QUALITY MANAGEMENT IN THE PUBLIC BUILDING CONSTRUCTION PROCESS

by

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Dedicated to

Ta Rwelamila Kalikawe, Ma Anna Otakiya, Ta Daniel Rwelamila and Ma Thereza Katonda'abela

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ABSTRACT

The poor quality of public buildings in the Botswana construction industry has been surrounded by controversy and strongly held opinions. The work reported here attempts to indicate some salient issues affecting the quality management system, with particular reference to the construction phase.

Three propositions are addressed by the work. First that quality problems related to public building processes in Botswana are primarily due to an inappropriate project organizational structure. Secondly, that the traditional building procurement system provides a poor quality management system. The third proposition is that the traditional building procurement system does not facilitate derived quality levels as defined by the contract drawings and specifications.

Five objectives of this study are identified and various issues which are fundamental to the research are reviewed. The first is the way in which the Botswana public building sector is organized, focussing on the building construction process. The second is the review of quality management theories both in the manufacturing and construction industries. The third is the relationship between the project management structure and project quality management, and the quality of building. The fourth is the proposal of a conceptual framework of an appropriate quality management system. Finally, recommendations about how to deal with organization of public building projects in order to select appropriate quality management systems are given.

Information is obtained on the research areas through the use of the following methods:

1. Consultations with quality management practitioners and review of the Quality Management literature.
2. Questionnaires to architects, quantity surveyors, engineers, construction firm executives, contracts managers, site managers, trade foremen and skilled tradespersons, on quality management problems and procurement systems.
3. Case studies investigating approaches to site quality management in general and the adequacy of quality management documents.
4. Semi structured interviews investigating public building clients views on the quality management system and project procurement systems.

The data collected are analysed using triangulation (qualitative and quantitative methodologies) methodology and the main results are reported below.

The primary conclusion to be drawn is that the quality management system purported to be in use in the Botswana public building sector differs significantly from that recommended in the theory, resulting in poor quality buildings. This is primarily due to the use of an inappropriate building procurement system. In general the traditional building procurement system in the Botswana public building sector is used as a `default system'. There are indications to suggest that it is used merely because the clients and consultants have failed to consider the issue of appropriateness. An appropriate quality management model for the construction phase is proposed with a proviso that the Botswana public building sector should establish appropriate methods of selecting appropriate procurement systems as a prerequisite in formulating appropriate quality management systems for various projects.

DECLARATION

No portion of the research referred to in this thesis has been submitted in support of an application for another degree or qualification at this or any other university or other institution of learning.

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CHAPTER TEN:
THE CONCEPTUAL MODEL OF A QUALITY MANAGEMENT SYSTEM

CHAPTER ELEVEN:
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

LIST OF ABBREVIATIONS

AACE-	American Association of Cost Engineers
AQE-	Architect, Quantity Surveyor and Engineer
ARCH-	Architect
ARCOM-	Association of Researchers in Construction Management (UK)
ASAQS-	Association of South African Quantity Surveyors
ASCE-	American Society of Civil Engineers
BCIS-	Building Cost Information Service (UK)
BHC-	Botswana Housing Corporation
BIDP-	Botswana Institute of Development Professions
BoQ-	Bills of Quantities
BRE-	Building Research Establishment (UK)
BS-	British Standards
BSI-	British Standards Institution
CFE-	Construction Firm Executive
CIB-	Conseil International Du Batiment
CIOB-	Chartered Institute of Building (UK)
CIRIA-	Construction Industry Research & Information Association (UK)
CM-	Contracts Manager
CPM-	Critical Path Method
CQC-	Contractor Quality Control
CAS-	Central African Standards (Zimbabwe)
CTB-	Central Tender Board (Botswana)
CWQC-	Company-wide Quality Control
DABS-	Department of Architecture and Building Services (Botswana)
DOE-	Department of Environment (UK)
ENG-	Engineer
FIDIC-	Federation Internationale Des Ingenieurs-Conseils
HMSO-	Her Majesty's Stationery Office (UK)
ICE-	Institution of Civil Engineers (UK)
ILO-	International Labour Organisation
IPR-	Institute for Planning Research (University of Port of Elizabeth)
ISO-	International Organization for Standardization
JCT-	Joint Contracts Tribunal
JQCH-	Juran's Quality Control Handbook
LRA-	Linear Responsibility Analysis
NEDO-	National Economic Development Office (UK)
PERT-	Programme Evaluation and Review Technique
QA-	Quality Assurance
QC-	Quality Control
QM-	Quality Management
RIBA-	Royal Institution of British Architects

RICS-	Royal Institution of Chartered Surveyors (UK)
SABS-	South African Bureau of Standards
SD-	Systems Dynamics
SERC-	Science and Engineering Research Council (UK)
SM-	Site Manager
SPC-	Statistical Process Control
SSM-	Standard System of Measurement (South Africa)
ST-	Skilled Tradesman
TF-	Trade Foreman
TQM-	Total Quality Management
TSI-	Total Systems Intervention
UK-	United Kingdom
UPE-	University of Port Elizabeth
USA-	United States of America
VSM-	Viable System Model

CHAPTER 1

GENERAL INTRODUCTION

1.1 Introduction to subject matter

The most important objectives for clients of the construction industry are the attainment of ***quality, cost and time*** (Chartered Institute of Building 1982; Draper 1984; Fin 1984; Rwelamila and Hall 1994). Although these three objectives are supposed to be construction project procument focus points, the vast majority of construction projects are procured based on only two of these parameters, namely : cost and time (Bennett and Grice 1990). Quality, the focus of this thesis, has been neglected (Hughes and Williams 1991). Quality is defined as *the measure of the fitness of the building and its parts to fulfil the purpose defined in the clients brief, value for money or client satisfaction* (Ashford 1989). The building clients requirements defined in the brief are normally contained in the contract drawings and specifications.

Hughes and Williams (1991) suggest that quality neglect is understandable since most project management control systems highlight time and cost, and leave the responsibility of quality to others. Because of this "unbalanced" approach to managing projects, project quality management has been neglected and most projects have experienced serious problems in the quality of constructed work. This has resulted in extensive delays to planned schedules, cost overruns, and a general increase in the number of claims and litigation (Herbsman and Ellis 1991). This has been referred to as a "construction quality management problem" (Rwelamila 1992).

Construction quality management is that aspect of the overall management function of the project (from inception to completion) that determines and implements the *quality policy:* defined as the overall quality intention and direction of the project, with regards to quality. It was defined by provisions of English Common Law, Napoleonic Code, De Architectura, and the Code of Hammurabi (Sandstrom 1970, Feld 1964, White 1960). Modern day concern is shown in the building regulations and several legal documents which protect the health, safety, and welfare of the public.

Clients, architects, engineers, and contractors, as members of construction teams, all have responsibilities to ensure an adequate level of quality in a construction project (American Concrete Institute 1973; American Institute of architects 1971; ASCE 1972; Feld 1968; American Institute of Architects 1970; Keim 1966; Consulting Engineers Council 1965). Dean *et al.* (1976) contend that construction contracts and judicial decisions attempt to establish the limits of responsibility and liability of the construction team members.

Increasing numbers of professionals, researchers, professional institutions, and publications associated with different construction industries throughout the world have, in recent years, expressed great concern over the often incorrect emphasis on the sub-elements of quality management (Willenbrock and Shepard 1980; Rwelamila 1992; American Society of Civil Engineers 1988; Tatum 1988; Flanagan 1988). They argue that emphasis on quality management hinges on what is called *quality control (QC)*, which refers to the operational techniques and activities that are used to fulfil project requirements for quality (Ashford 1989) and *quality assurance (QA)*, which is defined as all those planned and systematic actions necessary to provide adequate confidence that the building will satisfy given requirements for quality. This emphasis, according to Paulson (1988) and Flanagan (1988) makes quality management focus on catching mistakes after the fact rather than before or as they occur, and it contributes to the heavy load of problems facing the global construction industry. The primary source of these problems is the cost of poor quality.

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Some of the items which contribute to the cost of poor quality (Ashford 1989) include:

: Repair of defective work.

: Purchase of replacement materials and components.

: Delay or disruption while repairs are carried out or replacements obtained.

: Handling of client complaints.

: Remedial works after construction.

: wastage of marketing effort.

: Arbitration/or legal representation.

: Arbitration/or court costs and

: Compensation payments.

The cost of poor quality is causing contractors' profits to decrease, `sick buildings' are added to existing stocks due to non detection of poor quality by consultants and hence clients are faced with soaring life cycle costs (Ashford 1989; Rwelamila 1992; Vaughan and Strange 1993).

Japan, the United States of America (USA) and the Western European countries: Germany, France, the United Kingdom, Sweden, Denmark, the Netherlands, and the newly industrialising countries around the Pacific Basin, have started to confront their quality management problems. The Japanese construction industry is leading in this quality management/total quality management crusade. Japan is embracing the latest phase of quality control evolution which is characterised by the emphasis of strategic implications of quality management. The essence of this approach is to incorporate quality in the competitive strategies and wield quality as an aggressive weapon to gain and maintain satisfied clients. The fact that construction projects are notoriously difficult to manage due to the nature of the construction industry, has made the Japanese accept the fact that the definition of quality should change with the changing times.

The African construction industry's understanding and application of quality management concepts has remained largely static. It has continued to emphasize traditional/conventional QA/QC methods (traditional/conventional quality management), where the criterion of acceptability of work completed is based on what Ashford (1989) calls: *"Will it be passed by the inspector?"* Workers at various project levels have found ways of deceiving or bypassing the inspectors: building trade manager; clerk of works; project structural engineer; project architect (Rwelamila 1992). An inspector can identify a fault only after it has been commited. He or she may then order the item/element to be scrapped or rectified in some way. Whatever the decision, waste will have occured, time wasted and harm done which can not be undone. In many cases the inspector will know the cause of the fault and how it can be prevented, but he or she has no incentive to pass on this knowledge to those incharge of construction. They are on the opposing side and are unlikely to welcome his or her advice (Ashford 1989; Rwelamila 1992; Culp *et al.* 1993). Such then, are the problems of attempting to manage project quality without integrating the interpersonal and technical aspects. The Botswana construction industry is a typical example, where traditional quality management methods partially satisfy the requirements for an effective quality management system (Rwelamila 1992). Could this partial effectiveness of traditional methods not have been due to the lack of evidence concerning the factors influencing quality management ? Had an understanding of the factors influencing quality under traditional/conventional procurement system been achieved, it would have been possible to devise an appropriate project quality management system/project quality organisation structure. A system/structure which will prevent problems by creating the attitudes and environment that make prevention possible.

1.1.1 The project organisational form

The dominant project organization system/or project procurement system in the Botswana public building sector is the conventional/traditional building procurement system indicated in Figure 1.1 and discussed in detail in chapter 5.

