hesitate to contact me.

Yours sincerely,

DAVID J PHILLIPS
Manager, Business Development
Representational Office - Wales
Information contained in this appendix is based on CV’s supplied by the experts during the interviews. Information was correct and current at the time of each interview.
Mr. Michael James Peter Board:
A Chartered Engineer and a registered Assessor of Quality Management Systems. Mr Board is also a Principal Lecturer at the University of Glamorgan and holds the position of Senior Consultant of Quality Management Services at W S Atkins.

Mr. Philip Andrew Brown:
A Certified Auditor of ISO 9000 and has been a member of the British Quality Foundation since 1994. Mr Brown has an extensive experience in Quality Assurance Systems and currently holds the position of Divisional Quality Assurance Manager at AMEC Construction.

Mr. Richard Grover:
Secretary of the British Quality Foundation Construction Group between 1987-1996, currently the Acting Head of School of Real Estate Management at Oxford Brooks University and has an extensive research experience in Quality Management. Mr. Grover is a member of the Institute of Quality Assurance and has a large number of publications in quality related issues.

Mr. Tom Harland:
Development Manager of Major Accounts at the BSI, and responsible for developing the pan BSI product portfolio acting as the BSI global ambassador. Mr Harland is also responsible for all aspects of the Quality Assurance business through his position as the BSI-QA Acting Director and General Manager.

Mr. Ronald Baden Hellard:
Founder and Chairman of the Polycon Group with an extensive experience in Quality Management. Member Board of Management, British Quality Association, 1992-1993. Chairman Register Steering Group, British Quality Foundation, Quality Consultants & Training Organisations since 1994. Mr Hellard is the author of nine books and a large number of articles.

Dr. Jeffrey Protheroe Jones:
Senior Lecturer, Construction Management Scheme Leader at the University of Glamorgan. Dr. Jones links with Sir Alfred McAlpines plc as a collaborating body on research into Quality Assurance Systems in Constructions.
Mr. Peter S. Jones:
Over thirty years experience with international constructing organisations holding senior positions in Quality Management, Line Management and Project Management. A member of the European Construction Institute’s Total Quality in Construction Steering Committee and Chaired the Construction Measurement and Benchmarking Task Force.

Mr. C. J. O’Donnell:
A Senior Managing Consultant specialising in Quality Management across a broad spectrum of industries. Extensive experience in Quality Management in the construction sector and worked with major construction companies in the UK and overseas. Carried out over two hundreds third-party assessments for registration bodies including BSI.

Mr. J. Phillips:
Holds a position with the BSI as a Business Development Manager. Quality Systems implementation and auditing experience across a wide range of industries backed by a sound knowledge of ISO 9000 and ISO 14000 principles and practices.

Mr. Richard Smith:
A member of the Institution of Civil Engineers and a trained Lead Assessor of ISO 9000 series. Currently holds the position of a Regional Quality Manager for Tarmac Building for the southern UK.

Mr. Alan L. Taylor:
Head of Quality Management for Bovis Europe and Chairman of the Construction Group of the British Quality Foundation. Represents the Construction Industry Employers Confederation (CIEC) on the Quality Liaison Group Established by the Department of Environment.

Mr. John Theophilus:
Held senior positions in various companies and has a broad experience in Quality Management issues. Established a Quality Assurance System for Allied Bar Coasters in 1991.
APPENDIX C

A construction company’s attempt to measure the effectiveness of its QA System
BS 5750 - IS IT WORKING?
QUALITY MANAGEMENT IN NORTHERN

Summary of Results from Questionnaire

Thank you to those who returned my questionnaire last year, and apologies for the delay in getting feedback to you. Just over half were returned, which is a good response, and in general the replies that I received were very encouraging. The overall impression is that implementing a quality management system to meet the requirements of BS 5750 has been a success, although there are one or two problems that need to be addressed in order to increase its effectiveness.

A majority clearly believe that achieving certification to BS 5750 has improved the image of the Company. Other than this, the most positive effect has been to more clearly define your own responsibilities and those of others.

On the other hand, it was considered that there has been a vastly increased amount of paperwork since the quality management system was introduced. Interestingly, this was despite the fact that very few additional forms have been introduced. This will need to be investigated in order to determine the extent of the problem, if any. It may be that people are now simply having to fill in forms that should have been done anyway, but are now an auditable requirement of the quality system.

Other results indicate that virtually all staff have seen, or been made aware of, the procedures relating to their own work, but that they have not introduced significant changes to previous methods of working. However there is a feeling that the procedures are difficult to follow, so there is some scope for simplification.

One area that has clearly been identified as needing attention is that of "Feedback". The responses indicated that a significant number of employees:

- felt there should be more opportunity to comment on procedures
- had not been involved in an audit
- do not understand the Experience Feedback Report (EFR)

Feedback on the performance and effectiveness of the system is obtained through the internal audits, and by completion of an EFR by individuals who have identified problems or potential improvements. We can ensure that as many people as possible are involved in the audits, allowing them an opportunity to make comments or suggestions, but I would encourage individuals to use the EFR. We need feedback from everyone if the quality system is to be continually improved, and enable the full benefits to be realised.

Do you think that the survey has reflected your own views? If not, please let me know, report any problems to David or raise them with the internal auditors on their next visit.

Thank you for your response.

(Quality Co-ordinator)
UK Construction
Please tick the appropriate box below to indicate the department/function in which you are principally employed:

- Estimating & Tendering / Buying [ ] Site Management [ ]
- Quantity Surveying [ ]
- General Management / Marketing [ ] Office Administration [ ]

Please tick the statement which you consider to be most appropriate for each of the questions 1 to 9 below.

1. i) I have been issued with a set of procedures relating to my current job [ ]
   ii) I have not been issued with any procedures, but I have read, or been made aware of, those procedures applicable to my current job [ ]
   iii) I have not seen the procedures applicable to my current job [ ]

2. i) The procedures are accurate and easy to follow [ ]
   ii) The procedures are difficult to follow but generally set out correctly the method by which I perform my work [ ]
   iii) The procedures do not correctly describe the method by which I currently perform my work [ ]

3. i) The procedures have introduced significant changes, and improved previous methods of working [ ]
   ii) The procedures have introduced significant changes, but have not improved the previous methods of working [ ]
   iii) The procedures have not changed significantly from previous methods of working [ ]

4. i) The principles of quality management, and the reasons why Northern are pursuing certification to BS 5750, were adequately explained to me before the procedure were introduced. [ ]
   ii) Although there was some explanation about quality management and BS 5750 before the procedures were introduced, there needed to be more. [ ]
   iii) I received no explanation about quality management or BS 5750 before the procedures were introduced [ ]
5. i) The procedures applicable to my job have been fully explained to me
   ii) The procedures have been explained, but not in sufficient detail to make me fully aware of how the system is to work
   iii) There has been no explanation of the procedures applicable to my job

6. i) My colleagues and I have been given plenty of opportunity to comment upon the procedures, and to suggest improvements to them.
   ii) We have not been given the opportunity to comment upon or suggest improvements to the procedures, but I consider that we should be involved.
   iii) We have not yet been given the opportunity to comment upon or suggest improvements to the procedures, and I do not consider that we need to be involved.

7. i) I have been involved in an internal quality audit and found it to be useful in identifying improvements to the procedures and methods of working.
   ii) I have been involved in an internal quality audit, but consider it to be a time-wasting imposition that achieves nothing of benefit.
   iii) I have not been involved in any internal quality audit.

8. i) I understand the procedure for using an Experience Feedback Report (EFR) to inform the Quality System Manager about problems or potential improvement relating to the system, and I have used an EFR for this purpose.
   ii) I understand the procedure for using an EFR, but I have yet to raise one.
   iii) I do not understand the function of an EFR.

9. i) I am aware of the function of a Project Quality Plan, and I have been involved in the preparation of such a document.
   ii) I am aware of the function of a Project Quality Plan and I have seen one in use, but I have not been involved in the preparation of one.
   iii) I am not aware of the function of a Project Quality Plan.
10. It is generally claimed that the introduction of a quality management system to BS 5750 will produce a number of benefits for a company, although there are those who claim that it can create additional problems. A list of possible effects of introducing a system to BS 5750 is given below. For each item on the list, please indicate what you consider the effect to have been since the system was introduced to Northern, by circling the response that you feel is most appropriate.

- (a) Image of the Company
- (b) Overall business performance of
- (c) Quality of service received from suppliers and subcontractors
- (d) Relationships with customers
- (e) Quality of work produced by your department or site
- (f) Your own performance
- (g) Your own job satisfaction
- (h) Overall morale of staff
- (i) Communications within
- (j) Instructions given by managers/supervisors
- (k) Your own responsibilities
- (l) Responsibilities of others
- (m) Time spent on correcting mistakes
- (n) Time spent answering queries raised by others
- (o) Amount of paperwork

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Please state whether you agree or disagree with the statements made below by circling the appropriate response (YES or NO) for each statement.

11. The management of [ ] is fully committed to improving the efficiency and performance of the company through the quality management system.

   YES / NO

12. The quality management system will enable improvements to be identified in all parts of the business, producing cost savings and other benefits.

   YES / NO

13. The quality management system will encourage greater cooperation between departments/sites, and allow staff to carry out their work more efficiently.

   YES / NO

14. The achievement of certification to BS 5750 will provide with a better chance of securing future work.

   YES / NO

15. The management has communicated its Quality Policy, and the objectives of the quality management system, effectively to all staff.

   YES / NO

16. The management keeps all employees well informed on the overall performance of the Company and the future plans for the business.

   YES / NO

17. Please note any additional comments that you wish to make about the quality management system for [ ] in the space below. In particular please describe any problems that affect the work you have to carry out but which have not been adequately covered by the system, or suggest anything about the system that you think needs improving or changing.
APPENDIX D

Letter from a company, interested in this research, inquiring about measures to assess the effectiveness of QA Systems
3 February 1999

Mr A Al-Nakeeb BEng., DBA, MBA
c/o Mr Trefor Williams
University of Glamorgan
Centre for Research in the Built Environment
Pontypridd
Mid Glamorgan
CF37 1DL

Dear Mr Al-Nakeeb

Re: Project on Quality Assurance

Further to the questionnaire that I completed in March 1998, please advise if you have been able to develop a model that measured the effectiveness of QA.

I would be most interested to hear of your results.

Yours sincerely

[Signature]

Peter Norman
Quality Manager
APPENDIX E

Response of the MOD
FROM: B D Shinton, Head of DWS Secretariat

DEFENCE WORKS SERVICES
Ministry of Defence
P.O. Box 1734 Rectory Road Sutton Coldfield West Midlands B75 7QB
Telephone (Direct Dialling) 0121 M311 2104
(Reception) 0121 311 2140
(FAX) 0121 311 3719

Mr A Al-Nakib
Centre for Research in the Built Environment
University of Glamorgan
3 Llantwit Road
Treforest
Pontypridd
Mid Glamorgan CF37 1TR

Dear Mr Al-Nakib,

Thank you for your letter dated 3 October 1995 concerning the attitude of the Ministry of Defence (MOD) towards Quality Assurance. It has been passed to me to reply.

The MOD places full responsibility on its contractors for the quality of the products and services which they supply and attaches great importance to quality control procedures operated by those contractors. In September 1993 the Department introduced a policy of “No Acceptable Certification - No Contract.” The objective of this Departmental wide policy is to place contracts only with firms holding the appropriate BS 5750 (now BS EN ISO 9001/2:1994) or equivalent.