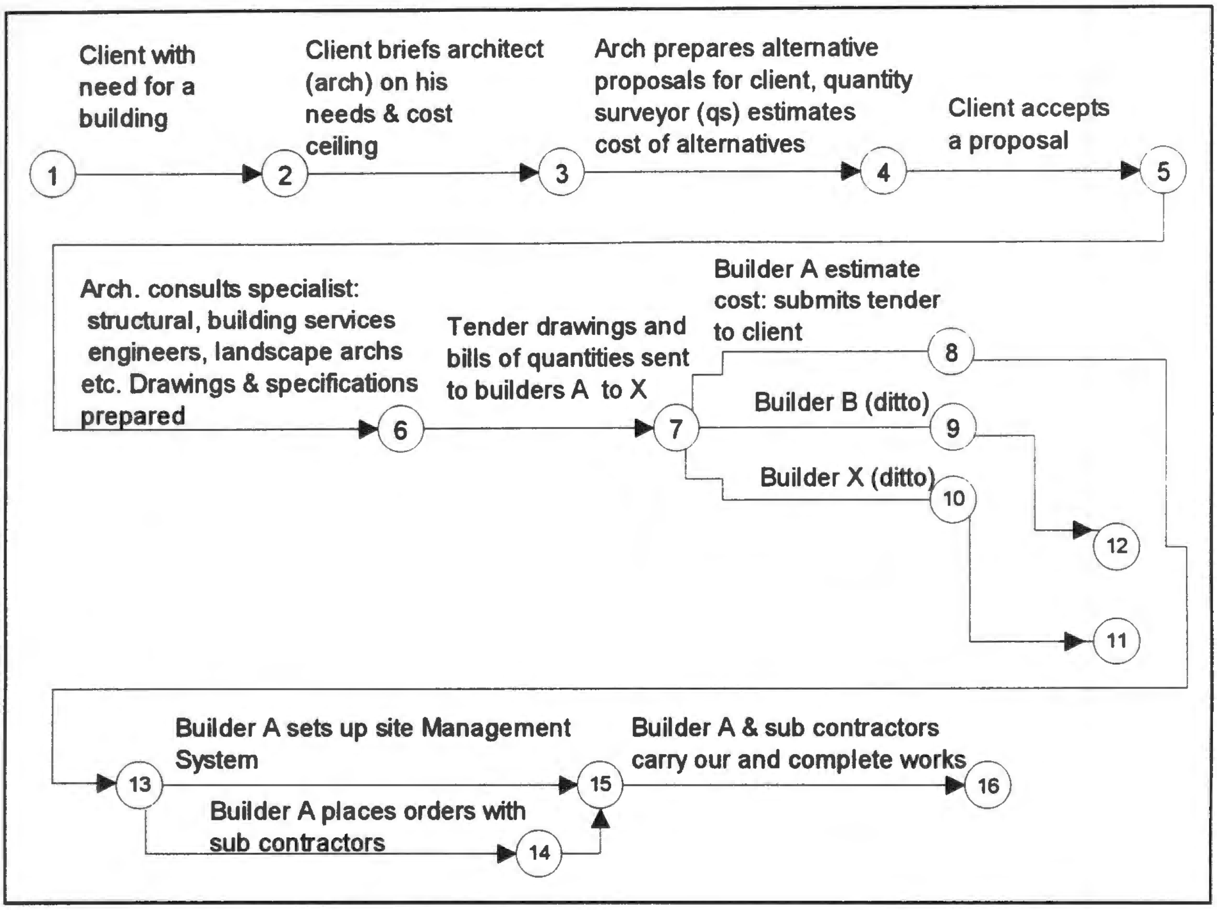


Figure 1.1 : The traditional procurement system (Franks 1984)

Briefly, the project organization structure of this system is characterised by the appointment of a principal adviser, an architect, who leads the design team (*the team may include structural, building services engineers, landscape architect etc.*) which is assembled at his or her recommendation. The building project is designed and detailed up to a point where the various elements of the design can be taken-off and worked up into a bill of quantities or a schedule of rates. At this stage the building contractor is invited to bid for the construction work and, if successful, is expected to start on site within a few days (quite often) with very little knowledge or understanding of the building he or she is to construct and probably having made no acquintance with the client for whom the building is to be produced. This project organisation structure as indicated in Figure 2, is normally formulated parallel with a standard project contract between the client and the building contractor. The contract defines what is to be built, the roles of the various parties concerned and the terms of the bargain between them. In so doing, it provides the framework of a quality system. It specifies the client requirements, it stipulates the measures to be taken to assure compliance and it states the remedies available to each party in the event of default.

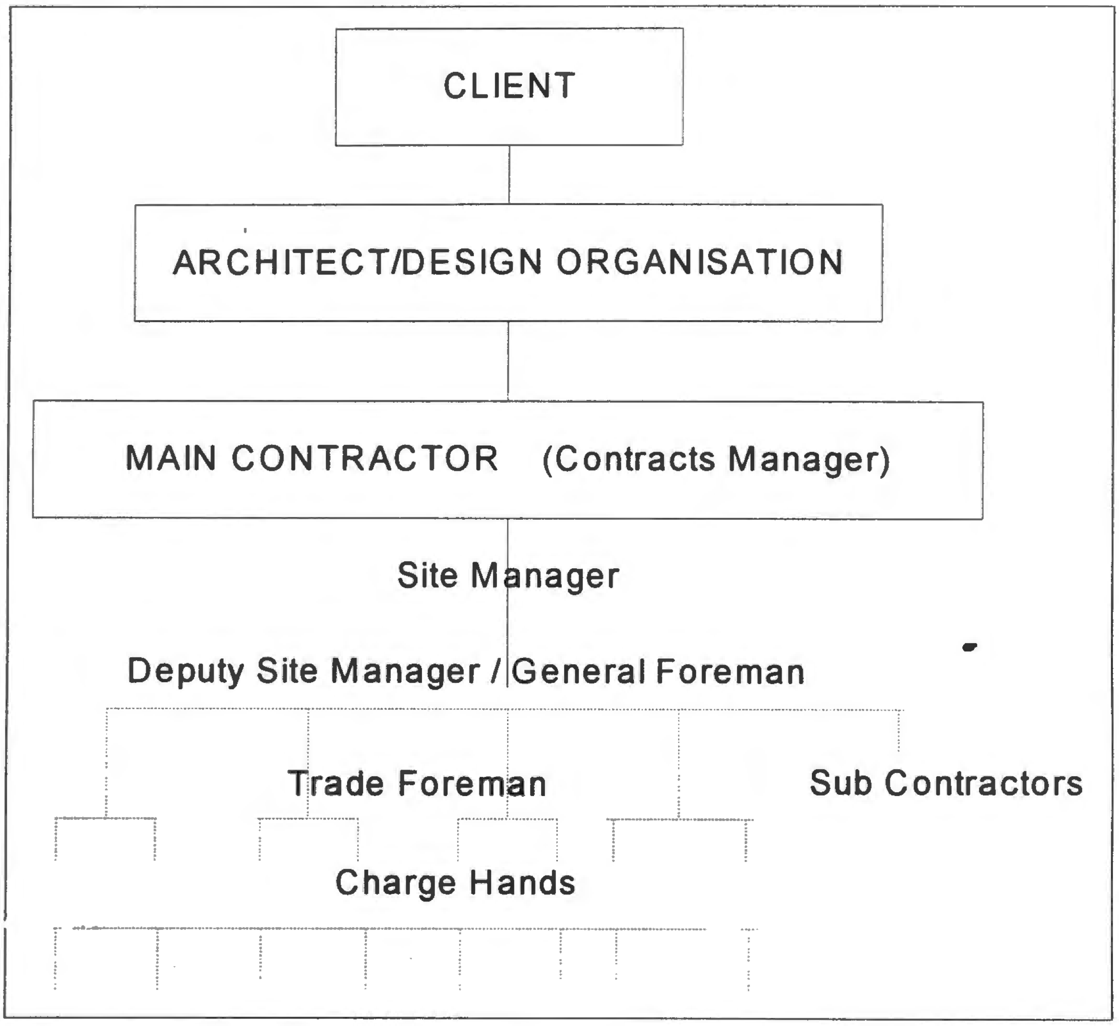


Figure 1.2 : Project organisation structure (*under the traditional procurement system*)

The Botswana public building sector has a tendency to use this project organisation structure, and hence the framework of a project quality system, in most building projects, despite the basically transient and unique nature of various buildings. This is contrary to an increasingly strong suggestion that organizational structures should be tailored to meet particular projects needs (Barrie and Paulson 1978; Burgess 1979; Walker 1984; Bennett 1985; Hughes 1990; Rwelamila and Hall 1994). As will be demonstrated by the results of the pilot study in chapter 3, this underlines the nature of quality problems in the Botswana public building sector.

As will be demonstrated in chapter 2, the whole outlook on quality has changed, it would be erroneous to manage quality on traditional concepts, concepts which do not take into considerations actual tasks peculiar to various building projects when designing their management structures. The apparent chaos facing the Botswana public sector building (Rwelamila 1992), where projects go wrong because the actual tasks peculiar to various projects are not identified, which has resulted in the new management environment (the Botswana construction industry is characterised by factors such as a fluctuating investment function, regulatory bodies and government policy changes) need to be evaluated in order to develop an appropriate quality management system.

1.2 A statement of the problem

The history and evolution of quality management described in detail in chapter 2, reveals that quality management systems (*inspection - statistical quality control- quality assurance- strategic quality management*), have changed with the changing times. As will be substantiated by the pilot study preliminary findings in chapter 2, there are indications to suggest that the Botswana public sector of the construction industry is lagging behind other countries in terms of quality management. The commonly occuring failures in the Botswana public building sector originating from *construction and use aspects* include (among others): *rippling of thin flooring; corrosion of steel reinforcement and other ferrous metal fixings; leakage of roofs; cracking of walls; dampness at walls, floors and ceilings; detachment and degradation of sealant in movement or expansion joints; buckling and dislodgement of brick slips on claddings.* While various researchers and practioners in Western Europe, USA, Australia and Pacific Rim countries are increasingly stressing the need for organizational structures to be tailored to meet particular needs (Barrie and Paulson 1978; Burgess 1979; Walker 1984;

Hughes 1989; Hughes 1990; Low and Goh 1994), in practice the Botswana construction industry, and specifically the public sector building procurement agency has fallen into what Hughes (1990) calls "the trap" of favouring the *traditional/conventional procurement system based on a traditional/conventional building project organizational structure,* hence the *traditional/conventional building quality management system* as indicated in section 1.1.1 above and detailed in chapter 5 (section 5.3) for almost all projects, despite the basically transient and unique nature of various projects. While the nature of the Botswana construction industry is changing, the traditional/conventional quality management system is still expected to work, but the system does not help managers of quality to cope with changes affecting the construction industry. The traditional/conventional procurement system which is modelled on the RIBA Plan of Work will be discussed in chapter 5 (5.3). Various commentators readily acknowledge the limitations of plans of work, particularly the RIBA Plan of Work. One of the main criticisms levelled at them is that they are inflexible and only suited to a limited range of jobs (Hughes 1989; Hughes 1990; Rwelamila and Hall 1994).

Research performed by the Building Research Establishment (BRE) in the United Kingdom (BRE 1982) on building failures in traditional housing, where the traditional procurement system similar to the system used in Botswana, has demonstrated that the incidence of failure was attributable in 50% of cases to design faults, 40% to faults in construction on site, and only 10% to materials/ components faults. These results appear to be slightly in conflict with the preliminary survey and pilot survey results described in detail in chapter 3, on the causes of quality problems in public sector building in Gaborone, Botswana. When ranked on the basis of the BRE study (BRE 1982), the incidence of failure was attributable in most cases to faults in construction on site. From both surveys it was evident that the traditional/conventional project organization system dominant in the Botswana public sector building defines what is to be built, roles of the various parties concerned, and the terms of the contract between them. It provides the framework of a quality management system (a traditional/conventional quality management system), a system which has characteristics that fit between a closed and open organisation structure, but with more dominant features of a closed/stable/mechanistic organisation structure. The management system was found to be characterized by an inappropriate project organizational structure. This has resulted in breakdowns in the directing task throughout the whole construction process, poor project documentation relative to standards, and inadequate time of project management was found to be spent on supervision of work on site.

Hence, the problem area to be researched may be stated as:

Public buildings in Botswana are of poor quality in that they do not adhere to the client requirements contained in the contract drawings and specifications.

1.3 Hypotheses

The pilot study discussed in chapter 3, established the hypotheses which the research intends to test:

Hypothesis 1 (HYP1):

"Quality problems related to public building construction processes are primarily due to an inappropriate project organizational structure."

Hypothesis 2 (HYP2):

"The traditional building procurement system provides a poor quality management system."

Hypothesis 3 (HYP3):

"The traditional building procurement system is incapable of facilitating derived quality levels as defined by contract drawings and specifications."

1.4 Objectives of the research

The following objectives must be achieved in order to accomplish the overall research objective:

(a) To analyse the way in which the Botswana public sector of the contruction industry organizes itself to produce buildings, focussing on the building construction process.

(b) To examine existing project management systems within both the manufacturing and construction industries, and identify strengths and weaknesses from both industries.

(c) To seek relationships between the project management structure, and project quality management, and the quality of a building.

(d) To propose a conceptual model of a quality management system based on an appropriate project organizational structure, which will ensure that client requirements are satisfied by the parties to the contract, resulting in the achievement of quality.

(e) To make recommendations (if any) about how to deal with organization of public building projects in order to select appropriate quality management systems.

1.5 Research methodology

To systematise the collection and compilation of relevant basic data for this research, the approach set out in Table 1.1 below is adopted.

Table 1.1 Methodology

Phase	Method	Aim
Literature Review	Books and Journals reviewed. Experts and professionals interviewed.	To establish the evolution of quality management systems and current practices.
Phase 1	Methods devised for analysing factors affecting project quality management in public buildings. Questionnaires and interview guidelines for: (a) pilot study (b) main survey.	To collect data to: (a) establish factors affecting quality management; (b) test established hypotheses for this research and provide insight on how to manage data.
Phase 2	Construction site visits using data collection techniques earlier developed. Visits to relevant government departments, contractors, and consultants offices involved in the survey.	To collect data.
Phase 3	Analysis of data collected and the formulation of a conceptual framework for a quality management system.	To analyse data collected and propose a conceptual framework.
Phase 4	Review Phase 1-3 towards streamlining earlier findings.	To validate the conceptual framework and make recommendations.

1.6 Organisation of the thesis

Table 1.1 illustrates the various steps taken in this research to achieve the stated objective. These steps are classified into four main phases which are presented as eleven core chapters which are now briefly described.

Chapter 2 - Quality management, once the exclusive province of manufacturing and operations departments, now embraces functions as diverse as construction and engineering, and commands the attention of different professionals and clients. The discipline is still evolving. This chapter reviews the world history of quality management, tracing its evolution from inspection to statistical quality control, quality assurance, and to present day quality management/total quality management (TQM).

Chapter 3 - This chapter provides a basic explanation of quality management concept. Based on the pilot study results, the factors affecting quality management are presented in this chapter, and their implications are discussed.

Chapter 4 - The pilot study in chapter 3 presented the indicator factors affecting quality management, where the project organizational structure was identified as the principal factor which has led into other factors. This chapter provides an analysis of general organization theory, as a basis for an examination of the building process with an emphasis on project management, and specifically to aid in a search for management actions or approaches that will lead to producing quality work.

Chapter 5 - As demonstrated in chapter 2, quality management systems in the construction industry could not be effectively studied without looking at quality management developments in the manufacturing industry. This chapter provides a disection of quality management theories both in construction and manufacturing industries. Traditional approaches to quality management in these two industries are highlighted, and current approaches based on organizational theories reviewed in Chapter 4 are briefly discussed.

Chapter 6 - Based on quality management theories reviewed in Chapter 5 and the pilot study results in Chapter 3, this chapter describes the development of the methods adopted to collect data and how they are used to test the hypotheses.

Chapter 7 - This chapter documents the methodology employed in, and results emanating from, a Gaborone survey into the current practice of quality management in Botswana. This survey is specifically focussing on public building projects with emphasis on construction processes under the traditional building procurement system. The major parties involved in public building projects; clients, contractors, architects, and engineers are surveyed.

Chapter 8 - An empirical study of quality management in practice is presented in this chapter. The results of interview surveys and case studies are presented. These findings, together with those derived from the questionnaire survey in chapter 7, form the basis of synthesizing the findings and arguments presented in chapter 9.

Chapter 9 - Based on the findings of questionnaires in Chapter 7, interview surveys and case studies presented in chapter 8, a synthesis of these findings and arguments is presented in this chapter. Views of different parties involved in public projects quality management on project supervision and communication are compared.

Chapter 10 - Based on literature reviews, and survey findings in the preceding chapters, a conceptual framework for a quality management system is proposed in this chapter. Finally the proposed conceptual framework is assessed in terms of its ability to address the problems affecting the quality management system in practice in the Botswana public building sector.

Chapter 11 - Finally, this chapter concludes the results obtained in the research, together with recommendations for practice and areas of future research are suggested.

CHAPTER 2
HISTORY AND EVOLUTION OF QUALITY MANAGEMENT

2.1 Introduction

From the preceding chapter, it is clear that quality management has been with us for millennia. However, only recently has it emerged as a formal project management function. The discipline is still evolving. In its original form, as is discussed in this chapter, it was reactive and inspection oriented; quality management-related activities have broadened and are seen in the literature as essential for strategic success. In Botswana, as is discussed in chapter 3, quality management is still reactive and inspection oriented. Building faults, as discussed in chapter 1, are frequently identified only after they have been committed. In many cases inspectors have been aware of the causes of the faults and how they can be prevented, but the quality management system has provided no incentive for them to pass on this knowledge to those in charge of production. The perception created by the quality management structure has been that inspectors, and those in charge of production, are on the opposing side and are unlikely to welcome their advice. Such then, as will be demonstrated by the results of the pilot study in chapter 3, are the problems of attempting to manage quality through inspection alone, an approach which is no longer adequate to deal with the changes facing the Botswana construction industry. The success of Japan, the newly industrialising countries around the Pacific Basin, USA and most countries in Europe in constructing buildings of superior quality is an indication that there has to be an appropriate way of managing quality.

The aim of this chapter is to provide a deeper understanding of the importance of ***quality management*** by drawing on evidence from the global domain. The chapter traces the history of the documented quality management movement from its roots to the present situation. It provides background and context, while also introducing a number of basic techniques.

Research in quality management in construction, has broadened. There is now a range of empirical work being undertaken by academics from different inclinations. The subject is no longer the traditional preserve of those researchers and authors from an operations management background of the manufacturing industry. However, while different research projects show a broadening, this has not necessarily resulted in truly holistic theoretical and research approaches in the construction industry. Quite the reverse. The majority of research work on quality management in the construction industry strongly suggests arguments without a firm base, arguments which are lifting principles from other industries (especially the manufacturing industry), without due consideration to their origins which is disappointing, given that quality management experiences of other industries (especially the manufacturing industry) provide construction with a pool of proven strategies for improvement.

Although there are significant differences between construction and manufacturing, research developments in the two industries have many parallels. Early research developments in the construction industry are not well documented (Rounds 1985). General trends in quality management research are much more documented for the manufacturing industry than for the construction industry (Rounds 1985, Hester 1979 and Isaak 1982).

The research of Garvin (1988), asserts that most modern approaches to quality have emerged gradually, arriving through steady evolution rather than dramatic breakthroughs. They are the product of a series of discoveries going back over a century. These discoveries can be organized into four distinct stages: *inspection, statistical quality control, quality assurance, and quality management.*

This chapter will summarize the above four global "quality management eras" as a foundation towards a truly holistic theoretical and research approach in the succeeding chapters.

2.2 The inspection stage

In the introduction of this chapter, it was 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 history and evolution of quality management during this early stage is written in the vernacular of the factory. But there are general developments in quality in the construction industry which represents a world trend during the inspection stage. According to Ashford (1989), buildings during that stage, beyond the stone age where the customer specifications were simple, had great beauty. The Aztecs and Greeks built temples, the Egyptians built pyramids. These were designed to comply with the assumed requirements of the gods to whom they were dedicated. Inspection was focused on functional limitations, but these limitations were outweighed by their aesthetic quality and they established a classical tradition of architecture which was to last for centuries.

This architecture fell to the Romans to introduce the more mundane concepts of utility and client satisfaction. The principle of the arch was developed to overcome the limits to column spacing imposed by the practical dimensions of a horizontal architrave, thus achieving new standards of internal space and access. The arch, and the vault which was developed from it, are engineering concepts, applicable not only to basilicas, bath-houses and theatres, but also to bridges, aqueducts and military fortifications. The buildings of an arch or vault required stones cut precisely to shape and size. This was the craft of the stonemason. The designers and quality inspectors of buildings were initially drawn from the ranks of the master-masons. They carried their design and quality inspection knowledge in their heads, and it grew as they moved from one construction site to another. They were an intellectual elite, and the skills of their hands and brains were secrets to be closely guarded from outsiders. The development of the Roman arch to the Gothic arch, the flying buttress, the fan vault, and all the other architectural delights of the European (including former colonies in Africa and Asia) ecclesiastical tradition were among the design and quality inspection of the master-masons.

But who were the customers whose satisfaction would provide a measure of quality? The market of the master-mason was patron. Many patrons during that stage were royal, others were ecclesiastical, political or commercial. They required palaces, cathedrals, town halls and mansions. The purpose of these buildings was not just to provide living accommodation or meeting places, but also to symbolize the power, spirituality or wealth of the patron. Their quality through design and inspection had to be judged not in terms of durability, serviceability or economy, but on their ability to impress and inspire.

Until 1970, inspection and testing were the only quality management activities in most French companies. French government officials developed the principle of interchangeability. According to Cave (1970), the first mechanical engineering rules were published, based on:

(1) Limiting the dimensions on the specifications to a set of standard sizes.

(2) Determining the tolerances assigned to these sizes.

(3) Using a conformance control system, implementing gauges, and adequate instruments.

In 1794, a workshop for manufacturing all gauges and inspection tools used in the national ammunition factories was created. Later on, standardization was extended to all mechanized industries. The 1804 Civil Code (Code Napoleon) has, for nearly two centuries, had a dominant influence on construction. Originally it was aimed at protecting small building clients, by making builders, and others like architects having contractual relations with the client, liable for major defects - mainly relating to structure and the weathershield - for ten years, and two years for lesser defects (Atkinson 1987). In 1967 a major change was effected in details in the Civil Code. Recognition was given to the fact that others might have responsibilities for building quality as well as architects and contractors.

In Germany, the eleventh century saw a growth of population. Hence the emergence of large settlements (the towns). Since the towns required extensive division of labour, the need arose for the services of artisans to provide the inhabitants with bread, meat, cloth, shoes, etc. (Juran and Gryana 1988). These artisans took steps to ensure their livelihood by incorporating into guilds, one for each product type. Evaluation of quality under the guilds included most of the concepts of modern quality assurance. The craftsmen themselves had to test the work of their journeymen as well as their own work. The chosen guild elders acted much like quality auditors. They conducted:

(a) Unannounced product audits in the marketplace or in the workshops, with signing of approved work.

(b) Workshop audits to ensure that input materials were of proper quality and that specified procedures were followed.

(c) Metrology calibration, originally a part of the workshop audit but later taken over by the community to ensure independence and also to collect the associated revenue.

In the eighteenth and nineteenth centuries, quality control as we know it today did not yet exist in the U.S.A. (Garvin 1988). According to Chandler (1977), most manufacturing was performed by artisans and skilled craftsmen or by journeymen and apprentices who were supervised by masters at the trade. Natural outgrowth of reliance on skilled tradesmen for all aspects of design, manufacturing, and service were accepted reasons for a well-performing product (Juran 1970). Garvin (1988) has shown that with the rise of mass production and the need for interchangeable parts, formal inspection became necessary. Like in France most initial efforts were connected with the military's demand for armaments. In the early 1800s a rational jig, fixture, and gauging system was developed. Jigs and fixtures are devices that position tools or hold parts while they are being worked on, keeping them fixed to the equipment so that machining operations can be performed accurately and precisely. Inspection received a new respect by 1819 when an elaborate gauging system was developed. Activities that were previously conducted by eye were replaced by a more objective, verifiable process. In the early 1900s, according to Garvin, Frederick W. Taylor, the father of "scientific management," gave the activity added legitimacy by singling it out as an assigned task for one of the eight functional foremen required for effective shop management. Bicking (1958) argues that for several years quality management was limited to inspection and to such narrow activities as counting, grading, and repair.

In the 1940s W. Edward Deming started his quality endeavour. According to Flood (1993), his early interests focused on statistical sampling techniques. For him, variability in manufacturing output was the main source for concern in the drive to achieve quality production. He argued for eradication of causes of variability. This was possible because the causes of variability could be located.

In Japan before 1945, quality management efforts were limited primarily to inspection. Japanese manufacturers were known primarily for inferior products. According to Ishikawa (1985) those days are known as "the age of `cheap and poor' products." One interesting aspect is that statistical quality control techniques were known but seldom applied. Kobayashi (1986) argues that for the most part, statistical quality control remained a technical oddity in the 1930s and 1940s, of interest only to a small circle of experts. About 1910 the standardization movement began, and Japanese Engineering Standards were first established in 1921 (Garvin). A number of British and American quality standards were studied by Japanese scholars; a few were translated for wider use during World War II. According to Ishikawa those efforts had only a slight impact. Japanese products remained poor, and most design, production, and quality management procedures were haphazard and uncoordinated.