For our works services we do require our external professional project managers to have BS EN ISO 9001 1994 for the function of project management. However, although the numbers of construction firms with a QA certificate are increasing, there are still too few for the Department’s QA policy to apply. Nevertheless, we give preference to registered companies when drawing up tender lists and also in the evaluation of tenders. I have attached an extract from MOD’s “Works Services Opportunities” bulletin which sets out our QA requirements. Eventually, the policy will apply to the full range of works services.

We do not hold statistics to demonstrate that firms with BS 5750 are “better” than those who are without it. However, the Department can generally be confident that firms which have made the investment and commitment necessary to attain and operate a certified Quality Management System will be capable of fulfilling the responsibility for quality.

I hope this is helpful and I wish you every success with your research.

Yours sincerely

B D Shinton
Quality Assurance
The MOD attaches great importance to the Quality Standards and aims to place contracts with companies which meet the requirements of BS EN ISO 9001 and BS EN ISO 9002: 1994. Sub contractors DO NOT necessarily need to be BS EN ISO registered. It is the responsibility of the main contractor to ensure that the standard of Quality Assurance fully meets the MOD's requirements.

Project Management Services - contracts will only be awarded to companies which have obtained registration by a third party certifying body, confirming that their quality systems and procedures comply with BS EN ISO 9001: 1994 for the function of Project Management (or BS EN ISO 9002: 1994 in exceptional circumstances). Professional and technical work should normally be carried out at registered offices. Companies registered for different but related works professional or technical disciplines may still be considered but are less likely to be short listed.

Construction - although preference is given to registered companies, others still may be considered. For Traditional contracts, BS EN ISO 9002: 1994 applies. MOD Design and Construct contracts have a requirement for the application of quality systems which comply with BS EN ISO 9001 or 9002 subject to the scope of registration appropriate to the contract. Contractors which have no in-house design capability and are registered to BS EN ISO 9002: 1994, would be expected to engage a professional design organisation registered to BS EN ISO 9001: 1994, in order to discharge their obligations under the contract.

Property Management

Establishment Works Consultant (EWC)
The Quality Management System requirements for the EWC are:
- SIC 8370 or equivalent NACE for Professional and Technical Services.

Works Services Manager (WSM)
The Quality Management System requirements for the WSM are:
- registration to BS EN ISO 9002.
- SIC 5010 (and BSI QAS 5010/332) or NACE equivalent for Building Contractors and Managing Contractors
APPENDIX F

AUTHOR’S PUBLICATIONS
Quality Assurance in Construction .... Does it Really Work?

Quality Management in Building and Construction
Proceedings of Eureka Conference
Hamar / Lillehammer, June 1994
Norway

Edited by Odd Sjoholt

Norwegian Building Research Institute
Pages 242 - 247
Quality Management in Building and Construction

Proceedings of
Eureka Conference
Hamar/Lillehammer, June 1994
Edited by Odd Sjøholt
Quality Assurance in construction....Does it really work?

A. A. Al-Nakib
F. H. Mustapha
Department of Civil Engineering and Building, University of Glamorgan, S.Wales, U.K.

Abstract
This paper is based on a recent research carried out at the University of Glamorgan. The research which is based on data from 41 large construction companies, shows how Quality Assurance Systems are actually being implemented today. The results of this research prove beyond doubt that the Quality Assurance Systems are working to the benefit of the construction companies. The results show that the vast majority of the large construction companies have recently (only 1-5 years ago) implemented a QAS due to two major reasons; client’s pressure and to gain a competitive advantage. The results also show that most of the companies surveyed for the purpose of this research, are taking some measures to motivate their employees. They are also employing experts to assist them with the implementation of the QAS. The impact of QAS on Quality-Related Events was also investigated by this research. Employees’ reactions toward the implementation of the QAS were also revealed by this research as well as the advantages and disadvantages of the QAS, as perceived by the Quality Assurance Managers.

Introduction
Today ‘Quality Assurance’ has become one of the latest buzzwords, and suddenly everyone seems to be interested in it. According to CIRIA Report 109 (1985), Quality Assurance is a systematic way of ensuring that organised activities happen the way they are planned. It is a management discipline concerned with anticipating problems and with creating the attitude and controls which prevent problems arising.

According to Griffith (1990), within the construction industry the application of quality assurance has been slow to emerge. Whilst construction must formally meet with requirement specified by the Building Regulations and conform to planning and building approvals set by local authority building control, there is no compulsory requirement for design practices, manufacturers, contractors, or consultants to conform to the requirements of BS5750: Quality Systems.

The purpose of British Standards 5750: Quality Systems, is to set a recognised standard for management procedures that a company is likely to use if it is to provide assurance to a client or certification body of consistent quality of service or product. The first edition of BS 5750 was introduced in 1979, in three parts, and was applied mainly in the manufacturing industries.
However, in 1987 the standard was renewed and made more applicable to many industries, particularly the construction industry.

Ashford (1989) stated that too many buildings and structures in recent years have failed to satisfy the legitimate requirements of their purchasers and the reasonable expectations of the community at large. The record is not one of which any manager or engineer can feel proud.

Furthermore, and also referring to Ashford (1989), analysis shows that only a minority of construction defects are technical in origin. Far more arise from inadequacies in the management structure of the industry, from lack of training from the commercial pressure which stem from the almost universal custom of awarding work only to the lowest bidder. This makes quality management in the construction industry a necessity.

All Quality Experts agree that a Quality Assurance System must be initiated from the 'top'. The system must start with the Chief Executive, or equivalent, who must make it crystal clear that they are absolutely serious and totally committed to quality. This commitment should then flow down to other levels of management.

According to Oakland (1989), the middle management plays a critical and an exceptionally important part in the management of quality. Not only they must understand the principals of quality management, they must go on to explain them to their subordinates, and make sure that their commitment is successfully communicated.

However, starting from the top is only one of many important aspects of QAS. Total commitment and support of all employees involved in the implementation of the system is another important aspect. Effective communication is also very important. According to Cornick (1991), one of the biggest factors that leads to quality problems is poor communications, where insufficient information is supplied for someone to do the job properly. Many agree that training is one of the most important components of a successful QAS. According to Ashford (1989) to give people the knowledge and skill to operate the system, they need to be trained. To give them the will, they need to be motivated. In fact Oakland (1989), believes that training is the single most important factor in actually improving quality, once commitment to do so is present and for training to be effective it must be planned in a systematic and objective manner. The results of this research reveal that the majority of construction companies are aware of the importance of training and motivating employees.

**Method of data collection**

A survey among construction companies was conducted by means of a postal questionnaire. This was sent to over a hundred large construction companies based in the United Kingdom. The questionnaire was addressed to Quality Assurance Managers in each of the Head Offices of the chosen companies. Some of the questionnaires were followed up by personal interviews.

The response to the questionnaire was rather encouraging. The total number of companies that responded was 65. However, after a close examination of these 65 questionnaires, only 41 were considered suitable to base the analysis on. Therefore, the results and analysis are based on 41 large, well established, construction companies.
Results and analysis

Companies’ experience with QA:
The results of the research show that out of the 41 companies, only 6 (14.6%) have introduced a Quality Assurance System 5-10 years ago. The vast majority have introduced a QAS only 1-5 years ago. It is therefore clear that Quality Assurance Systems are relatively new to the construction industry as 85% of the large construction companies have introduced a QAS less than five years ago. This also indicates that the construction marketplace is beginning to become more aware of the need for Quality Assurance.

Company’s reason(s) for implementing a QAS:
The results show that the vast majority of the large construction companies have implemented a QAS for two major reasons. 73% of the companies indicated that they have introduced a QAS due to client’s pressure. Another 73% of the 41 companies indicated that they have implemented a QAS to gain a competitive advantage (i.e. for marketing reasons). Furthermore, 34% of the companies indicated that they have introduced the system to eliminate previous quality-related problems and only 27.6% of the companies have introduced a QAS hoping to reduce costs.

Resistance and methods of handling the resistance:
All literature agree that whenever an organisation is implementing a new system of any kind there will be some resistance, simply because ‘new’ implies change, and change causes ‘ambiguity’. According to Huczynski and Buchanan (1991), change brings resistance because it involves both confrontation with the unknown and loss of the familiar. It is also widely assumed that resistance to change is a common and natural phenomenon.

The results show that 14.6% of the large construction companies had no resistance at all when they first introduced their QAS. Another 14.6% have indicated that not only they had no resistance but they also had the full support of all the staff. 70% of the companies however, had some resistance. The results reveal that 56% of the resistance came from the middle management, followed by 19% from site managers and 14.6% from older employees (age55+). It is not surprising that most of the resistance came from the middle management as it carries most of the burden of the change process, as mentioned in the introduction.

It is the authors’ opinions that resistance must be managed effectively. By ignoring the resistance a company would only create more problems. The resistance might spread throughout the company if it is not carefully controlled. The results show that none of the companies have ignored the resistance, and different measures were taken to handle it.

The results show that the most widely used technique of handling resistance is by involving the employees in creating the change. 93% of the companies indicated that they have used this technique. Many agree that this is the best technique to handle resistance. For example, Duncan (1989) emphasised the importance of the total participation in creating the change. He states that the system will be resisted to some degree unless the people can be made to feel involved with the process of the change.
The results also show that the second most popular technique of containing the resistance (76%) is by helping the employees to understand the reasons for change. This of course will help to reduce some of the employees' ambiguity and hence helps to reduce resistance.

Only one company indicated that it has sacked some of their employees in order to control resistance. However, one can never agree that sacking employees is a good way to handle resistance. According to Duncan, Thorpe and Sumner (1990), quality systems should not be imposed, they should be introduced on a progressive basis in a manner which generates the understanding, acceptance and commitment of all concerned.

Measures taken to motivate the employees:
All organisational behaviour books devote many pages discussing the importance of motivation and how it affects human's behaviour. According to Basil and Cook (1974), one of the most important factors that affect man's ability to live with change is man's psychological motivation to accept and initiate change.

The construction companies seem to be aware of the importance of motivation as 93% of them have taken some measures to motivate their employees in order to cope better with the QAS. All of these companies indicated that they have improved communication, and updated staff with QA related information as a measure to motivate them. 12% indicated that they have increased the employees' responsibilities as another measure to motivate them. None of the companies have used pay increase as a measure to motivate employees.

Training for quality:
No matter how sophisticated and well planned a QAS is, it can only be put into effect by people. Therefore, the system will be as good as the people who run it. This is a logical fact that no one can argue with. Duncan, Thorpe, and Sumner (1990) recommended that training must never be ignored for all levels of management and staff at each key stage during the development and introduction of the system.

The construction companies seem to be well aware of the necessity of training and only one company out of the original 41 companies did not offer any training. The results show that the most widely used technique for training is by giving lectures and seminars (in-house) as 98% of the companies indicated that they have used this method. Also 49% indicated that they have trained employees by offering printed instructions and 29% have offered lectures and seminars (outside the company).

Quality Experts / Consultants:
The results show that today most of the construction companies are seeking the assistance of quality consultants to help them implement the QAS. Some of those experts are hired on temporary basis only. In fact, the results show that 19% of the companies have hired experts on temporary basis. The results also reveal that 34% of the construction companies have actually employed Quality Consultants permanently. 46.3% of the large construction companies indicated that they did not need the assistance of experts at all. QA Managers in 41 large construction companies were asked to mark, on a scale of 1-5, the extent of the contribution of their QAS to gaining a 'competitive advantage'. Statistical analysis was then
carried out on these results and showed a strong positive correlation between the use of experts and competitiveness. In other words, those companies that employed QA experts/consultants, have managed to increase their competitive advantage.