2.3 Statistical quality control stage

Looking at the global construction sector, during the early period of this stage, the predominant construction material for buildings was stone. Masonry structures can resist only compressive forces, and even the most elaborate require little more than an understanding of the triangle of forces for their analysis. However, the introduction of wrought iron, and later after 1860 of steel, created new problems. These materials can resist tension, indeed this is their purpose. The analysis of structures incorporating members both in compression and tension cannot satisfactorily be undertaken by empirical methods, hence the need to collect and classify facts towards managing quality.

In the U.S. construction industry according to Willenbrock and Shephard (1980), a new "statistically based quality assurance/quality control" approach received its first major thrust as a result of a Bureau of Public Roads sponsored research project that began in 1967. By 1976 systems based on this approach had been developed and at least partially adopted in 33 states. These systems generally attempted to integrate the role of project specifications with the responsibilities of: process control; final acceptance of phases of construction; and quality assurance. According to Dean *et al.* (1976), the U.S. Navy implemented a Contractor Quality Control (CQC) programme in 1970 in which contractors took a more active role in the control of quality. Some of the benefits expected of this programme, as outlined in the Navy's CQC Manual, are better use of personnel, more control by the contractor of his or her own operations, and fewer claims. Economic savings due to reduced amount of delays and to increased probability of findings and correcting mistakes quickly were also cited (NAVFAC 1974). Following CQC programme implementation, research was carried out for the purpose of determining the feasibility of employing a programme similar to Navy CQC in civilian construction. It was concluded according to Dean *et al.* (1976), that the use of CQC on non government construction projects could be justified by those projects in which cooperation among the members of the construction team can be expected.

In the 1950s a wide spread of modern statistical methods began in Germany. Research was conducted in the textile industry on new types of control charts using original data despite the possible absence of a normal population distribution (Juran and Gryna 1988). A book on statistical methods in textile research was published in 1952. The book described comprehensively all statistical methods for production, investigation, and research work. A small group of engineers and scientists founded a subcommittee on statistics in technology (Technische Statistik, TESTA). In 1956 TESTA became (Committee for Statistical Quality) internationally better known under its present name (Germany Society for Quality).

According to Garvin's study, the year 1931 marked a watershed for the quality management movement in the U.S.A. The result of research conducted at Bell Telephone Laboratories were published. W.A. Shewhart's Economic Control of Quality of Manufactured Product book gave statistical quality control discipline a scientific footing for the first time (Shewhart 1931). Garvin asserts that much of modern-day quality control can be traced to that single volume. Quality control was established as a recognized discipline by the late 1940s. Its impact was confined largely to the factory floor and its methods were primarily statistical.

In Japan it was after World War II when real changes began in the use of statistical methods, stimulated in large part by U.S.A. advisers. In 1946 the Japanese Union of Scientists and Engineers (JUSE) was established. According to Juran and Gryana (1988), it was established ***"to contribute to human prosperity through industrial development, achieved by creating, applying, and promoting advanced science and technology."*** W. E. Deming accepted the invitation of JUSE to visit Japan in 1950. He lectured at JUSE's 8-day Quality Control courses and seminars for top management held in several large cities in Japan. He helped the Japanese participants to understand the importance of statistical quality control in manufacturing industries (Deming 1982).

Deming's interest on eradicating causes of variability in manufacturing featured in his lectures. He recognised `special' and `common' causes in variability. He argued that special causes are assignable to individual machines or operators, and common causes are those shared by operations and are management's responsibility. Statistical Process Control (SPC) charts were the main techniques put forward to perform the separation and aid diagnosis.

Other U.S.A. quality experts (Juran and Feigenbaum) were invited to conduct seminars. Deming, Juran and Feigenbaum impact, asserts Abbot and Leaman (1982), was both profound and long lasting.

2.4 Quality assurance stage

Taking a cross-section of the world construction sector during the quality assurance (QA) stage, quality assurance activities were focusing on administrative and surveillance functions. Surveillance functions were encompassing the monitoring of the contractor's materials, methods, personnel, and any inspection and testing activities. Administrative action included active coordination between contractors and designers, and documentation of all aspects of the construction process. According to Hester (1979), the typical surveillance functions on paper [*very few projects were adhering to all the surveillance functions (Rwelamila 1988)*], included: (a) Monitoring laboratory and field testing of construction materials and completed work; (b) Reviewing contractor compliance with specification requirements for construction methods and personnel; (c) Monitoring or performing pre-operational tests, or both; and (d) Preparing and maintaining a Quality Assurance Manual. QA has been criticized for producing unreasonable, unrealistic, and poorly worded specifications (Abdun-Nur 1970).

In 1974 an economic crisis severely affected the whole spectrum of processing industries in France. Engineering, steel, textiles, and plastics suffered from competition from Far East (Juran and Gryana 1988). The loss of orders in many companies was the warning that motivated chief executives to take interest in quality assurance. French industrialists and staff managers toured Japan in 1978 in order to study the basis of Japanese productivity. Gogue in Juran and Gryana (1988) argues that wide spread existence of quality circles impressed them, and on their return they initiated a French quality circle movement. Quality circles were introduced late 1979, and were rapidly adopted by many big organisations as well as small and middle-sized companies. AFCERQ Services was founded in 1981 in order to help French companies to develop quality circles. Every year since 1980 the public utility association devoted to quality management (AFCIQ) has awarded a national prize to companies for their good quality management.

In Germany quality assurance concepts were promoted by individuals. These were idealists-who elaborated or adapted methods learned mainly through the activities of the Germany Society for Quality (Juran and Gryana 1988). They became the experts who introduced the methods to industry. The initiatives and activities of these experts influenced some industry branches, eg., electronics, textiles, steel, aeronautics, and automotive, which achieved notably high quality products. Unlike U.S.A., Germany industry made only limited use of the practice of sharply separating production planning from actual production. According to JQCH this was mainly due to high availability of skilled workers. In addition JQCH asserts, procedures developed in other countries were used only after they had been adapted to the Germany cultural pattern.

The study by Garvin found that until the 1950s, most U.S.A. efforts to improve quality were based on the unstated assumption that defects were costly. How costly was a matter of conjecture, for few companies had gone to the trouble of tallying up the expenses they incurred because products were not built right the first time. Managers accustomed to making decisions on the basis of hard numbers had little to go on. For them, Garvin (1988) asserts, a critical question remained: "How much quality was enough?" Garvin states that the question was tackled by Joseph Juran's book (Quality Control Handbook - first edition) in 1951. He observed that the costs of achieving a given level of quality could be divided into avoidable and unavoidable costs. Unavoidable costs were those associated with prevention-inspection, sampling, sorting, and other quality control initiatives. The former were the costs of defects and product failures scrapped materials, labour hours required for rework and repair, complaint processing, and financial losses resulting from unhappy customers. Juran regarded failure costs as "gold in the mine" because they could be reduced sharply by investing in quality improvements. Feigenbaum (1956) advanced this principle by proposing "total quality." He argued that high-quality products were not likely to be produced if the manufacturing department was forced to work in isolation. The quality assurance sub-stage which focused on management expectations and the human relations side of the equation (popularly known as zero defects), argues Garvin was the last major movement in the quality assurance stage. Design, engineering, planning, and service activities were now relevant as statistics and manufacturing control. In spite of these changes, argues Garvin, approaches to quality remained largely defensive throughout this period. Prevention of defects was still the main objective of the quality department. Although the application of statistical methods to manufacturing and inspection processes yielded remarkable results, many Japanese managers and engineers started to feel that they were reaching a dead end and that a breakthrough was needed (JQCH). After 1957 JUSE's efforts to address this situation were directed to educating foremen and shop-floor employees in the basics of quality control. Hence quality circles were created. A quality circle consisted of a group of workers and a supervisor who voluntarily met to solve job-oriented quality problems. These activities were intended to be tightly linked with company-wide quality control (CWQC) activities. Today CWQC includes four principal elements: the involvement of functions other than manufacturing in quality activities; the participation of employees at all levels; the goal of continuous improvement; and careful attention to customer's definitions of quality. CWQC incorporates elements of each preceding stage. By all accounts, argues Garvin it has been remarkable successful. Japan's quality management record is the envy of all professionals and clients around the world.

2.5 Quality management stage

The beginning of this stage cannot be dated precisely, for no literature marks the transition. But one fact is clear that across a spectrum of different industries; clients, professionals, and chief executives were concerned about quality (British Institute of Management 1990, Shilstone 1983, Burati *et al.* 1992, Ledbetter 1983, Diekmann and Nelson 1985, Flanagan 1988, Paulson 1988). These concerns are a reflection of the need to look at quality management in the context within which projects are managed. Managers are operating under turbulent conditions (Coulson-Thomas 1992). Markets have become more open, competitive, and international, clients are more demanding. To survive, managers need models which enable them to make sense of the apparent chaos outlined above - models which simplify the situation but retain a high degree of reality. Such a model is contained within what is currently known as Strategic Quality Management or Total Quality Management (TQM), which will be referred to as ***Quality Management*** in this Dissertation.

The research of Chevalier (1991) of 12 major companies in very different sectors in France (i.e. automobile, iron and steel, mechanical engineering, food industry, etc.) that are known for their dynamic quality circle policies found that quality circles were `running out of steam.' Hence a desire to shift from quality circles (now considered as `narrow logic') to a new way of organising work both within existing management systems and by using new more global means of integrating strategic thought. According to Chevalier the development of this new complementary approach highlights the vitality of thought and action in this field. It is fair to advance Chevalier's thesis beyond company boundaries: embracing ***Quality Management*** is, in fact, a way of distinguishing between the personnel's expectations, consequently diversifying the means of progress, and lastly, integrating the overall system of strategic orientation within the project organisation. In the U.S.A. argues Garvin (1988), a variety of external forces each linking losses of profitability and market share to poor quality, paved the way to embracing Quality Management. Among the most important influences were increased foreign competition, a sharp jump in the number of product liability suits, and pressures from the government on several fronts.The rudest awakening came from the dramatic inroads made by Japanese manufacturers because of their superior quality and reliability over certain U.S.A. products (Abernathy *et al.* 1981, Abernathy *et al.* 1983, Magaziner and Reich 1982). An instructive example is provided by the semiconductor industry (Finan and LaMond 1985). Tests were carried out on 300,000 16K RAM chips from three American and three Japanese manufacturers, wide disparities in quality were discovered. According to Finan and LaMond, at incoming inspection, the Japanese chips had failure rate of zero; the comparable rate for the three U.S.A. manufacturers was between 0.11 and 0.19 percent; after the same period, the American chips had a failure rate between 0.059 and 0.267 percent. Okimoto et al.(1984) are of the opinion that the differences in quality fitted well with the rapid ascendancy of Japanese chip manufacturers, who in a few years had gone from a standing start to large market shares. The extent of these differences shocked the industry. Managers in industries as diverse as machine tools, radial tires, and colour televisions, saw their positions erode in the face of Japanese competition. Calfee and Ford (1985) sees the U.S. Federal Trade Commission's product defect programme as a response to Japanese competition. The manufacturers are held responsible for failures incurred shortly after expiry of warranties. In a similar vein, several states have enacted "lemonlaws" (statutes) to automobiles with recurrent defects (New York Times 1983). Faced with such humiliating measures, argues Garvin (1988), a growing number of companies and professionals came to the conclusion: "Quality was a powerful competitive weapon." On both the market and cost sides, it offered great leverage. Hence managers went a step further. They called for a rethinking of traditional approaches to quality. A need for a clear shift away from a narrow policing role toward one that emphasizes more of a general management perspective. Many companies according to Garvin, mistakenly think they have adopted the new approach (quality management) when their programmes merely include elements of quality assurance and quality control. For the most part, these companies are still thinking defensively about quality they have yet to see its competitive potential.

While the U.S.A. quality management crusade is far less successful, the Japanese are making an enormous stride. Garvin (1988) argues that they have gone from laggards to leaders and have done so by following a systematic and orderly progression. Quality management is now widely diffused throughout Japan, while in the U.S.A. only a handful of leading companies are following the same path. The Japanese approach thus qualifies as an organized movement where managers embrace models which enable them to make sense of different forces.

2.6 Managing quality `the new paradigm'

Today's emphasis on professionals dealing with quality management functions, is that they should be managers, not inspectors; planners, not controllers; sensitive to clients as well as to production. They should bear little resemblance to their turn-of-the-century predecessors. This view was expounded by Garvin's study (Garvin 1988), that competitive pressures have broadened quality management professionals perspective and forced them to link quality with other business needs. The result, he argues, is a discipline that now attracts the interest of managers at all levels. He further argues that:

> ***`The discipline's center of gravity, in fact, has been shifting steadily toward greater and greater emphasis on management. Quality is no longer an isolated, independent function, dominated by technical experts.'***

Table 2.1 charts the four major quality stages in more detail. It shows, with the help of information already covered in the above sections, how the current stage (strategic quality management/total quality management - **TQM**) contrasts with its predecessors. Garvin argues that this new approach incorporates important elements of the first three quality stages but goes a crucial step further, linking quality with competitive success. Client opinion research on quality, pressures for continuous improvement, and high level of communication and participation are now required. These responsibilities broaden the job of general managers, project managers, and other professionals within a quality management system. *"They must attend to quality if they hope to succeed in the face of intense global competition."*, asserts Garvin (1988).

Table 2.1 The major quality management stages (adapted from Garvin 1988)

	1930	EARLY 1960s		1980s
CHARACTERISTICS	**INSPECTION**	**STATISTICAL QUALITY CONTROL**	**QUALITY ASSURANCE**	**QUALITY MANAGEMENT (OR TQM APPROACH)**
Primary concern	Detection	Control	Co-ordination	Impact
View of quality	A problem to be solved	A problem to be solved	A problem to be solved but one that is attacked proactively	A competitive opportunity
Emphasis	Product uniformity	Product uniformity with reduced inspection	The entire production chain, and the contribution of all functional groups to prevent quality failures	The market and client needs
Methods	Gauging and measurement	Statistical tools and techniques	Programmes and systems	planning, goal-setting and mobilizing the organization
Who has responsibility for quality?	The inspection department	The production and engineering departments	All departments	Everyone in the organisation, with top management exercising strong leadership
Orientation and approach	"Inspects in" Quality	"Control in" Quality	"Build in" Quality	"Manage in" Quality

2.7 Summary

The following points summarise this chapter.

1. The history and evolution of quality management in construction is not well documented as in the manufacturing industry, but its evolution has many parallels with that of manufacturing.

2. Inspection quality control evolved when the manufacturing system became complex.

3. Statistical quality control flourished during World War II when tremendous mass production was necessary. In effect, this stage was a refinement of the inspection stage and resulted in making the large inspection organizations more efficient.

4. During quality assurance stage, problem prevention was the primary goal, but profession's tools expanded far beyond statistics. Four separate elements were involved: quantifying the costs of quality, total quality control, reliability engineering, and zero defects.

5. Quality management (the strategic approach) or total quality management (TQM) stage, differs from the preceding stages in several critical respects. Quality is defined from the client's (customer) point of view; is linked with profitability on both the market and cost sides; is built into the strategic planning process; and is obtained through an organizationwide commitment, spearheaded by corporate management.

CHAPTER 3

PILOT STUDY FINDINGS: SUBSTANTIATION OF THE PROBLEM

3.1 Introduction

The purpose of this chapter is to report on the findings of the pilot study which was carried out in order to substantiate the research problem. According to Leedy (1993), the problem is the axial centre around which the whole research effort turns, hence it was necessary to go beyond the comments of *Botswana newspapers, interested groups and politicians'* comments on the problems of extensive defects and other quality problems on public buildings and carry out the pilot study in order see the research problem with clarity and to be able to state it in precise and unmistakable terms as indicated in Chapter 1 (section 1.2).

3.2 The Pilot Study

In order to carry out a pilot study which will produce a researchable problem on quality management problems in the Botswana public building sector, it was necessary to review the related literature. This was done in order to look at investigations on quality management and to find out how the collateral researchers had handled these situations.

Based on previous research studies (for example Burati 1992, Dean, *et al.* 1976, Isaak 1982, Property Service Agency 1986, Cornick 1988 and 1991), the following were identified as **'global'** quality management problems:

1. Lack of teamwork;
2. Poor project organizational structures; and

3. Inadequate project planning and scheduling.

These research studies identified the causes of quality management problems as:

1. Lack of understanding of the expectation of project team members;
2. Lack of team-building exercises at the commencement of project site works;
3. Little or no team-oriented planning and scheduling;
4. Traditional specifications are often unrelated to the quality requirement of a particular building contract and are therefore rarely referred to;
5. Contractual arrangements, as such, have little effect on the quality achieved, but management structures have considerable influence.

This examination of problems and local information from various sources in Botswana, formed the basis for development of pilot study questionnaires and interviews focusing on the Botswana construction industry.

In order to obtain a preliminary comprehensive view of the problems involved it was decided to obtain information from different groups who are directly involved in the management of quality in construction. These are **general contractors, architects, structural engineers, quantity surveyors and service engineers.**

3.2.1 General contractors' survey

It was decided to include only general contractors in the survey, rather than include specialists, because there is a large number of firms in this category, they are involved in activities of a complex nature, and they are also able to give a balanced opinion as they employ either directly or as subcontractors, most of the trades in the Botswana construction industry.

The total sample size analyzed in the survey was 15 (out of a total number of 56 contractors). The respondents were classified into five categories from the Botswana, Department of Architecture and Building Services (DABS) of the Ministry of Works, Transport and Communications - Central Tender Board (CTB), classified as indicated in Table 3.1.

Table 3.1. Classification of Contractors and sample size

Contractor Grade Size	Contract Size in Pula (Pula 2.2 = 1 US$)	Sample Size
A	Up to 450,000.0	3
B	Up to 900,000.0	3
C	Up to 2,000,000.0	3
D	Up to 4,000,000.0	3
E	Unlimited	3

To allow for meaningful comparisons, contractors were approached through a postal questionnaire which was circulated to their respective site managers on 15 randomly selected projects. Brief follow-up interviews on posted questionnaires were conducted.

3.2.2 Professional consultants survey

The same projects randomly selected under 3.2.1 (15 projects), each had an architect(ARCH), a quantity surveyor(QS), a structural engineer(SE), and a services engineer(SEE)-(mainly electrical). These consultants were interviewed.

3.2.3 Analysis of results

The commonly occurring failures in the Botswana public building sector of the construction industry originating from construction and user aspects include (among others): *corrosion of steel reinforcement and other ferrous metals; leakage of roofs; cracking of walls; dampness at walls, floors and ceilings; detachment and degradation of sealant in movement and expansion joints; buckling and dislodgement of brick slips on cladding.* These failures suggest an extensive quality problem.

From the projects studied, it was evident that there are indications to suggest that the traditional building procurement system dominant in the Botswana public building sector of the construction industry, defines what is to be built, the roles of the various parties concerned and the terms of the contract between them. In so doing, it provides the framework of a quality management system, perhaps not so detailed, but partly effective none the less. All public building contracts in Botswana have specifications and drawings incorporated in them, but the amount of detail they give is subject to practical limitations. It is not possible, for example, for the drawings of a multi-storey building to specify the precise location of each block or each nail. The designer relies on the good sense of the builder to interpret what is needed and to follow what is known as ***'customary good practice'*** in carrying out the designer's instructions. Thus a designer might reasonably respond to a charge of defective design resulting in a damp or leaking building by saying that a competent contractor should be aware of the need for proper damp-proof courses and other waterproofing measures and the absence of specific requirements for such measures on the drawings is no excuse for failing to provide them.

The data analysis of this study, reveals one major weakness of the system, its main characteristic of being 'partly ineffective'. The need to address this 'partly ineffectiveness' is therefore great.

There are strong indications to suggest that a gap exists between, on the one hand, how standards of quality within the established practice of the construction industry are defined by consultants in the form of specifications with a heavy reliance upon Codes of Practice, and on the other, how standards of quality are established in the site situation. It would appear from the survey that site managers, along with their supervisors establish quality and their decisions are highly arbitrary. Their experiences and management abilities, therefore determine the level of quality that occurs.

Site managers, usually have copies of specifications, but not copies of Codes of Practice, (which are expensive to buy and often inaccessible for quick reference) to which the majority of specification items refer. It would appear therefore, that site management is generally unaware of the required 'imposed' standards of quality.

The majority of architects, structural engineers and service engineers surveyed are of the opinion that, the specifications are poorly written, ambiguous, unclear, and irrelevant. On the basis of this there are indications to suggest that site managers and their subordinates make decisions on quality with little guidance from outside the building site. Hence the existence of a gap between definition of standards and actual establishment of standards is accompanied by a series of breakdowns in the managerial directing task throughout the whole construction process.

The foundations for directing as one of the managerial tasks seem to exist. What appears to be wrong is the lack of written communication throughout the whole construction process, with a subsequent reliance upon verbal communication. The current practice of supervision and inspection by the architect, structural engineer, or services engineer is to a large extent ineffective due to the total time spent on these activities. Using the architect as an example, the average time spent on supervision and inspection was found to be 3% of working time. This compares badly with the RIBA (1962) finding of 5.5%.

It appears that 15% of ARCH, SE and SEE found relatively little job satisfaction in the managerial aspect of their work. They regarded written or verbal communication as one of their four major dislikes. This observation indicate a weakness in the aspects of work which are so important to quality achievement.

Although a limited number of 15 projects surveyed cannot support definitive conclusions, it suffices for its intended purpose. As a pilot study for an intensive research project, it has established some indicators on the critical areas affecting quality management in public buildings construction processes in Botswana. It is fair therefore to start from these indicators, towards an intensive survey of establishing the validity of these factors.

This study focused on site managers, architects, structural engineers and quantity surveyors, and dealt neither with the site lower work-group level nor with the higher construction company level. In order to propose an appropriate system addressing the main factors affecting quality management, both levels deserve thorough investigation.

The most important indication of this pilot study is that the traditional building quality management system for assuring client satisfaction and compliance with drawings and specifications is based on a system which partially satisfies the requirements for an effective quality system. There is lack of integration between the designers and contractors and the diffusion of responsibility for the supervision of work on the construction site. The system was founded upon traditions established at a time when building was predominantly a craft-oriented industry, and when empirical design methods used, allowed ample margins for error. To-day's circumstances are very different, the nature of the Botswana public building sector of the construction industry is changing fast with many negative factors which pose particular problems for managers trying to apply sound quality management principles. Managers need a system which will enable them to make sense of forces confronting the construction industry - a quality management system which will simplify the situation but retain a high degree of reality. A quality management system which will confront what the Tavistock Report (1966) calls the `endemic crisis' facing the industry.

This pilot study has established some indicators on the critical areas influencing quality management. There is an indication to suggest that an organizational structure used for procurement of public building projects is inadequate and this has produced an inappropriate quality management system, which in turn, has resulted in quality problems.

3.3 Summary

The following points summarise this chapter:

1. Some of the common building defects originating from construction and user aspects include: *corrosion of steel reinforcement and other ferrous metals; dampness at walls, floors and ceilings; leakage of roofs; cracking of walls; detachment and degradation of sealant in movement and expansion joints; buckling and dislodgement of brick slips on cladding*. These failures suggest an extensive quality problem.
2. There are indications to suggest that the traditional building procurement system dominant in the Botswana public building sector provides the framework of a quality management system.
3. The building procurement system was found to be characterized by inappropriate organizational structure.
4. There are indications to suggest that the inappropriate organization structure has resulted in poor project documentation relative to standards, and inadequate time of project management was found to be spent on supervision of work.

CHAPTER 4

A REVIEW OF GENERAL ORGANIZATION THEORY

4.1 Introduction

The purpose of this chapter is to provide an analysis of general organization theory, in order to provide a basis for an examination of the **building process** (research focus area as indicated in Chapter 1) with an emphasis on the management of a construction site, and specifically to aid in a search for management actions or approaches that will lead to the achievement of building project quality - through quality management.