Impact of Quality Assurance Systems on Quality-Related problems:
According to Griffith (1990), in recent years there have been a number of UK based research projects surrounding the concept of quality and its assurance. Some of these UK based research projects were carried out by the Building Research Establishment (BRE).

The BRE in their report Quality Control on Building Sites (1981), and during their observation of a number of construction sites, have identified 501 'Quality-Related Events'. According to the BRE, anything that required the clerks of works, site managers, architects or tradesmen to pause in their work and consider the quality or 'rightness' of the building, is referred to as a Quality-Related event. Furthermore, the BRE has divided quality-related events into two broad aspects, within which particular causes of quality-related problems are emphasised. These include the following: ① Aspects of workmanship and site management causes: lack of skill, lack of care, lack of knowledge, poor planning by tradesman, poor contractor's organisation, no protection of completed work. ② Aspects of design or project information causes: no co-ordination of design, difficult to build, design will not work, unclear/missing project information, low quality design, designer not understanding materials.

The BRE have found that most of the quality-related events were caused by unclear/missing project information and also due to lack of care.

The research examined the impact of QAS on six of the above mentioned causes for Quality-Related Events. As shown in the bar chart below, all Quality-Related Events (caused by these six factors) were reduced dramatically after the implementation of the Quality Assurance Systems. For example, Quality-Related Events caused by poor contractor's organisation were reduced by 39.2%. Also, Quality-Related Events caused by unclear/missing project information (which is usually the biggest cause of Quality-Related Events) were reduced by 30.5% after the implementation of Quality Assurance Systems. In fact, the smallest reduction (which is still
significant) was in Quality-Related Events caused by lack of skill, as they were reduced by 20%.

Advantages and disadvantages of Quality Assurance Systems:
The results show that the most obvious advantages of QAS (as perceived by the QA managers), and starting with the most popular answers, are as follows:
(I) Better flow of information;
(2) Improved relationship with customers;
(3) Quality improvement on site;
(4) Gain competitive advantage;
(5) Cost reduction.
Therefore, the most obvious contribution of QAS was to better flow of information, and the least contribution was to cost reduction.

The results also show that Quality Assurance Managers in the large construction companies have identified some disadvantages to their QAS. In fact only 7% of the Quality Assurance Managers did not find any disadvantages to the QAS. 73% of QA Managers complained that Quality Assurance Systems are time consuming, 32% complained that QAS are too costly (at least initially), 22% indicated that their QAS have created too much formality and rigidity, and 19% complained that their QAS have caused resistance and conflict within their organisations. Although some disadvantages to QAS were identified, the advantages seem to outweigh the disadvantages.

Concluding remarks

From the evidence above, and despite the disadvantages, it seems that Quality Assurance Systems are working to the benefit of the construction companies. This is especially true with regards to the reduction in Quality-Related Events. The Authors would like to emphasise that all the results and analysis are based on large well established construction companies. Also, all the results are based on the opinions and perceptions of the Quality Assurance Managers at those companies.

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Professor David T H Weir
Director
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Dr Mazen J Alwani
Convenor
Arab Management Unit
Quality Assurance Systems in the United Arab Emirates

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Summary

This paper reports the findings of a recent research based on survey carried out in the United Arab Emirates for the University of Glamorgan. Data was gathered, by means of postal questionnaires and in-depth interviews, from twenty-one companies. The survey covered a wide range of National, Joint Venture, and International companies of different industries and various activities. All participating companies are currently implementing Quality Assurance Systems.

The research findings show that the vast majority of the surveyed companies have implemented a QA System within the last two years. The main reason for implementing a QA System was to reduce costs. The findings also show that the majority of companies have managed to implement the system within a period between 1-2 years and that was usually achieved by employing foreign Quality Consultants. Human aspects of the QA System, such as employee motivation and employee resistance, are examined and research findings regarding the cost-effectiveness of the QA Systems are also reported in this paper.

Introduction

‘Quality’ has become one of today’s latest buzzwords, and suddenly everyone seems to be interested in quality assurance. The principals of quality assurance however, are not new and can be traced, thousands of years ago, to early civilisations along the river banks of the Tigris the Euphrates, and the Nile. Brown (1993) stated that Quality Standards have a very long history, being in operation at the time of the building of the Pyramids whereby, at crucial points, each stone had to fulfil exacting parameters of size and weight.

According to Larue (1969), the Babylonian King Hammurabi (1792-1750 B.C.) set one of the earliest written records of standards as he stated, in his famous Stele, the following laws:

⊙ “If a builder constructed a faulty structure which subsequently collapsed, causing the loss of an aristocrat’s life, the builder might be put to death”.

⊙ “A shipbuilder was required to guarantee the caulking of a boat for one year, and should the vessel spring a leak during that time the builder might be required to completely dismantle and reconstruct the boat”.
With regard to modern Quality Systems however, and according to Naoum and Mustapha (1994), the concept of QA System first originated in the USA where it was applied to the NATO defence projects. In the UK, the British Government in 1972 decided to implement the QA standard on a wide scale including the defence department which eventually produced a commercial version of the standard, namely BS 5750 which was published in 1979. Following the publication of BS 5750, the demand for an international QA System has increased which led to the preparation of ISO 9000 which was published in 1987.

Since the publication of BS 5750/ISO 9000, Quality Assurance Systems have been implemented in thousands of companies all around the world. This paper discusses the implementation of QA Systems in the United Arab Emirates and examines some of the methodologies adopted by companies that have implemented QA Systems.

**Research Findings and Analysis**

The research findings and analysis are based on twenty-one companies, of all sizes, covering a wide range of activities such as construction, petroleum, airline, etc. As mentioned above, data was collected by means of postal questionnaires as well as in-depth interviews. All surveyed companies are currently implementing QA Systems.

**Companies' experience with QA Systems**

Results show that the vast majority of the surveyed companies, as indicated by more than 63%, have implemented a QA System within the last two years. 15.79% of the surveyed companies implemented a QA System 2-3 years ago, and a further 15.79% implemented a QA System 3-4 years ago. Only one company indicated that its QA System has been running for more than ten years.

From the results above, one can see that these systems have not been running for a long time and Third Party Certification, in the UAE, can be described as a rather new phenomenon.

**Time taken to acquire a Third Part Certification**

As shown in Figure 1, The vast majority of the surveyed companies, as indicated by 58.8%, have managed to implement a QA System and acquire a Third Party Certification in a period ranging between 1-2 years.

![Figure 1](chart.png)
Results also show that 29.4% of the companies have managed to acquire a Third Party Certification in less than a year. Only 11.76% took more than two years to acquire a Third Party Certification.

It seems that the majority of the surveyed companies have managed to implement a QA System and acquire certification within the normal time period of 1-2 years. This is supported by Brown (1993) as he stated that the planning involved and the actual work required, together with the time needed to prove the system works, means that getting ISO 9000 will take between six months and two years, with the majority of firms taking around a year.

**Reasons for implementing a QA System**

As shown in Figure 2, the main reason for implementing a QA System, as indicated by 71% of the surveyed companies, is to gain competitive advantage.

![Figure 2](image)

Cost reduction is the second reason for implementing a QA System as indicated by 47% of companies. Other reasons for implementing a QA System are illustrated in Figure 2.

It is a well-known fact that the main, and sometimes the only, reason for implementing a QA System in western companies is client pressure. However, this reason has only been indicated by 33.3% of the companies surveyed in the UAE. The reason for this, in the authors' opinion, is due to the fact that QA Systems have been implemented only within the last two years in the UAE, which means clients are still not aware of the full advantages of these systems and therefore would not put much pressure on companies.
Employees' reaction

Results regarding employees' reaction toward the implementation of QA Systems are very encouraging as 55% of the surveyed companies reported full support by their employees. Other companies, 25%, indicated that although they had no employee support, they also had no resistance. However, 20% of the companies reported resistance from the middle management.

It seems that employee resistance to change is a fact of life in all kinds of organisations as according to Huczynski and Buchanan (1991), Change can bring resistance because it involves both confrontation with the unknown and loss of the familiar. It is also widely assumed that resistance to change is a common and natural phenomenon. People find change threatening since it means they have to change their attitudes, values, and behaviour. Change means ambiguity and uncertainty and many find this painful and frustrating. Furthermore, people resist change when they do not understand the reasons for the change or its nature and likely consequences.

It is not surprising that most of the resistance came from the middle management as it is particularly sensitive to change. According to Oakland (1989), middle management plays a critical and exceptionally important part in the management of quality. Not only they must understand the principals of quality management, they must go on to explain them to their subordinates, and make sure that their commitment is successfully communicated.

Measures taken to minimise employee resistance

Although only 20% of the companies reported employee resistance, none of them ignored it. All of these companies have taken some measures to motivate their employees in to accepting the implementation of the QA Systems.

The results show that the most widely-used technique of handling resistance is by involving employees in creating the change. In fact, 93% of the companies indicated that they have used this technique. This is supported by Duncan (1989), as he emphasised the importance of employee involvement in creating the change, and stated that the system will be resisted to some degree unless the people can be made to feel involved with the process of change.

The results also reveal that 57% of the companies have controlled resistance by helping employees to understand the reasons for change. This seems very sensible as, according to Huczynski and Buchanan (1991), people resist change when they do not understand the reasons for the change or its nature and likely consequences.

Employee motivation

All organisational behaviour books, consulted by the authors of this paper, devote at least one chapter to discuss the importance of motivation in all types of organisations.
Jackson and Ashton (1993) put the subject of motivation in a rather interesting way: a quality system is like a new car without petrol: perfect in every respect, but it will not go. The quality fuel is staff attitude and motivation and any business has to address this. Employee motivation was also mentioned by Griffith (1990) when he stated that management, responsible for the organisation's direction and operation, must provide not only the basic policy and structure but provide leadership, instruction, motivation and resources to implement the quality system.

The results show that the surveyed companies are well aware of the importance of employee motivation.

As shown in Figure 3, the vast majority of the surveyed companies have taken measures to motivate their employees into accepting the implementation of the QA System.

All of the companies indicated that they have improved communication between staff and management at all levels as a measure to motivate employees. Results also show that 28.57% of the companies have increased staff responsibilities in order to motivate them. Both these measures make a lot of sense. Improved communication, especially in the form of feedback, will, in the authors' view, reduce employee ambiguities and hence increase their motivation. Hedenstad and Meyer (1993) discussed the importance of effective communication and stated that feedback can be regarded as a form of communication where behaviour is evaluated in relation to explicit or implicit aims. Psychological research has shown that feedback has an effect on motivation and can guide behavioural changes.

Increasing employee responsibilities will also lead to increased employee motivation, according to Mullins (1989).

None of the companies used pay increases to motivate employees. This was very sensible. In fact, according to the American psychologist Frederick Herzberg (cited in Huczynski and Buchanan, 1991), 'salary' is classified as one of the so called 'hygiene factors', for these factors might remove dissatisfaction, but would not increase motivation.
Training for quality

The identification of training needs is a requirement of BS 5750/ISO 9000, and much has been written about the importance of training. In fact, Oakland (1989) believes that training is the single most important factor in actually improving quality, once commitment to do so is present. And for training to be effective it must be planned in a systematic and objective manner.

Johnson (1990) stated that apart from establishing specialist QA staff, it is necessary to train and educate all staff at all levels. Training falls into three general areas. Firstly, there is awareness of the concept and principles of quality assurance. Secondly, an introduction and explanation of the quality system itself and finally, nuts and bolts training in the application of the system where it specifically applies in the individuals' area of operation.

The results show that the surveyed companies have used different methods to train their employees. The most popular method of training, as used by 90.47% of the companies, was by offering in-house lectures and seminars. The second most popular method of training, used by 42.85% of the companies, was by distributing printed instructions to all employees. Results also show that 33.3% of the companies have sent their employees to lectures and seminars outside the company and 28.57% have sent some of their employees overseas for training.

Quality Assurance consultants

The use of QA consultants is a matter of great controversy and there is much evidence to suggest that the use of consultants may bring some disadvantages. According to Hughes and Williams (1994), QA consultants often produce a system based upon a previous model which, whilst satisfying the standard, does not match the company's particular practices and needs. Parker (1993) notes that one of the commonest complaints about QA consultants is that they try to change their clients to fit the manual, rather than the other way around.

The system would be more workable if it was designed by the people using the system, rather than the adaptation of an externally generated system (Baxendale, 1994).

Results show that the majority of the surveyed companies have actually employed QA consultants. In fact, 42.8% of the companies employed QA consultants on full-time bases, and 9.5% on temporary bases. The rest of companies did not employ any QA consultants.

The results also show that all QA consultants employed are of foreign nationalities, mainly Britons. The use of foreign consultants is not surprising, since the implementation of QA Systems in the UAE is still a new phenomenon, as previously mentioned, and therefore local expertise must be very limited.
Cost-effectiveness of QA Systems

The cost-effectiveness of QA Systems is a matter of great dispute. One of the major criticisms of setting up a Quality System is that the initial and running costs are too high. According to Grover and Grover (1989), the costs of introducing and maintaining a Quality System include the costs of recruiting and employing suitable staff, the preparation of manuals and procedures and updating them, training costs, and the costs of record keeping. There may also be the costs of obtaining certification, if required by the company, and marketing costs, if the company is to make customers aware of its Quality System.

However, quoting a report by the Federation of Civil Engineering Contractors (1988), "As with all new management techniques which are of value in theory, Quality Assurance must become cost-effective in practice".

The results show that 14.3% of the surveyed companies have indicated that their QA Systems have not proven to be cost-effective yet, and 23.81% are not sure whether their systems are cost-effective or not.

However, the majority of the surveyed companies, 62%, have indicated that their QA Systems are cost-effective. This in the authors' opinion is very encouraging especially as the majority of these systems have been introduced, to companies practising in the UAE, only within the last two years.

Conclusions

The implementation of QA Systems in various companies in the United Arab Emirates is a new phenomenon as the vast majority of companies have implemented such systems only within the last two years. Companies have different reasons for implementing QA Systems, however, the main reason is to gain competitive advantage. Time taken for the implementation is on average 1-2 years. The use of foreign QA consultants, either on full-time bases or temporary, is the common trend in companies practising in the UAE. Employees' reaction toward the change process was generally favourable and the only resistance came from the middle management. All companies took measures to minimise employee resistance as well as measures to motivate employees. Although QA Systems have not been running for a long time in the UAE, most companies however, find their systems to be cost-effective.

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HUMAN ASPECTS OF QA SYSTEMS IN CONSTRUCTION

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Summary

This paper reports some of the findings of a continuing research carried out at the University of Glamorgan. The aim of the research is to determine the methodologies adopted by construction companies that have implemented Quality Assurance Systems and have a Third Party Certification. The research also puts special emphases on the ‘human side’ of the Quality Assurance Systems.

The research findings so far, are based on data collected from forty-one large well-established construction companies by means of postal questionnaires backed up by case studies.

This paper highlights the importance of the human side of QA Systems and discusses important human aspects such as employee motivation and employee resistance to change.

Introduction

No matter how sophisticated and well-planned a Quality Assurance System is, it can only be put into effect by people. The success or indeed failure of any QA System will, therefore, depend a great deal on the people implementing the system.

Sheng-Hsiung and Chan (1994) stated that the worth of a quality system depends largely on how well people do their jobs. People are responsible for the success of the system and play a major role in the functions it performs.

The importance of human side of quality systems was also emphasised by Hellard (1994) when he stated that serious attention is needed to the “people” or psychological side of quality systems in construction. There is a tremendous amount of work to be done in this general area and the results will have profound implications for the manner in which standards are implemented and used.

The importance of human aspects of QA Systems in construction has been recently emphasised by many authors. However, most of what has been written so far, is purely based on the perception and opinions of the authors. With the exception of the research recently published by the Norwegian Building Research Institute entitled ‘Establishing a Quality System: Pitfalls and Psychological Problems’ by Hedenstad and Meyer

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(1993), serious research in this area remains scarce, and the human side of QA Systems in construction is still very much neglected and underestimated.

The more recent development of the BS 5750, namely part 8 of the standard (ISO 9004-2), came as a very encouraging step towards the recognition of human aspects, as it mentions social processes, customer's perception, culture and motivation.

ISO 9004-2 recognises that in a service industry and service situation management is a people process, where human interactions are a critical part of the service's quality (Hellard 1994). Furthermore, as discussed by Barrett (1994a), ISO 9004-2 is written specifically for services, thus confirming by implication what everyone knew: that the standards up to that date not only came from the manufacturing arena, but were intended for it. However, ISO 9004-2, as stated by Barrett (1994b), is a quality management standard not quality assurance standard and so cannot be certified against. The distinction between QA and QM, according to Barrett (1994a), is straightforward. QM is concerned with the internal management of quality, whereas QA is interested in being able to demonstrate externally that systems and procedures have been followed.

**Construction Organisations are not Mechanistic**

As mentioned above, BS 5750 / ISO 9000 was originally written for the manufacturing industry. It is also well known that the vast majority of manufacturing companies fit the criteria of a mechanistic organisation, whereas construction companies have much more in common with an organic organisation.

Mullins (1989) defined the characteristics of mechanistic and organic organisations. Some of these characteristics are summarised below:

<table>
<thead>
<tr>
<th><strong>Mechanistic Organisations</strong></th>
<th><strong>Organic Organisations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• The specialisation of tasks;</td>
<td>• The contribution of special knowledge and experience to the tasks of the organisation;</td>
</tr>
<tr>
<td>• Closely defined duties, responsibilities and technical methods;</td>
<td>• The adjustment and continual redefinition of tasks;</td>
</tr>
<tr>
<td>• Knowledge centred at the top of the hierarchy;</td>
<td>• A network structure of control, authority and communication;</td>
</tr>
<tr>
<td>• The tendency for vertical interaction between superior and subordinate;</td>
<td>• Technical or commercial knowledge located throughout the organisation;</td>
</tr>
<tr>
<td>• The use of instructions and decisions by superiors on methods of operation and working behaviour.</td>
<td>• A lateral direction of communication, and communication based more on information and advice than on instructions and decisions.</td>
</tr>
</tbody>
</table>

From the distinction drawn above between mechanistic and organic organisations, one can see that construction companies fit the characteristics of an organic organisation.
By nature the construction industry is very 'people-oriented' and human interaction bulks far more largely than in the manufacturing industry. Unlike the manufacturing industry, construction has not got a fixed site. Construction sites are unique with different teams working on each site.

Furthermore, the life-cycle of construction projects are longer than those of most manufactured products. Therefore, the period of human interaction between members of individual project teams on one side, and between the construction company and its clients on the other, is much longer than that of most manufacturing organisations.

The culture of the construction industry, as stated by Tyler and Frost (1993), differs substantially from that found in many manufacturing organisations. Individual site managers, who compare with line managers in manufacturing terms, are far more autonomous in day-to-day activities.

From the discussion above one can see that the construction industry is very much a 'people industry'. Therefore, those responsible for the implementation of QA Systems should be aware of the importance of the human aspects and avoid treating people like robots. A mechanistic approach to quality systems must be avoided at all cost. This may seem obvious but, according to Hellard (1994), even experienced QA consultants and certification bodies with limited experience of the building industry have a tendency to adopt a mechanistic approach in applying the principles of ISO 9000 to the construction process.

Trying to control people through systems and treating people as robots causes two things to happen: - people will get round the system, - it will seem that the system is working. Of course we need systems, but they will work only if people make them work (Mortiboys and Oakland, 1991).

The following sections will highlight the importance of two important human aspects of the QA Systems, namely employee motivation and employee resistance. The authors will also discuss the results of their research findings in these two areas.

**Employee Motivation**

All organisational behaviour books, consulted by the authors of this paper, devote at least one chapter to discuss the importance of motivation in all types of organisations.

According to Langford, *et al* (1995), it has been found that labour represents approximately 40 per cent of total costs in a construction project. Levels of absenteeism, labour turnover, productivity, etc., are all commonly identified as directly attributable to employee motivation, and so it is important for us to have understanding of the factors likely to motivate (and dissatisfy) employees.

Jackson and Ashton (1993) put the subject of motivation in a rather interesting way: a quality system is like a new car without petrol: perfect in every respect, but it will not go. The quality fuel is staff attitude and motivation and any business has to address this.
Employee motivation was also mentioned by Griffith (1990) when he stated that management, responsible for the organisation’s direction and operation, must provide not only the basic policy and structure but provide leadership, instruction, motivation and resources to implement the quality system. Griffith (1990) further stated that the quality system must ensure that the procedures are updated correctly and that individuals are sufficiently well informed and motivated to implement them.

Employee Motivation (Research Findings)

The research findings, as mentioned above, are based on forty-one large well-established construction companies in the United Kingdom. These companies were surveyed by means of postal questionnaires backed up by case studies.

The results show that the surveyed construction companies are well aware of the importance of employee motivation.

As shown in Figure 1, the vast majority of the surveyed construction companies have taken measures to motivate their employees into accepting the implementation of the QA System. Only seven per cent of the companies did not take any measures to motivate their employees.

Ninety-three per cent of the companies have improved communication between staff and management at all levels as a measure to motivate employees. Twelve per cent of the companies indicated that they have increased staff responsibilities in order to motivate them. Both these measures make a lot of sense. Improved communication, especially in the form of feedback, will, in the authors’ view, reduce employee ambiguities and hence increase their motivation. Hedenstad and Meyer (1993) discussed the importance of effective communication and stated that feedback can be regarded as a form of communication where behaviour is evaluated in relation to explicit or implicit aims. Psychological research has shown that feedback has an effect on motivation and can guide behavioural changes.
Increasing employee responsibilities will also lead to increased employee motivation, according to Mullins (1989).

Only two per cent of the companies have initially involved employees in the process of setting up the system. This result is rather surprising and disappointing. There is much evidence to suggest that employee involvement in decision making is a great motivator, owing to the employee’s feeling trusted and in control. Hedenstad and Meyer (1993) stated that an employee’s control over his work situation is increased when he is involved in decision making. One assumes that his increased control increases his motivation and efficiency.

None of the companies used pay increases to motivate employees. This was very sensible. In fact, according to the American psychologist Frederick Herzberg (cited in Huczynski and Buchanan, 1991), ‘salary’ is classified as one of the so called ‘hygiene factors’, for these factors might remove dissatisfaction, but would not increase motivation.