In order to understand the concept of quality management in the construction industry, it is important to start from the background information which was established in Chapter 2. Historical development of quality management embraced developments in general management and, more specifically, the application of quality management in the manufacturing industry, from which the construction industry has adapted most of its management practices. Looking at the broader general management theory, quality management falls under organization management, hence the need to understand organization theory.

Organization theory as a discipline has been chosen as a research vehicle based on the following main reasons:

(i) In the search for indicators on the factors influencing quality management in public building projects in Botswana (Chapter 3), an indication was found that most quality management problems were due to inadequate project organization structure.

(ii) Beside the pilot study findings, it will be demonstrated in Chapter 5 that present project quality management systems, in construction and manufacturing industries, are direct reflections of project organization set-ups/procurement systems.

(iii) Organizatiion theory is a holistic discipline and it encompasses the way in which organizations function: as such it examines the basic parts of an organization and how these parts are related; it examines all aspects of organization processes from the skills shown by operatives to ways in which strategy is formulated;

(iv) Small groups in construction projects play an important role in establishing the psychosocial system of projects. Organization theory as a discipline includes the relevant aspects of general psychology and general sociology.

Furthermore, Baker *et al.* (1976), an intensive study of the factors contributing to successfully managed projects (Ireland 1983), it was found that what they measured as "coordination and relations to pattens" accounted for 77% of the variance and was significant at the 0.001 level. They reported that "none of the specific project management tools such as PERT, CPM, PERT-COST, Work Breakdown Structures, Systems Engineering, Configuration Management, Life Cycle Planning Concepts, or Status Reports, loaded on the factor of Project Manager satisfaction." Accepting Ireland's (1983) argument on this point, the possible argument that it is unreasonable to use organization theory to examine a processes, is rejected. Ireland further argues that every organization is made up of a number of process, the whole application of open systems theory to organizations, which is based on inputs-transformation-outputs, indicates this. But it must be said that many organizations have only one prime process that they are concerned with and in this case the organization is composed to facilitate the process. This is the case with the building process but the main distinction about the building process is that it is usual to compose a special organization to deal with each item produced. It must be emphasized that while it has been said that it is the building process which is being studied one could just as accurately have said that the organizations that are formed to produce the separate buildings are the subject of this study.

Finally, it is very important to state from the outset that it is not the intention of this research to make a contribution to organization theory. The intention is to better understand the management of the building process (focusing on quality management during the construction process) and to contribute to knowledge in that area.

4.2 The development of organization theory

Looking at the development of organization theory through this century, a number of phases could be observed. The notable classifications of the contributions of the various theorists are given by Handy (1985),Khandwalla (1977) and Pugh *et al.* (1971). The best classification appears to be given by Khandwalla, modified by the researcher as indicated in Table 4.1. Table 4.1 Schools of Thought in the Development of Organization Theory (adapted from Khandwalla 1977)

Table 4.1 Schools of Thought in the Development of Organization Theory (adapted from Khandwalla 1977)

*** BUREAUCRACY SCHOOL** Weber; Merton; Selznick; Gouldner
*** PRINCIPLES OF MANAGEMENT/SCIENTIFIC MANAGEMENT** Fayol; Taylor; Mooney; Follett; Urwick; Bernard; Brown
*** HUMAN RELATIONS SCHOOL** Mayo; Cartwright; Likert
*** BOUNDED RATIONALITY SCHOOL** Simon and March; Cyert and March
*** HUMAN RESOURCES SCHOOL** Argyris; McGregor; Hertzberg
*** CONTINGENCY THEORY SCHOOL** Woodward; Burns and Stalker; Thompson; Lawrence and Lorsch; Perrow; Kast and Rosenzweig
*** SYSTEMS SCHOOL** Bakke; Trist; Flood and Jackson; Flood and Carson

4.3 The use of organization theory in this research

Khandwalla's (1977) review (modified) of organizational schools of thoughts as indicated in Table 4.1, could be bracketed into four main groups (Bowey 1980): the Classical School, Human Relations, Contingency Theory, and Systems Analysis. The analysis of organizational structures has its roots in the ground work done in the first two of these groups (for example Mayo 1933, Likert 1961, Blake and Mouton 1964, Argyris 1957, Herzberg 1966, Fiedler 1965, Jaques 1951, and Lawler 1971). The main thrust of those studies was the investigation of people's roles within organizations, and the nature of their interactions. The structural aspects of organizations were secondary. **The work in this area has already been extensively reviewed many times, and there is little to be gained in reviewing it again.** A good summary review is given by O'Shaugnessy (1976) who correctly argues that these reviews have left the implications for organizational structure sparse and vague.

4.4 Contingency theory

Contingency theory focusses on environmental approaches (e.g. Burns and Stalker 1961 and Lawrence and Lorsch 1967). It also includes the technology approaches (e.g. Woodward 1958 and Perrow 1967) since technology and environment are often intertwined; they are both external sources of uncertainty (Schreyogg 1981).

This theory concentrates on isolating the functional relationships between two or more variables. Luthans (1976) describes this theory as an `if then' relationship and comments that the environmental variables (external or internal) are usually the independent variables with the management variables the dependent ones. According to Ireland, the aim of the contingency approach is to determine the relationship between environment and structure that will lead to the most effective goal attainment. Various authors have used this approach (Kast and Rosenzweig 1973, 1974, 1984; Khandwalla 1977; Luthans 1976; Hellriegel and Slocum 1974; Mintzberg 1979). In addition, Alloway (1976), Ortega (1976) and Schoonhoven (1976) have used the contingency approach in their research projects.

Schreyogg (1981) suggest that the " contingency theorists have decided (implicitly) to treat the individual, the organization designer, as theoretically irrelevant for their approach." "The environment imposes such a high degree of constraint upon people creating or developing the structure of an organization that they cannot but adapt the structure accordingly" (Schreyogg 1981:307).

This pure environmental approach has been criticised by various authors (for example, Cyert and March 1963, Child 1972, and Schreyogg 1981). The criticism is along the lines that there is some scope for decision-making choice available and therefore this scope for choice should be included within the theoretical framework.

Another line of argument which could be considered is that, since human action is included as part of the framework, one should reconstruct the network of meanings behind actions in order to understand actions properly. According to Ireland, this will lead to an action frame of reference. This thesis will not consider this action frame of reference.

Using Ireland's (1983) argument on the importance of technology and choice in organization structures, it can be argued from the point of view of this research into the building process that both *choice* and *technology* have a role in determining the structure of the building project organization.

4.4.1 General contingency models of organization

Here a general model of an organization will be used towards structuring the description of the research done on organizations. This will identify the types of variables that are likely to exist in an organization.

(i) Kast and Rosenzweig

Kast and Rosenzweig (1984:19) proposed what Ireland calls a `loose fit' model which is depicted in Figure 4.1. They view the organization as an open, socio-technical system composed of the following subsystems:

Technical Subsystem:

> *"refers to the knowledge required for the performance of tasks. By organizational technology we mean the techniques, equipment, processes, and facilities used in the transformation of inputs into outputs. The technical subsystem is determined by the purpose of the organization and will vary according to the task requirements. The technology frequently proscribes the type of organization structure and affects the psychosocial system."*

Psychosocial Subsystem:

> *"consists of individual behaviour and motivation, status and role relationships, group dynamics and influence networks. This subsystem is, of course, affected by external environmental forces as well as by technology, tasks, and structure of the internal organization."*

Structure Subsystem:

> *"is concerned with the ways in which the tasks of the organization are divided (differentiation) and with the coordination of these activities (integration). In a formal sense, structure can be set forth by organization charts, job descriptions, and rules and procedures. It is concerned with patterns of authority, communication, and work flow."*

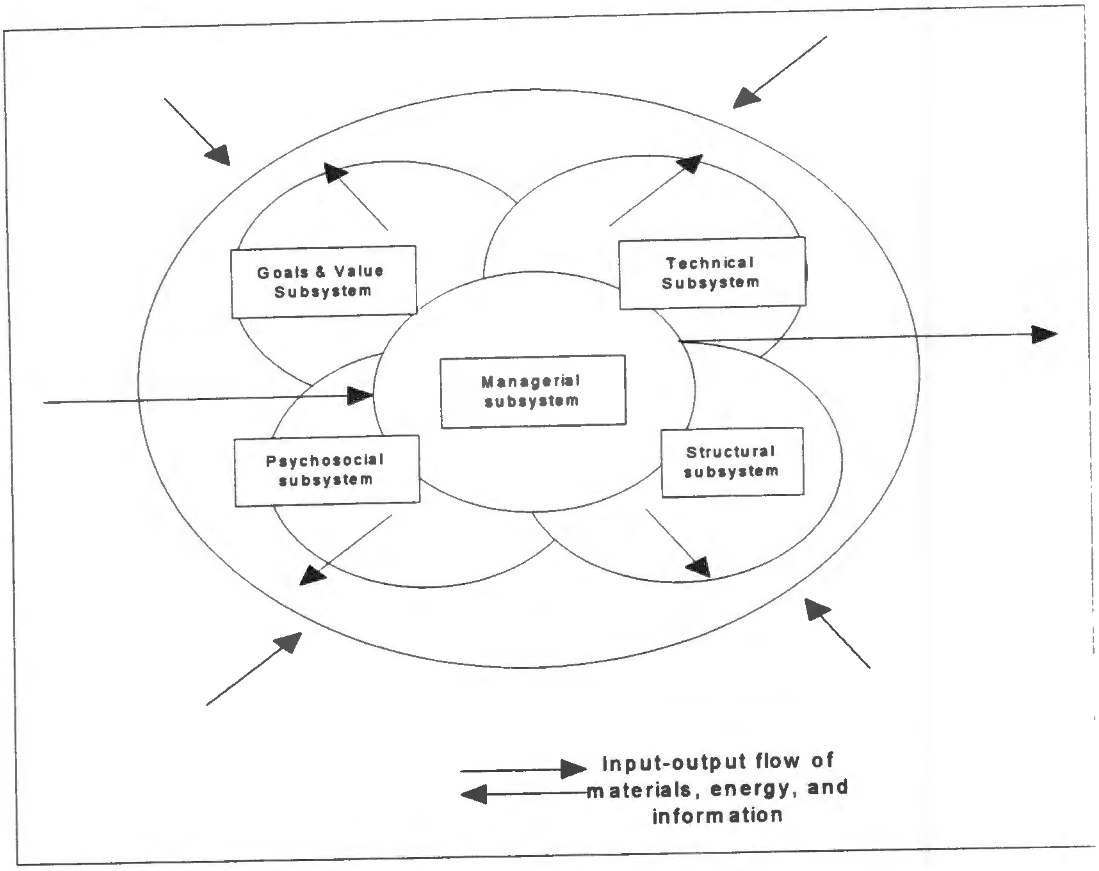


Figure 4.1 Organizational system of Kast and Rosenzweig (Kast and Rosenzweig 1984)

Goals and Values Subsystem:

"represents one of the more important subsystems. While organization takes many of its values from its broader sociocultural environment, it also influences societal values."

Managerial Subsystem:

"plays a central role in goal setting, planning, designing organizations, and controlling activities, as well as in relating the organization to its environment. Managerial functions and practices are vital to the integration of activities in all the other subsystem."

Ireland provides an overview that: "this model includes and relates many of the major influences that have occured in the development of organizational theory." Some confirmations are provided by Leavitt (1964) that the four major organization variables are task, structure, people and technology. He argues that these variables are highly inter-dependent, and a change in one could probably result in a change in the others.

(ii) Khandwalla

Figure 4.2 represents Khandwalla's (1977) proposed model. Ireland provides a true reflection of this model, by arguing that it is not as dissimilar to Kast and Rosenzweig's as it appears as Khandwalla's situational variables exist in Kast and Rosenzweig's concept although the demographic variables of age, type and size would be subsumed as part of the technical or structural subsystem. The performance variables are important, not as a subsystem of the organization, but rather as a consequence of the organization's functioning. According to Ireland pattern variables are acknowledged as being important, this being a basic tenet of the general system approach. However rather than being a subystem, pattern variables can be seen as a measure of the effectiveness of the relationships. This can be seen as part of Kast and Rosenzweig's managerial subsystem, as a task of management is to maintain the proper pattern between strategic, structural and behavioural variables.