Statistical analysis carried out on the questionnaires’ data shows that there are two significant positive correlations:

1. A strong positive correlation is found between number of measures taken to motivate employees and the level of employee participation in the QA System. In other words, those companies that took more measures to motivate their employees experienced a greater level of employee participation than those companies that made less effort to motivate their employees.

2. The forty-one construction companies were asked to mark, on a scale of 1-5, the extent of the contribution of their QA System to ‘cost reduction’. A strong positive correlation was found between the number of measures taken to motivate employees and the level of cost reduction, i.e. those companies that took more measures to motivate their employees experienced higher cost reductions.

The results of the above-mentioned correlations reflect the importance of taking measures to motivate employees, especially during the initial stages of the implementation of a QA System. Employee motivation brings various benefits to the construction company and therefore should be taken seriously.

**Employee Resistance**

Employee resistance is a fact of life in any organisation. This is especially true, in the authors’ opinion, whenever organisations implement a new system of any kind. This is simply because ‘new’ means ‘change’ and change carries with it ‘ambiguities’, and some people do not know how to deal with these ambiguities: so they get frustrated and ‘resist’.

According to Huczynski and Buchanan (1991), change can bring resistance because it involves both confrontation with the unknown and loss of the familiar. It is also widely assumed that resistance to change is a common and natural phenomenon. People find
change threatening since it means they have to change their attitudes, values, and behaviour. Furthermore, people resist change when they do not understand the reasons for the change or its nature and likely consequences.

With regard to the implementation process of QA Systems, Watling (1989) stated that the process requires that long established customs be examined and perhaps abandoned. Skeletons have to be brought out of the cupboards and vested interests have to be challenged. Inevitably many people will find this process disturbing and uncomfortable.

There will always exist an opposition to the implementation process, according to Dolve (1994), not by people in the company being against quality management, but by the way we always have done our jobs, and by lack of time, caused by doing things in the way we always have done it.

**Employee Resistance (Research Findings)**

As shown in Figure 2, the majority of the surveyed forty-one large construction companies have experienced some employee resistance when their QA System was initially introduced.

![Employees' reaction to QAS](image)

Figure 2 shows that 14.6% of the large construction companies experienced no resistance at all when they initially introduced their QA Systems. Another 14.6% indicated that not only had they no resistance, but they had the full support of their staff. However, 70.8% of the companies had experienced some employee resistance. Details regarding the type of employee resistance are currently being examined by further research.

The results reveal that 56% of the resistance came from middle management, followed by 19% from site managers and 14.6% from older employees (age 55+).

It is not surprising that most of the resistance came from the middle management as it is particularly sensitive to change. According to Oakland (1989), middle management...
plays a critical and exceptionally important part in the management of quality. Not only they must understand the principals of quality management, they must go on to explain them to their subordinates, and make sure that their commitment is successfully communicated. This is especially true in construction organisations.

The resistance of site managers is also understandable and expected. One can argue that not only must site managers deal with the ambiguities of the new system, inevitably, they may have to work for longer hours on sites in adverse weather conditions until they get more familiar with the QA system.

The resistance of the older employees (age 55+), in the authors’ view, can only be attributed to human nature. We all tend to be more set in our ways and less flexible to change as we grow older. One can imagine the older employees arguing: this is the way we have always done things, so why change now?

As shown in Figure 3, all the companies that have experienced employee resistance when they initially introduced their QA Systems took some measures to minimise the resistance.

### Techniques Used To Handle Employee Resistance

<table>
<thead>
<tr>
<th>Technique</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Ignoring it hoping it might go away</td>
<td>Others</td>
</tr>
<tr>
<td>Helping employees to understand the reasons for change</td>
<td>80%</td>
</tr>
<tr>
<td>Involving employees in creating the change</td>
<td>76%</td>
</tr>
</tbody>
</table>

The results show that the most widely-used technique of handling resistance is by involving employees in creating the change. In fact, ninety-three per cent of the companies indicated that they have used this technique. This coincides with the views of Duncan (1989), who emphasised the importance of employee involvement in creating the change, and stated that the system will be resisted to some degree unless the people can be made to feel involved with the process of change.

The results also reveal that seventy-six per cent of the large construction companies have controlled resistance by helping employees to understand the reasons for change. This seems very sensible as, according to Huczynski and Buchanan (1991), people resist change when they do not understand the reasons for the change or its nature and likely consequences.
One company, however, indicated that it has dismissed some employees in order to control resistance. One can hardly agree that dismissing employees is a sound technique of handling employee resistance. According to Duncan, Thorpe and Sumner (1990), quality systems should not be imposed, they should be introduced on a progressive basis in a manner which generates the understanding, acceptance and commitment of all concerned. Nesbit (1992) stated that change cannot be implemented through fear, or just absorbing the message, nodding, then do nothing. 'Top down' orders will get ignored, sabotaged or re-interpreted in many ways.

Statistical analysis carried out on the questionnaires’ data reveals two significant correlations:

1. A significant negative correlation between resistance and ‘flow of information’ within the organisation.
2. A strong negative correlation between resistance and ‘cost reduction’, i.e. the greater the resistance the lower the cost reduction.

Both of these correlations make sense. As discussed above, resistance can lead to de-motivation, or even sabotage, which might increase costs and break communication chains and therefore reflect negatively on the flow of information within the organisation. The message these correlations send, especially the second one, is that employee resistance, if not handled correctly and sensitively, will lead to financial loss and employee de-motivation.

**Conclusions**

The construction industry is a very human-oriented industry, and construction organisations are better described as organic rather than mechanistic. Human aspects in construction organisations are much more magnified than in most manufacturing organisations. Therefore, those responsible for the implementation of QA Systems should give great consideration to the human aspects of the systems and avoid treating people like robots.

Employee motivation is a very important human aspect of QA Systems in construction. The vast majority of the construction companies surveyed recently are aware of the importance of employee motivation and have taken some measures to motivate their employees to accept the implementation of the QA Systems. Results suggest that employee motivation leads to a greater degree of employee participation in the QA System, as well as cost reduction.

Employee resistance to change is a fact of life in all organisations. Results show that most of the resistance comes from the middle managers as they carry most of the burden of the change process. Results also reveal that the majority of construction companies have taken some measures to handle employee resistance. Employee resistance, as results suggest, can interrupt the flow of information within the organisation and increase the cost of the QA System.
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Implementation of Quality Assurance Systems in the United Arab Emirates

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Implementation of Quality Assurance Systems in the United Arab Emirates

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The United Arab Emirates is today the most buoyant market in the Gulf Region, with many multinational companies operating in industry and commerce. Quality Assurance Systems, initiated by such companies, are strongly emphasised in this important market. This paper presents the findings of a research project conducted to investigate the details of implementing Quality Assurance Systems in the UAE. Objectives were met through an extensive literature review and in depth interviews with 'Quality Managers' of 28 large companies operating in a wide range of activities. Results show that in spite of being a new concept, Quality Assurance Systems have been well thought of by most companies and their implementation received full support from almost all employees at all levels. The average time taken for the full implementation of a system is around two years. Gaining competitive advantage has been identified as the main attraction for companies to implement Quality Assurance Systems. The results of the research also revealed that improved communication and continuous training are the most important factors in establishing effective Quality Assurance Systems. Such results may provide important guidelines for the companies thinking of starting Quality Assurance Systems and for the ones who have already implemented it.

Definitions of Quality

The subject of quality has been much publicised but confusion has risen with the definition of different terms related to this important subject such as Quality Assurance (QA), Quality Control, Quality Management (QM) and recently Total Quality Management (TQM). Quality is often used to signify 'excellence' of a product or service, people talk about Rolls-Royce quality as 'top quality'. In engineering projects it may refer to conformity to specification whilst in hospitals and schools it may be used to indicate some sort of 'professionalism'. Some authors define quality as simply meeting the true requirements of the customer (Oakland 1995). The above definitions have been expressed in many ways by other authors such as: fitness for purpose or use (Juran 1988); quality should be
aimed at the needs of the consumer, present and future (Deming 1982); conformance to requirements (Crosby 1979). A dictionary definition of quality is 'degree or grade of excellence'. A formal definition of quality is 'the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs' (Hellard 1995). According to Hellard, the formal definition of the other quality related terms are:

Quality Assurance (QA): all activities concerned with the attainment of quality - a process designed to increase confidence in a product's or service's ability to achieve the stated objectives (hence this implies the application of various management techniques).

Quality Control: the operational techniques and activities which together sustain the product, service or quality specified.

Quality Management: that aspect of the overall management function that determines and implements the quality policy.

Total Quality Management (TQM) is a comprehensive approach to improving competitiveness, effectiveness and flexibility through planning, organising and understanding each activity, and involving each individual at each level. It is useful in all types of organisations. Saylor (1992) notes that the primary emphasis of the TQM philosophy is total satisfaction for both internal and external customers, within a management environment that seeks continuous process improvement. It is obvious that organisations 'delight' the customers by consistently meeting their requirements, and then achieve a reputation of 'excellence'.

This paper investigates the implementation of quality assurance systems in the UAE, so it uses the previous definition of Quality Assurance as 'all activities concerned with the attainment of quality'.

Historical Background

Quality assurance might be considered to be a modern concept; however, its basic principles can be traced back to thousands of years, more specifically to the early civilisations along the river banks of the Tigris, the Euphrates, and the Nile. Brown (1993) stated that Quality Standards have a very long history, being in operation at the time of the building of the Pyramids whereby, at crucial points, each stone had to fulfil exacting parameters of size and weight. According to Larue (1969), the Babylonian King Hammurabi (1792-1750 B.C.) set one of the earliest written records of standards as he stated, in his famous Stele, the following apophthegms:
If a builder constructed a faulty structure which subsequently collapsed, causing the loss of an aristocrat's life, the builder might be put to death.

A shipbuilder was required to guarantee the caulking of a boat for one year, and should the vessel spring a leak during that time the builder might be required to completely dismantle and reconstruct the boat.

The modern awareness of quality systems started in the early 1950s (Naoum & Mustapha 1994; Manning 1994). A group of American quality experts started to advise the world on how quality should be best managed. The Japanese were the first to benefit from these experts. Juran (1988) led these efforts and was the first to define quality as 'fitness for purpose', adding an extra dimension to the earlier definition of 'conformance to specifications'. He also emphasised the importance of 'an understanding of human situation associated with the job in solving technical problems'.

Deming (1982, 1993) was another American who also gained fame by helping Japanese companies to improve quality. He defined quality as 'a predictable degree of uniformity and dependability, at low cost and suited to the market', and established the concept that quality is whatever the customer requires (see Table 1). Deming supported employee participation in decision making, claiming that management is responsible for 94 per cent of quality problems and that barriers between different departments should be broken to do a proper job. He believed that inspection, whether of incoming or outgoing goods is too late, ineffective and costly.

Crosby (1979, 1984) is best known for the 'zero defects' concept and introduced a conformance and non-conformance philosophy instead of high or low quality. He summed up quality in one word as 'prevention'. His approach is to have a clear statement of requirements, the establishment of a system which all understand, the setting of performance standards and the measurement of conformance. He believes that constant improvements in all areas of operation are essential for survival, warning that too much reliance on rigidity of codes, standards and traditional methods can 'cap' improvements. Table 1 compares the quality approaches of the three American gurus.