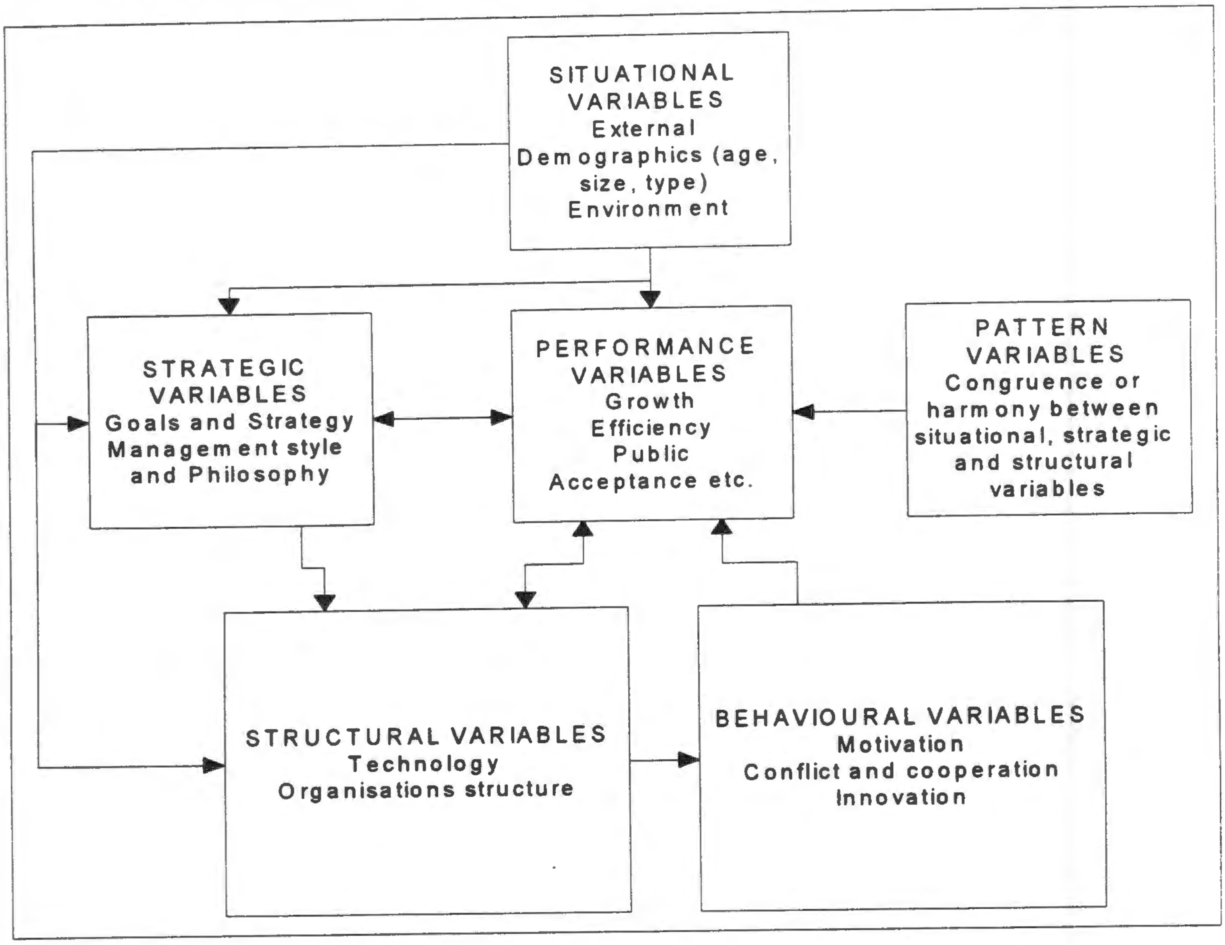


Figure 4.2 Khandwalla's model of organizational functioning (Khandwalla 1977)

4.5 Systems Theory

According to Ireland contingency theory has grown out of the premises of systems theory which were first formally stated by Bertalanffy (1956, 1968). General systems theory is concerned with developing a systematic, theoretical framework for describing general relationships. Flood and Jackson (1991a) further suggest that the concept "system" must first be used to refer to a particular way of organising thoughts about the world and secondly the notion of "system" should be considered as an organising concept, before going on to look in detail at various systematic metaphors that may be used as a basis for structuring thinking about organisations and problem situations. Systems theory must provide a framework for visualizing internal and external environmental factors as an integrated whole. Quoting Ireland

(1983:184), systems theory: ".....allows recognition of the proper place and functions of subsystems."

Schoderbeck, Kefalas and Schoderbeck (1975:30) define system as a " set of objects together with relationships between the objects and between their attributes connected or related to each other and to their environment in such a manner as to form an entirety or whole"

The insights of almost all management and organization theory are based on five metaphors (Flood and Jackson 1991a:7). These are:

- machine metaphor, or "closed system" view;
- organic metaphor, or "open system" view;
- neurocybernetic metaphor, or "viable system" view;
- cultural metaphor; and
- political metaphor.

The **machine metaphor** is useful when the task to be performed is straightforward; there is repetitive production of a single product; when the "human parts" fit into the design and are prepared to follow machine-like commands; and when the environment is stable.

The **organic metaphor** view is useful when there is open relationship with a changing environment; when there are needs to be satisfied in order to promote survival; when there is a need to promote responsiveness and change; and when the environment itself is complex, containing a variety of competitors and so on.

The **neurocybernetic metaphor** is useful when there is need to promote self-enquiry and self-criticism and therefore the possibility of dynamic goal seeking based on learning; when there is a high degree of uncertainty; and when there is a need to encourage creativity.

The **culture metaphor** view is useful in practice when it shows that "rational" aspects of organizational life are only rational in terms of the "installed" culture and that there are other values with which any official culture can be contrasted; and when there is a possibility that the cohesion generated by shared social and organizational practices can both inhibit and encourage organizational development and this has to be recognised and managed.

The **political metaphor** is useful when there is a need to highlight all organizational activity as interest based and emphasizing the key role of power in determining political outcomes, hence the need to place power at the centre of all organizational analysis; when there is an emphasis that goals may be rational for some actors while not so for others; when there are proposed disintegrative strains and tensions and thus it balances the more usual systems emphasis on functionality and order (such as in the "open system" metaphor); and when there is a need to encourage recognition of the organizational actor as political for both motivational and structural reasons.

Based on the above metaphors it is obvious to say, that in the modern world we are faced with innumerable and multifaceted difficulties and issues which cannot be captured in the minds of a few experts and solved with the aid of some super-method. Systems theory rests on the recognition of a fact that organizations are predominantly faced with "messes", sets of interacting problems, which range from the technical and the organizational to the social and political, and embrace concerns about the environment, the framework of society, the role of organizations and the motivation of individuals.

Systems theory acknowledges the need to retain rigorous and formalised thinking, while admitting the need for a range of "problem-solving" methodologies, and accepting the challenge which that brings.

Total Systems Intervention (TSI) (logic and process of TSI covered under section 4.8) offers an approach to creative problem solving which will enrich the way managers, decision makers and their advisers perceive the diversity of difficulties they face. This approach removes the basis of original criticism that systems theory is abstract and difficult to apply in practical managerial situations as argued by Kast and Rosenzweig (1973). TSI approach, is to choose an appropriate methodology for tackling the problem situation as it is perceived, but always recognising that other possible perceptions of that problem situation are possible. Flood and Jackson (1991a: 46-47) point out:

> *" The philosophy underpinning TSI is "critical systems thinking"...... ....critical systems thinking can be seen as making its stand on three positions. These are "complementarism", "sociological awareness" and the promotion of "human well-being and emancipation"."*

The systems theory through TSI accepts the reality that, to survive, the organization must respond, adapt and cope with the environment, hence it embraces the contingency view as part of its strength base (e.g. Flood 1990, Flood and Jackson 1991b, Jackson 1991, Oliga 1992, Habermas 1972, Habermas 1974, and Habermas 1984).

From the point of view of research into the building process, it seems reasonable to assume that both technology and choice have a role in determining the structure of an organization. This appears to be the case within the building process. Since it is not the role of this research to arbitrate between schools of thought within organization theory it will be assumed that both technology and individual choice can influence organization structure.

As a theoretical approach Systems Theory through Creative Problem Solving seems to be especially appropriate to the problem of this research because it is concerned with the relationship between environment and the parameters required to optimise performance. Flood (1990), and Flood and Jackson (1991a &b) found it to be the best approach.

4.5.1 General system model of organizations

In order to structure the description of the research work done on organizations, and to act as a general paradigm, a general model of an organization will be used. This will identify the types of variables that are likely to exist in an organization. These could be seen as paradigms, or `loose-fit' models.

4.5.2 Flood and Jackson

Flood and Jackson (1991a:5&6) proposed a general conception of system which is depicted in Figure 4.3. The terms used to describe the model are: element, relationship, boundary, input and output, environment and feedback. Flood and Jackson (1991a) add further notions to describe the complete conception, these are : attributes, transformation, purpose, open system, homeostasis, emergence, communication, control, identity and hierarchy. Although Flood and Jackson's general conception of system (Fig. 4.3) uses different terminologies for its parts in comparison with Kast and Rosenzweig's model (Fig. 4.1), the basic interpretation of the two models is the same.

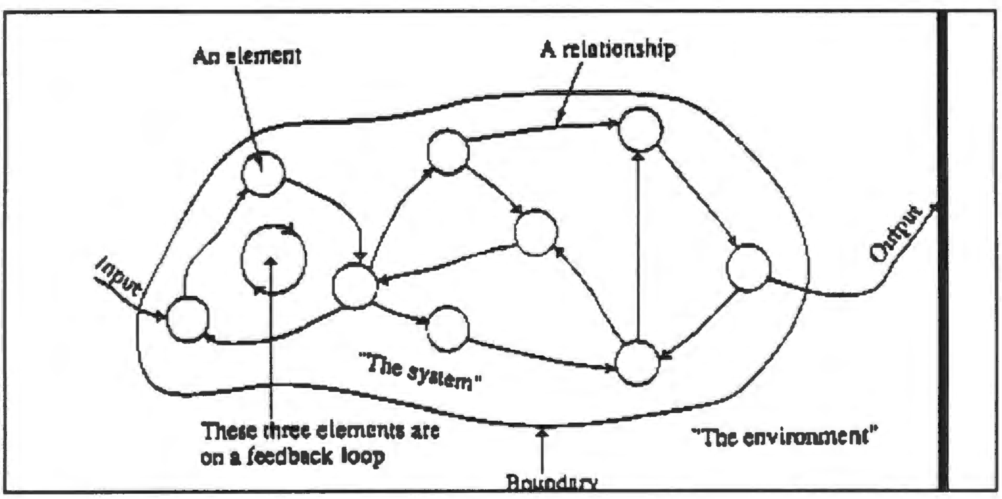


Figure 4.3 A general conception of system (Flood and Jackson 1991a)

From the figure it is evident that a system consists of a number of elements and the relationships between elements. The system identified by a boundary will have inputs and outputs, which may be physical or abstract. The system does the work of transforming inputs into outputs. The processes in the system are characterised by feedback, whereby the bahaviour of one element by way of their relationship, or indirectly via a series of connected elements, to influence the element that initiated the behaviour. Flood and Jackson suggest that attributes should be given to elements and relationships according to how they are measured (e.g. for an element size could be used, colour, number, volume; and, for relationships, measurements could be interms of intensity, strength, flow).

A system (Fig. 4.3) is separated by its designated boundary from its environment. It is termed an open stystem if the boundary is permiable and allows input from and outputs to the environment (this is labelled homeostasis). Contrary to contingency models protagonists against systems theory models that this implies that nothing is happening in the system (Kast and Rosenzweig 1973); it actually means that all the constituent parts may themselves have to adapt and/or change in the process of continuing essential transformation processes. A system that maintains an identity and stable transformation processes over time, in changing circumstances, according to Flood and Jackson (1991a), is said to be exhibiting some form of control. Essential to this they argue, is the communication of information between the elememnts. A system can be said to be purposive if it is carrying out a transformation, and is termed purposeful if its purpose is internally generated.