The above were the first steps towards developing the concept of Quality Assurance into codes and standards. The USA and Japan were the first two major nations to adopt this concept, particularly by government departments (e.g. the defence sector and defence projects). In 1972, the British government had decided to implement a more formalised approach through the introduction of British Standards, which did little more than addressing definitions and principles. This was followed by the production of a commercial version of the standard, namely BS 5750 in 1979. The publication of BS 5750 and its wide usage in the UK has increased the demand for an international quality assurance system. This has led to the preparation of ISO 9000 which was published in 1987. The British government's
1982 White Paper, 'Standards, Quality and International Competitiveness', was far reaching in its objectives, and set up a system of certification through companies registered with the National Accreditation Council. Since the publication of BS 5750 and ISO 9000, quality assurance systems have been implemented in thousands of companies all around the world.

Table 1
American Quality Gurus Compared

<table>
<thead>
<tr>
<th></th>
<th>Crosby</th>
<th>Deming</th>
<th>Juran</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition of quality</strong></td>
<td>Conformance to requirements</td>
<td>A predictable degree of uniformity and dependability at low cost and suited to the market</td>
<td>Fitness for use</td>
</tr>
<tr>
<td><strong>Degree of senior quality management responsibility</strong></td>
<td>Responsible for quality</td>
<td>Responsible for 94% of quality problems</td>
<td>Less than 20% of quality problems are due to workers</td>
</tr>
<tr>
<td><strong>Performance standard motivation</strong></td>
<td>Zero defects</td>
<td>Quality has many scales. Use statistics to measure performance in all areas. Critical of zero defects</td>
<td>Avoid campaigns to do perfect work</td>
</tr>
<tr>
<td><strong>General approach</strong></td>
<td>Prevention not inspection</td>
<td>Reduce variability by continuous improvement. Cease mass inspection</td>
<td>General management approach to quality especially human elements</td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td>Fourteen steps to quality improvement</td>
<td>Fourteen points for management</td>
<td>Ten steps to quality improvement</td>
</tr>
<tr>
<td><strong>Improvement basis</strong></td>
<td>A process not a programme. Improvement goals</td>
<td>Continuous to reduce variation. Eliminate goals without methods</td>
<td>Project-by-project team approach. Set goals</td>
</tr>
<tr>
<td><strong>Teamwork</strong></td>
<td>Quality improvement teams Quality councils</td>
<td>Employee participation in decision making. Break down barriers between departments</td>
<td>Team and quality circle approach</td>
</tr>
<tr>
<td><strong>Costs of quality there is</strong></td>
<td>Cost of non-conformance. Quality is free</td>
<td>No optimum - continuous improvement</td>
<td>Quality is not free an optimum</td>
</tr>
</tbody>
</table>

Notes: Adapted from Oakland (1995).
Implementation of Human Aspects and QA Systems

No matter how sophisticated and well-planned a quality assurance system is, it can only be put into effect by people. The success, or indeed failure, of any QA system will, therefore, depend a great deal on the people implementing the system.

Sheng-Hsiung & Chan (1994) stated that the worth of a quality system depends largely on how well people do their jobs. People are responsible for the success of the system and play a major role in the functions it performs. Inspectors detect and report defects in products; engineers solve technical problems; supervisors direct the activities of others. But how can good job performance be obtained? The answer to this question is found in the particular set of individual, physical, and organisational factors which influence a person in his/her job. The general term for these influences is human factors.

Human aspects of QA systems are important in all industries, however, they are more emphasised in 'people-oriented' industries. A good example of this is the construction industry. By nature the construction industry is very 'people-oriented' and human interaction bulks far more largely than in the manufacturing industry. Unlike the manufacturing industry, construction has not got a fixed site. Construction sites are unique with different teams working on each site.

The importance of human side of quality systems in the construction industry was emphasised by Hellard (1994) when he stated that serious attention is needed to the 'people' or psychological side of quality systems in construction. There is a tremendous amount of work to be done in this general area and the results will have profound implications for the manner in which standards are implemented and used.

The more recent development of the BS 5750, namely part 8 of the standard (ISO 9004-2), came as a very encouraging step towards the recognition of human aspects, as it mentions social processes, customer's perception, culture and motivation. According to Hellard (1994) ISO 9004-2 recognises that in a service industry and service situation, management is a people process, where human interactions are a critical part of the service's quality. Furthermore, as discussed by Barrett (1994a), ISO 9004-2 is written specifically for services, thus confirming by implication what everyone knew: that the standards up to that date not only came from the manufacturing arena, but were intended for it. However, ISO 9004-2, as stated by Barrett (1994b), is a quality management standard not quality assurance standard and so cannot be certified against. The distinction between QA and QM, according to Barrett (1994a), is straightforward. QM is concerned with the internal management of quality, whereas QA is interested in being able to demonstrate externally that systems and procedures have been followed.
Research Findings and Analysis

The research findings and analysis are based on 28 large companies in the United Arab Emirates covering a wide range of activities such as construction, petroleum, airlines, etc. Data were collected by means of in-depth interviews. The companies surveyed are currently implementing QA systems. The following variables were assessed by the survey:

- company-related variables (age of company, type of business, size of company)
- companies' experience with QA systems
- reasons for implementing a QA system
- time taken to acquire third party certification
- employee reaction toward the implementation of QA systems
- employee motivation
- training for quality
- use of QA consultants
- cost-effectiveness of QA systems

Companies' Experience with QA Systems

The results show that the vast majority of the surveyed companies, 61.5 per cent, have implemented a QA system within the last two years whilst 15.38 per cent of the surveyed companies 2-3 years ago and 23 per cent over 3 years ago. From the results above, one can see that these systems have not been running for a long time. Therefore, in comparison with the companies in the West, third party certification, in the UAE, can be described as a rather new phenomenon.

Reasons for Implementing a QA System

As shown in Figure 1, the main reason for implementing a QA System, as indicated by 65.38 per cent of the surveyed companies, was to gain competitive advantage. Cost reduction is the second most cited reason for implementing a QA system. Most research shows that the main, and sometimes the only, reason for implementing a QA system in Western companies is client pressure. Al-Nakib & Mustapha (1994) noted that 73 per cent of large construction companies in the UK have implemented a QA system due to client pressure. However, this reason has only been indicated by 38.46 per cent of the companies surveyed in the UAE. The reason for this, in the authors' opinion, may be due to the fact that QA systems have been implemented only within the last two years in the UAE, which means clients are still not aware of the full advantages of these systems and therefore would not put much pressure on companies, compared to the situation in the West.
Reasons for Implementing a Quality Assurance System

- To follow the trend in the West
- To eliminate previous quality problems
- Client pressure
- To reduce costs
- To gain competitive advantage

Figure 1

Time Taken to Acquire a Third Party Certification

As shown in Figure 2, the vast majority of the surveyed companies, 52.38 per cent, have managed to implement a QA system and acquire third party certification in a period ranging between 1-2 years. Results also show that 38 per cent of the companies managed to acquire third party certification in less than a year. Only 9.5 per cent took more than two years. It seems therefore that the majority of the surveyed companies have managed to implement a QA system and acquire certification within the normal time period of 1-2 years. This finding was emphasised by Brown (1993). He found that the planning involved and the actual work required, together with the time needed to prove the system works, means that getting ISO 9000 will take between six months and two years, with the majority of firms taking around a year.

The importance of human aspects of QA systems has been discussed earlier in this paper. The following two sections, namely measures taken to minimise employee resistance and employee motivation, will reveal the actions taken by the companies based in the UAE to acknowledge the human side of the QA system.
Measures taken to Minimise Employee Resistance

Employee resistance is a fact of life in most organisations. This is especially true, in the authors' opinion, whenever organisations implement new systems. This is simply because 'new' means 'change' and change carries with it 'ambiguities', and some people do not know how to deal with these ambiguities. According to Huczynski & Buchanan (1991), change can bring resistance because it involves both confrontation with the unknown and loss of the familiar. People find change threatening since it means they have to change their attitudes, values, and behaviour. Furthermore, people resist change when they do not understand the reasons for the change or its nature and likely consequences.

With regard to the implementation process of QA systems, Watling (1989) stated that the process requires that long established customs be examined and perhaps abandoned. Skeletons have to be brought out of cupboards and vested interests have to be challenged. Inevitably many people will find this process disturbing and uncomfortable.

There will always exist an opposition to the implementation process, according to Dolve (1994), not by people in the company being against quality management, but by the way we always have done our jobs, and by lack of time, caused by doing things in the way we always have done it.

Our results show that 73 per cent of companies had no employee resistance to the implementation of the QA system. Only 27 per cent of the companies reported employee resistance and indicated that most of the resistance came from the middle management. It is not surprising that most of the resistance came from the middle management as it is particularly sensitive to change. According to Oakland (1989), middle management plays a critical and exceptionally important part in the
management of quality. Not only they must understand the principals of quality management, they must go on to explain them to their subordinates, and make sure that their commitment is successfully communicated.

Although 27 per cent of the companies reported some employee resistance, this percentage is considered to be very low when compared with that in Western companies. In fact, Al-Nakib & Mustapha (1995), noted that 70.8 per cent of construction companies in the UK had experienced some employee resistance when they introduced their QA Systems. This comparatively low level of employee resistance, in the authors' opinion, is probably due to cultural differences as employees in the UAE may be more obedient to instructions.

Although only 26.9 per cent of companies had employee resistance none of them ignored it. All of these companies have taken some measures to motivate their employees in to accepting the implementation of the QA systems.

The results show that the most widely-used technique of handling resistance is by involving employees in creating the change. In fact, the vast majority of the companies indicated that they have used this technique. This is supported by Duncan (1989), as he emphasised the importance of employee involvement in creating the change, and stated that the system will be resisted to some degree unless the people can be made to feel involved with the process of change.

The results also reveal that the second most popular method of controlling employee resistance is by helping them to understand the reasons for change. This seems very sensible as, according to Huczynski & Buchanan(1991), people resist change when they do not understand the reasons for the change or its nature and likely consequences.

The authors would like to emphasise that the results above are subjective as they are based on the views and opinions of Quality Assurance Managers at the surveyed companies and may be biased towards what they want it to be rather than what the reality is.

Employee Motivation

Jackson & Ashton (1993) put the subject of motivation in a rather interesting way: a quality system is like a new car without petrol: perfect in every respect, but it will not go. The quality fuel is staff attitude and motivation and any business has to address this. Employee motivation was also mentioned by Griffith (1990) when he stated that management, responsible for the organisation's direction and operation, must provide not only the basic policy and structure but provide leadership, instruction, motivation and resources to implement the quality system.

The results show that the surveyed companies, according to their QA Managers, are well aware of the importance of employee motivation. As shown in Figure 3, the vast majority of the surveyed companies have taken measures to motivate their employees into accepting the implementation of the QA system.
All of the companies indicated that they have improved communication between staff and management at all levels as a measure to motivate employees (quick delivery of information with clarity). Results also show that 26.9 per cent of the companies have increased staff responsibilities in order to motivate them. Both these measures seem very logical as improved communication, especially in the form of feedback, will, in the authors' view, reduce employee ambiguities and hence increase their motivation. Hedenstad & Meyer (1993) discussed the importance of effective communication and stated that feedback can be regarded as a form of communication where behaviour is evaluated in relation to explicit or implicit aims. This point was also emphasised by Mullins (1989), as he stated that, increasing employee responsibilities will also lead to increased employee motivation.

None of the surveyed companies used pay increases to motivate employees. In fact, according to the American psychologist Frederick Herzberg (cited in Huczynski & Buchanan 1991), 'salary' is classified as one of the so called 'hygiene factors', for these factors might remove dissatisfaction, but would not increase motivation. In other words, it is assumed that the action of the companies was right.

Training for Quality

The identification of training needs is a requirement of BS 5750/ ISO 9000, and much has been written about the importance of training. In fact, Oakland (1989) believes that training is the single most important factor in actually improving quality, once commitment to do so is present. And for training to be effective it must be planned in a systematic and objective manner.

Johnson (1990) stated that apart from establishing specialist QA staff, it is
necessary to train and educate all staff at all levels. Training falls into three general areas. Firstly, there is awareness of the concept and principles of quality assurance. Secondly, an introduction and explanation of the quality system itself and finally, nuts and bolts training in the application of the system where it specifically applies in the individuals' area of operation.

The results of our survey show that the most popular method of training, as used by 84.6 per cent of respondents, was by offering in-house lectures and seminars. The second most popular method of training, used by over 38 per cent of the companies, was by distributing printed instructions to all employees. Results also show that 30.7 per cent of the companies have sent their employees to lectures and seminars outside the company and a further 28.57 per cent have sent some of their employees overseas for training. These results may reflect the budget allocated for training for the implementation of QA systems, and the concentration on in house training shows that the surveyed companies might have aimed at the cheapest solution.

Quality Assurance Consultants

The use of QA consultants is a matter of great controversy and there is much evidence to suggest that the use of consultants may bring some disadvantages. According to Hughes & Williams (1994), QA consultants often produce a system based upon a previous model which, whilst satisfying the standard, does not match the company's particular practices and needs. Parker (1993) notes that one of the commonest complaints about QA consultants is that they try to change their clients to fit the manual, rather than the other way around. The system would be more workable if it was designed by the people using the system, rather than the adaptation of an externally generated system (Baxendale, 1994).

Results show that 52 per cent of the surveyed companies have actually employed QA consultants. In fact, 40 per cent of the companies employed QA consultants on full-time bases, and 12 per cent on temporary bases. The rest of companies did not employ any QA consultants.

The results also show that almost all QA consultants employed are of foreign nationalities, mainly Britons. The use of foreign consultants is not surprising, since the implementation of QA systems in the UAE is still a new phenomenon, as previously mentioned, and the authors think that local expertise may be very limited, but there is no evidence to support this.

Cost-effectiveness of QA Systems

The cost-effectiveness of QA systems is a matter of great dispute especially in some industries were the implementation of QA systems is relatively new. One of the major criticisms of setting up a Quality system is that the initial and
running costs are too high. According to Grover & Grover (1989), the costs of introducing and maintaining a Quality system include the costs of recruiting and employing suitable staff, the preparation of manuals and procedures and updating them, training costs, and the costs of record keeping. There may also be the costs of obtaining certification, if required by the company, and marketing costs, if the company is to make customers aware of its Quality system. However, a report by the Federation of Civil Engineering Contractors (1988) noted that 'as with all new management techniques which are of value in theory, Quality Assurance must become cost-effective in practice'.

The results show that 15.4 per cent of the surveyed companies have indicated that their QA Systems have not proven to be cost-effective yet, and 30.8 per cent are not sure whether their systems are cost-effective or not. However, the majority of the surveyed companies, 54 per cent, have indicated that their QA systems are cost-effective. This in the authors' opinion is very encouraging especially as the majority of these systems have been introduced, to companies practising in the UAE, only within the last two years.

It is worth mentioning here that Al-Nakib (1993) noted that only 17 per cent of large construction companies in the UK have found their systems to be cost-effective. The vast majority of companies did not find their systems cost-effective. In fact 44 per cent indicated that their systems are not cost-effective and 39 per cent indicated that they are still unsure. Therefore the results of the UAE survey are very promising indeed. Further research is needed to find the reason for the significant difference in the cost-effectiveness results between the Western companies and the companies in the UAE. One can only assume that since the companies in the UAE have only started to implement the QA systems very recently, they had more time to observe and learn from the mistakes of the western companies.

Once again, the authors would like to stress that above results remain subjective as they reflect views and opinions of the QA Managers in the surveyed companies.

Conclusions

The following conclusions can be drawn regarding the implementation of QA systems in UAE:

- most of the surveyed companies (randomly chosen from the large companies) have implemented QA systems within the last two years which shows that it is a new concept.
- two years is the typical period for acquiring third party certification (full implementation process) which is a normal period compared to the implementation process by Western companies.
• the major reason for implementing QA systems is to gain competitive advantage followed by reduction of cost and client's pressure.
• support was provided at all levels for the QA systems implementation process with the exception of some resistance from middle management; this is similar to the findings of the implementation process by the Western companies.
• most of the surveyed companies did take important measures to train and motivate their employees to achieve better results, this seems to be part of the QA implementation system.
• improving communication is the most important motivating factor for the smooth implementation of the process.
• most of the companies have employed an external QA consultant (mainly British) to help in the implementation process; one may therefore argue that these consultants may have tried to import the methods used in the West for the implementation of QA systems (without the necessary alteration) and consequently similar problems are exercised.
• the majority of the surveyed companies are convinced that QA systems are cost effective, but this view remains subjective and needs further research using objective measures for more reliable results.

It is important to note the above conclusions are based on QA systems implementation by large companies in UAE. One may argue that the research sample is too limited to provide reliable results; however, the nature of data collection being by in-depth interviews should overcome such an argument. Finally it may be important to note that some of the surveyed companies are multi-national companies working in UAE in partnership with local companies, therefore, results may reflect similarities with the problems associated with the implementation process of the QA systems in the West.

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QUALITY ASSURANCE SYSTEMS IN THE UAE

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Measuring the Effectiveness of Quality Assurance Systems in the Construction Industry

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Measuring the effectiveness of quality assurance systems in the construction industry

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Introduction

This paper is based on current research at the University of Glamorgan that is investigating the effectiveness of quality assurance (QA) systems in the construction industry.

Evidence shows that construction companies have implemented QA systems for various reasons. For example, Al-Nakeeb (1993) surveyed 41 large construction companies in the UK and found that the four main reasons for implementing a QA system were client pressure, to gain competitive advantage, to reduce costs and to eliminate previous quality problems. This implies that each construction company has its own requirements and expectations regarding the implementation of a QA system and therefore, the measure of effectiveness of the system is dependent on what the company defined as its purpose. In other words, if you do not define what the system is set to achieve, i.e. define its objective, you cannot measure the effectiveness or the impact of the system.

Throughout the research, “effectiveness” of the system is defined as: meeting the company's specified requirements and prescribed quality objectives. For example, if the company has implemented a QA system in order to reduce rework on site, then the effectiveness of the system is judged by how well it does this. However, it is appropriate at this point to emphasise that, since most construction companies seem to have implemented QA systems due to client pressure, it is important to measure quality in terms of meeting the client's objectives and not only industry norms.

This paper starts by giving a brief literature review and problem identification, it then discusses why it is important for quality to be measured and describes examples of how quality is being measured in other industries. The paper also discusses a matrix that was proposed by the researchers as a possible way of measuring the effectiveness of QA systems and how it was found that such a matrix still would not reveal truly objective measures.

Literature review and problem identification

General review

BS 5750 was first published in 1979, and was quickly embraced by the manufacturing industries. Within the construction industry,
the implementation of QA systems has been slower. However, the construction industry made efforts to improve its position and according to CIRIA (1996), by the early 1990s many firms in the construction industry had put in place QA systems to BS 5750 (now BS EN ISO 9000) and achieved third-party certification.

A range of publications, regarding QA systems in construction, is now available. However, most of what has been written is based on different personal views and experience and is often contradictory.

According to CIRIA (1996), a recent survey shows that, overall, firms from certain sectors believe they have made significant improvement to key areas of their business as a result of implementing a QA system to BS 5750 and gaining certification. Firms' clients have also experienced significant improvements to the products and services supplied to them by these firms. The evidence obtained from both the firms themselves and their clients suggests that, generally, BS 5750 is appropriate for these sectors of the construction industry.

This, however, contradicts a report by the Quality Liaison Group for the DoE (1995), which states that:

While some parts of the construction industry have invested a great deal in improving quality, research reveals that defects arising today are virtually unchanged from those identified 20 years ago.

Constructing the Team (Latham 1994), often referred to as The Latham Report, also highlighted the issue surrounding the uncertainty of the effectiveness of QA systems. It stated that:

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.

A total of 18 years have passed since BS 5750 first appeared, yet the effectiveness of these systems in the construction industry remains a matter of great controversy and uncertainty.

Problem Identification

In order to determine the reasons behind the confusion surrounding the effectiveness of QA systems in construction, and as a pilot study for the current research, the QA managers of eight well-known national contractors were interviewed each for two to three hours.

All companies interviewed were running a QA system to BS 5750/ISO 9000 and had held a third-party certification for more than two years.

The QA managers were asked if they had any hard evidence as to whether their QA systems have proved to be effective or otherwise. None of the interviewed managers had such evidence based on objective measures, apart from their perceptions of the system's effectiveness. Also, none of the interviewed companies had developed any measures, nor knew of any available, to assess objectively the effectiveness of their QA systems. Several implied that since they were awarded a third-party certification then their systems must be working as required. Others, misled by the wording of BS 5750/ISO 9000, were under the illusion that because the internal quality audits of their system showed positive results then their system must be effective.

According to BS 5750 Part 1 Clause 4.17: The supplier shall carry out a comprehensive system of planned and documented internal quality audits to verify whether quality activities comply with planned arrangements and determine the effectiveness of the quality system.

Also, according to BS 5750: Part 8: 1991, Clause 5.4.4:

Internal quality audits should be performed periodically to verify the implementation and effectiveness of the quality system....

The word "effectiveness" in the BS 5750 seems to mislead people into thinking that it implies the effectiveness of the system in meeting the specified requirements and the prescribed quality objectives, whereas in fact it refers to the effectiveness of the system in meeting and complying with the specified requirement of the BS standards.

According to Evans and Lindsay (1996), auditors typically ask such questions as: Does a documented policy on quality exist? Have management objectives for quality been defined? Have the policy and objectives been transmitted and explained to all levels of the organisation? Have job descriptions for people who manage or perform work affecting quality been documented? Are job descriptions of functions that affect quality available? Has management designated a person or group with the authority to prevent non-conformities in products, identify and record quality problems, and recommend solutions? What
means are used to verify the solutions? While these questions might find the deficiencies, the corrective action required, and so on, they remain audits on the planned and systematic actions and do not actually measure the quality improvement or the impact of the implementation of the QA system on the organisation.

This research, therefore, identified the problem to be the absence of much needed measurement tools to assess the effectiveness of QA systems in the construction industry and attempted to remedy this by developing a matrix to measure the effectiveness of such systems.

**The need for measurements**

In order to determine whether a QA system is being effective in achieving the specified requirements and the prescribed quality objectives, it is necessary to check that the resultant construction and the service offered meet the specified requirements and quality. This can only be achieved by introducing measures to give objective results. This is emphasised by Hoyle (1995), who stated that:

> Having established a quality system it is necessary to install measures that will inform management whether the system is being effective. Installing any system without some means of verifying whether it is doing the job it is intended to do, is a waste of time and effort.

The importance of measurement of quality was also emphasised by the vice-president of the Juran Institute, Early (1991) who stated that:

> Quality improvement without measurement is like hunting ducks at midnight without a moon – lots of squawking and shooting with only random results and with a high probability of damage.

Furthermore, Early (1991) argues that measurement seems to come more easily and naturally in the physical processes associated with manufacturing than in the apparently less objective area of services. Measurement of quality is, as a result, less advanced in service industries than is found in manufacturing companies. Unfortunately, the lack of developed practice in measuring the quality of services often becomes an impediment for successful quality improvement in services.

According to the US Office of Management and Budget (1989), one critical element of managing for continuous improvement is to know the level of quality achieved at any given time and this requires the use of some quality measures. Without these measures, it is possible to be talking about quality improvement while quality is, in fact, declining. Measures enable managers to know how close they are to their targets and how to make the right decisions for improving work processes.

In short, without developing a range of measures to determine the effectiveness of QA systems and the quality achieved, doubts will remain regarding the suitability and applicability of such systems in the construction industry.

**Examples of measurement of quality**

As mentioned previously, none of the construction companies interviewed had developed measures to assess the effectiveness of their QA systems. However, some of these companies use "quality costing" to assess their quality. Much has been written on "quality costing" therefore this paper will not dwell on this subject. While quality costing can be a good indicator of quality trends in financial terms, it remains limited to certain areas of the business and tends to be more "project-oriented" and site related and, therefore, does not give a clear indication of the effectiveness of the QA system overall.

It is appropriate to mention at this point that financial indicators such as increased profit would be seriously misleading if taken as a measure of the effectiveness of the QA system. The macro-environment, recession and inflation, for example, play a great part in financial results and it would be naïve to assume that any increase, or indeed decline, in profit margins is solely attributed to the implementation of a QA system.

The majority of the interviewed companies use customer surveys as a measure to assess their quality. These surveys are excellent indicators of client's satisfaction, and after all, many refer to clients' satisfaction as the ultimate measure of quality. However, customer surveys are not enough to reflect the full extent of the quality trend in a construction company. Many of the clients are "a one off" type and have very limited experience, also some clients might have unreasonable expectations of what the contractor's QA system can offer them. Therefore, relying solely on the clients' views, perceptions, and quality characteristics could be seriously misleading.

The need and expectations of the internal
customers must also be addressed. After all, no matter how sophisticated and well-planned a QA system is, it can only be put into effect by people.

Many organisations in different industries across Europe and the USA are using self-assessment to evaluate their systems and processes against a model for continuous improvement. According to Davis et al. (1996), the models most frequently used are the European Quality Award (EQA), British Quality Award (BQA), and the Malcolm Baldrige National Quality Award (MBNQA) models. Self-assessment as defined by the European Foundation for Quality Management, according to Davis et al. (1996), is "an internal, comprehensive, systematic and regular review of an organisation's activities against a model".

Other organisations chose not to follow a pre-designed model and instead they developed their own quality assessment models. For example, in the paper of the US Office of Management and Budget (1989), a quality measurement matrix was suggested for the Department of Education to assess the quality of its discretionary grant function. Based on the opinions and expectations of customers (internal and external), attributes of quality are gathered and ranked according to their importance to those customers. The entire work process that provides the product/service is then defined and the value-adding activities (that are likely to affect quality) are identified. Quality indicators/measures are then assigned to each of the defined attributes of quality within every value-adding activity (or vital step). Quality measures are represented on a common scale and each individual measure is then ranked by its importance. Some quality attributes may be more important than others because they represent quality attributes particularly significant to customers. Each measure is then weighted according to its rank giving the highest percentage to the most important measure. The actual data for each vital step of the process (value-adding activity), represented on a scale, is then entered in the matrix and the common-scale scores of each measure is multiplied by its weight. The sum of this multiplication represents the quality index for the area that one is measuring.

The quality matrix above is comprehensive, considers all areas of the work process and takes into account the views and expectations of both the internal and the external customers. The matrix also uses the ranking technique and gives more weight to the processes that are considered more important than others in order to arrive at a final, fair and more representative quality score. However, this score remains as an indicator of the trend of quality within the organisation and does not completely reveal the impact of the implementation of a QA system and its effectiveness.

The current research

Aim of the research

Initially, the research was set out to investigate how the effectiveness of QA systems is being measured in the construction industry. However, the main aim of the research was changed since none of the construction companies contacted had in place a model to measure the effectiveness of their systems. The aim then was to develop a hypothetical comprehensive system (in the form of a matrix), that incorporated defined quality factors, to measure the effectiveness of a QA system in construction companies. The matrix also aimed to allow the contractor to identify its QA system's strengths as well as areas where improvements could be made.

It was then realised that although such a comprehensive matrix would provide an indication of the trend of quality improvement or otherwise, it would still not give a complete picture of the effectiveness of QA systems. The matrix is discussed below as well as the reasons why such a comprehensive matrix still would not measure the effectiveness of QA systems.

Methodology

Clients perceive service in their own unique way, and the client's perceptions may differ from the contractor's perceptions (Ahmed and Roozbeh Kangari, 1995).

According to Galloway (1996):

Those whose judgement is most important, the customers, do not necessarily see quality in a way that matches the needs of those responsible for providing it, the operations management.

BS EN ISO 9004-2 (1991) recognises the importance of customer assessment as it states the following in clause 6.3.3:

Customer assessment is the ultimate measure of the quality of a service. Customer reaction may
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be immediate, or it may be delayed and retrospective. Often subjective evaluation will be the sole factor in a customer’s assessment of the service provided.

The research, therefore, aimed to balance fairly the views, opinions and expectations of, both the external customers (those who are paying the bills) and the internal customers (individuals within the contractor’s organisation).

Step 1
A number of clients’ organisations, throughout the UK, were to be approached by means of in-depth interviews. The focus would have been on “experienced” clients who have dealt with contractors before and after certification.

Clients were to be asked to comment on their quality needs and requirements as well as their expectations of contractors’ QA systems. Clients’ needs and expectations would then be translated into measurable quality characteristics or attributes and ranked according to their importance to the client.

Step 2
Main contractors’ organisations, with adequate experience in QA systems (at least two years of experience) would have been approached by means of postal questionnaires and/or in-depth interviews with individuals at different levels of management (senior management/quality representatives, middle managers, and operatives/technicians).

The individuals approached were to be asked to express their views and expectations of their QA system and to suggest ways to measure the effectiveness of the system. They would have also been asked to identify their quality needs and requirements and rank them in order of importance. Key quality activities, throughout the entire construction process, which have direct impact on quality, would have been identified. It was proposed that those individuals would also be asked to suggest measures to assess how well the vital elements of the ISO 9000 was in meeting their objectives. For example, quality auditing is a requirement of the ISO 9000 and is thought to be a vital element of the standard. Therefore, those responsible for carrying out the internal audits would have been asked to comment on how effective their audits are in finding deficiencies and how to measure this effectiveness. It is important for these measures to be comprehensive and objective where possible.

Step 3
When the quality characteristics have been identified and ranked by the contractors and their clients, and measures for each of these characteristics has been agreed on, it was proposed that each of these quality characteristics would be assigned a weight (represented as a percentage) according to its rank (importance). A common scale of 0-10 is assigned and the results of the measures of each quality characteristic is represented as a number on the common scale.

The quality measurement matrix is now ready to be formed. The first row of the matrix includes all the defined quality characteristics. The second row includes the weights, as percentage, assigned to each of the quality characteristics (based on their importance rank). The third row includes the results of the measurement of each of the quality characteristics (translated on a common scale of 0-10). The fourth and the final row of the matrix include the results of the multiplication of the previous two rows (rows 2 and 3).

The sum of the data in the last row gives a final quality index. The example below helps to explain how the quality measurement works:

Let us assume that meeting a client’s budget and the speed of responsiveness to a client’s initial inquiry are identified as two of many quality characteristics. To assess these two characteristics, two measures are used. These are, respectively,

\[
\text{amount in £} = \frac{\text{Total number of contracts awarded}}{\text{Total number of inquiries}}
\]

and

\[
\text{Number of days passing before responding} = \frac{\text{Total number of inquiries}}{\text{Total number of inquiries}}
\]

If meeting a client’s budget has a higher rank (more important) than the speed of responsiveness to a client’s initial inquiry, then the weight assigned to it would be higher.

Assume the weights are 40 per cent and 5 per cent, respectively.

The actual results of the measurements of each of the two quality characteristics are then represented on a common scale of 0-10.

Assume that the first result is £1,000 per contract and the second result is two days per inquiry. If the first result is considered to be below average and therefore assigned two on
the common scale and the second result is considered to be well above average and therefore assigned seven on the common scale, the data can be entered in the matrix as shown in Table I.

The sum of the data in the last row gives a final quality score that can be compared with other scores during a time period to give an indication of the trend of quality and it was anticipated that this quality trend would reflect the effectiveness of the QA systems.

Problems with the proposed matrix

The proposed matrix is very comprehensive and while it would give excellent indication of quality trend over a period of time, it falls short in reflecting the effectiveness of QA systems. The problem is that QA systems are so well embedded and integrated within the organisation, they are therefore impossible to evaluate in isolation from other organisational and external factors. For example, and in relation to the matrix above, if the score for "meeting the client's budget" increased in time, one cannot assume that this increase in the score is solely due to the implementation of a QA system. Other factors, for example, change in management or new members of staff, could be the reason for the increase in the score and therefore, this cannot be attributed solely to the QA system.

One might argue that the matrix may be used in a company before the implementation of a QA system and then used after the implementation of the system and the scores compared. This would also be misleading as one would have the exact problem discussed above.

One might also suggest that the matrix may be used in two different companies, one with a QA system and one without, or indeed within the same company, but compare the quality trend of a certified office against a non-certified one. The very same argument discussed above still stands. The increase or decrease of quality trends cannot be attributed solely and directly to the QA systems because of the presence of other influencing factors.

It is important to emphasise at this point that the problems above are even more magnified in the construction industry because of its nature. In construction, each product is unique, with different sites and different teams and hence many quality-influencing factors. This makes it more difficult to look at the QA system, in isolation from other factors, and to measure its effectiveness.

One can send questionnaires to staff and managers at different levels in construction companies as well as questionnaires to the clients asking them if they are satisfied with the QA system. While the results of such an approach may be beneficial in highlighting some problems, it is solely based on views and opinions of individuals and, therefore, remains subjective.

Conclusion

It is now 18 years since the publication of BS 5750, yet its effectiveness in the construction industry is still uncertain and debates on this subject are continuing. The reason for this uncertainty results from the absence of a measurement tool to assess the effectiveness of QA systems in construction. While it is possible to develop some models, in the form of a matrix or otherwise, to give some indication of the trend of quality over a period of time, such models do not measure the effectiveness of QA systems themselves.

The problem is that the QA systems are well integrated within the organisation, which is how they are intended to be, that makes it impossible to attribute any increase of quality solely to the QA system without taking into consideration other influencing factors.

<table>
<thead>
<tr>
<th>Measurable quality characteristics</th>
<th>Meeting client's budget</th>
<th>Speed of responsiveness to client's initial inquiry</th>
<th>Other quality characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weights (per cent)</td>
<td>40</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Results in relation to the common scale</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Score = weight (per cent) x results</td>
<td>0.8</td>
<td>0.35</td>
<td></td>
</tr>
</tbody>
</table>

Note:
This is only a small part of the matrix showing only two quality characteristics for demonstration purposes.
The search continues for the best possible way to measure the effectiveness of QA systems among doubts whether such measures can exist in reality.

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