Flood and Jackson (1991a) view a system in its stable situation due to its control mechanisms, and possession of an identity. Further, they argue that a system can also be understood through its emergent properties. These are properties relating to the whole system but not necessarily present in any of the parts. The increased value of parts working together as a whole, is termed "synergy". They argue that emergent properties similarly arise where a complex interconnected network exhibits synergy such that "the whole is greater than the sum of the parts".

Systems generally occur in hierarchies, so that a system being considered may also be a sub-system of a wider system (for example a project design system is a sub-system of a project pre-contract system). According to Flood and Jackson (1991a) sub-systems may themselves be considered in terms of parts, or subsystems, at an even higher resolution level.

4.5.3 The search for structure in the building process

According to Ireland structure is concerned with a number of aspectsin the building process, among which are how tasks are divided, to whom they are allocated, how tasks are coordinated, when is the best time to do a task, what can be standardised and formalised and what must remain flexible? It must respond to various tasks, to the behaviour of those doing various tasks and to the goals and values (choices) of these people and others. In order to establish an appropriate structure which will deal with the above issues within the building process, it is important to know how to employ the range of different systems approaches available. Therefore using a model such as Flood and Jackson's to structure the search for relevant variables appears reasonable.

4.5.4 A system of systems methodologies

Flood and Jackson (1991a:32&33) argue:

> *"A major difficulty for managers and management scientists seeking to use systems thinking is knowing how to employ the range of different systems approaches available."*

There are so many systems approaches (for example contingency theory, systems engineering, interactive planning, system analysis etc.), and each of these has been tried and tested and works well in some circumstances. The manager has a responsibility to know the most suitable approach in the situation facing him or her. Flood and Jackson (1991a) provide advice on the strengths of different approaches and guidelines on the circumstances in which each may be best employed.

The most important systems methods and methodologies are logically grouped together by Flood and Jackson (1991a) into a "system of systems methodologies". They do this by looking at the undelying assumptions they make about problem situations or problem contexts in terms of the metaphors already discussed (section 4.5), and by presenting two new dimensions which give clearer understanding of those metaphors and their interrelatedness, and how they can aid in relevant methodology choice(s) and interventions.

4.5.5 Problem contexts

Here the categorisation of problem contexts is made with the aim of grouping the different systems methodologies. "It is not meant as a grid into which different problem situations in the "real world" can be fitted" (Flood and Jackson 1991a:32). Problem contexts are grouped according to two dimensions:

- systems

- participants

The *systems* dimension refers to relative complexity in terms of the "system" or "systems' that make up the problem situation, and within which other difficult pluralistic or coercive issues of concern may be located.

The *participants* dimension refers to the relationship (of agreement or disagreement) between individuals or parties who stand to gain (or lose) from a systems intervention. This allows the building of pluralistic and coercive appreciations of problem situations into any understanding of complexity that is promoted through the systems dimension.

Flood and Jackson (1991a:33,34&35) very generally suggest a continuum of "system types". At one end of the continuum they suggest simple "systems", and at other end "systems" which are highly complex:

(i) Simple "systems"

These have the following characteristics:

- a small number of elements;
- few interactions between elements;
- attributes of the elements are predetermined;
- interaction between elements is highly organised;
- well-defined laws govern behaviour;
- the "system" does not evolve over time;
- "sub-systems" do not pursue their own goals;
- the "system" is unaffected by behavioural influences;
- the "system" is largely closed to the environment.

(ii) Complex "systems"

These have the following characteristics:

- a large number of elements;
- many interactions between the elements;
- attributes of the elements are not predetermined;
- interaction between elements is loosely organised;
- they are probabilistic in their behaviour;
- the "system" evolves over time;
- "sub-systems" are purposeful and generate their own goals;
- the "system" is subject to behaviour influences;
- the "system" is largely open to the environment.

Generally "simple systems" manifest "easy" problems, and complex problem contexts which contain relatively "complex systems" manifest "difficult" problems. But Flood and Jackson (1991a:34) warn against superficial simplicity or superficial complexity, by giving an example:

> *"...if we consider an aeroplane that has many parts and interrelations we might mistakenly label this complex. Mistaken it would be, because characteristically such technological realisation are operated according to "well-defined" laws of behaviour and are not evolutionary, and on these grounds should be labelled relatively simple.*

On the other hand a superficially simple system, say the organisation of two people in interaction, is often non-deterministic and evolutionary (it may be a learning system) and hence should be labelled relatively complex."

In classifying participants Flood and Jackson (1991a) see the possible relationships between participants as being of unitary, pluralist and coercive nature. These are defined as:

(i) Unitary

These have the following characteristics:

- they share common interests;
- their values and beliefs are highly compatible;
- they largely agree upon ends and means;
- they all participate in decision making;
- they act in accordance with agreed objectives.

(ii) Pluralist

These have the following characteristics:

- they have a basic compatibility of interest;
- their values and beliefs diverge to some extent;
- they do not necessarily agree upon ends and means, but compromise is possible;
- they all participate in decision making;
- they act in accordance with agreed objective.

(iii) Coercive

These have the following characteristics:

- they do not share common interests;
- their values and beliefs are likely to conflict;

- they do not agree upon ends and means and "genuine" compromise is not possible;
- some corce others to accept decisions;
- no agreement over objectives is possible given present systemic arrangements.

When the dimensions of systems and participants are combined, they yield what Flood and Jackson (1991a) calls "a six-celled matrix", hence the following ideal-type categories:

- Simple-Unitary
- Complex-Unitary
- Simple-Pluralist
- Complex-Coercive
- Complex-Coercive

4.5.6 Types of systems methodology

A six-celled matrix, problem contexts indicated in Table 4.2, differs in a meaningful way from the others and its integrated characteristics are found usefully to reflect types of what Flood and Jackson (1991a) calls: "problem issues".

Table 4.2 Grouping of problem contexts (Flood and Jackson 1991a)

	UNITARY	**PLURALIST**	**COERCIVE**
SIMPLE	Simple -Unitary	Simple -Pluralist	Simple -Coercive
COMPLEX	Complex -Unitary	Complex -Pluralist	Complex -Coercive

These six "ideal type" problem contexts implies the need for six types of "problem-solving" methodology.

Types of systems methodology could be grouped according to six ideal-type problem contexts identified above (Table 4.2):

(i) Simple-Unitary

These are methodologies that assume problem contexts are simple-unitary. Examples are:

- systems analysis;
- operational research;
- systems engineering;
- systems dynamics.

(ii) Complex-Unitary

This include:

- contingency theory;
- general system theory;
- viable system diagnosis;
- socio-technical systems thinking.

(iii) Simple-Pluralist

Here the assumption is that the issues are difficult to handle primarily because of disagreements among participants about the goals to be served through the "system" of concern.

(iv) Complex-Pluralist

The design of these methodologies is based on tackling contexts in which there is a lack of agreement about goals and objectives among the participants concerned, but where some genuine compromise is achievable (a pluralist situation). Advice is given on how to deal with complex). Guidelines are given for the design of whatever "systems" which could be brought into existence.

(v) Simple-Coercive

The "politics" of problem contexts could be revealed under this category, where real differences of interest as well as values and beliefs may exist, and where different groups may seek to use whatever power they have to impose their favoured strategy upon others (the relationship between participants is coercive).

(vi) Complex-Coercive

Under this category, complexity characterising the situations of concern hides the true sources of power of the various participants. No systems methodology currently bases itself upon the assumptions that problem contexts are complex and coercive. There are no tools yet to tackle such contexts when they arise in what Flood and Jackson (1991a) calls the "real world".

4.5.7 Total systems intervention: logic and process

As indicated in section 4.5, TSI represents a new approach to planning, designing, "problem solving" and evaluation beyond original general system theory work by Bertalanffy (1956, 1968), Schoderbeck, Kefalas and Schoderbeck (1975), and Kast and Rosenzweig (1972, 1973,1974, 1984) just to mention a few.

The process of TSI employs a range of systems metaphors to encourage creative thinking about organisations and the difficult issues that managers have to confront. TSI enriches general system theory by removing the high level of abstraction which characterized the original system theory.

4.5.8 The philosophy of TSI

TSI rests on what Flood and Jackson (1991a &b) refers to as "critical systems thinking". Critical system thinking as indicated under section 4.5 above stands on three positions:

complementarism, sociological awareness, and the promotion of human well-being and emancipation.

Complementarism or the complementarist position in systems thinking could be set out in comparison to the prevailing **pragmatist** and **isolationist** (see Jackson 1987, and Flood 1989). According to Flood and Jackson (1991b:322):

> *"Pragmatists argue that management scientists should not concern themselves with "airy-fairy" theoretical issues but concentrate on building up a "tool-kit" of techniques which have been shown to work in practice. This is a popular position among, for example, management consultants anxious to get the job done and keep the client happy. It neglects, however, to consider whether better results might be obtained if more theoretically guided interventions were made. It fails to recognise that learning can take place only if practice (successful or otherwise) can be related to a set of theoretical presuppositions which are being consciously tested through that practice."*

On the other end the extreme of isolationism implies sticking to one method or methodology only, because the analyst knows and wants to know no other approach. More sophisticated isolationists, argues Flood and Jackson (1991b), engage in a kind of "imperialism," adhering stolidly to one well worked out theoretical position and linked methodology, but adapting other methods and methodologies for use under the tutelage of the preferred theoretical position. This, they further argue has the inevitable effect of distorting the methods or methodologies chosen for incorporation, with a consequent loss of the force they command when properly used in the service of their more appropriate theoretical rationalities. Flood and Jackson (1991b:323) further suggest:

> *"Isolationism divides management science and the systems community into warring factions, each arguing for the primacy of their favoured approach_whether it be hard (approaches based on means-end), soft (approaches based on interpretations and their interrelations) or cybernetic (approaches based on laws of organisation)_and its ability to tackle all (or the great majority) of problem types."*

The "pick and mix" strategy favoured by the pragmatists, is opposed by the complementarist. Complementarism accept that different methodologies express different rationalities stemming from alternative theoretical positions which they reflect. It insists that these positions must be respected. Further, the claim of any one theoretical rationality to be the sole legitimate one (isolationism) or to absorb all others (imperialism) must be resisted.

The sociological awareness of critical systems thinking, which is necessarily incorporated into TSI, recognises that there are organisational and societal pressures which have led to certain systems methodologies being popular for guiding interventions at particular times. Sociological awareness should make users of TSI contemplate the social consequences of using particular methodologies.

4.5.9 Principles of TSI

According to Flood and Jackson (1991b:325), there are seven principles which are embraced by TSI:

(i) Organisations are too complicated to understand using one management "model" and their problems too complex to tackle with the 'quick fix."

(ii) Organisations, their strategies and the difficulties they face should be investigated using a range of systems metaphors.

(iii) Systems metaphors which seem appropriate for highlighting organisational strategies and problems can be linked to appropriate systems methodologies to guide intervention.

(iv) Different systems metaphors and methodologies can be used in a complementary way to address different aspects of organisations and their problems.

(v) It is possible to appreciate the strengths and weaknesses of different systems methodologies and to relate each to appropriate organisational concerns.

(vi) TSI sets out a systemic cycle of inquiry with iteration back and forth between the 3 phases.

(vii) Facilitators, clients and others are engaged at all stages of the TSI process.

4.5.10 TSI methodology

There are three phases of TSI, which are labelled:

- Creativity
- Choice
- Implementation.

Creativity

During this phase the task is to use systems metaphors as organising structures to help managers think creatively about their enterprises. The sort of questions it would be pertinent to ask are suggested by Flood and Jackson (1991b:326):

(i) Which metaphors reflect current thinking about organisational strategies, structures, and control and information systems (including past, present and future concerns)?
(ii) Which alternative metaphors might capture better what more desirably could be achieved with this organisation?
(iii) Which metaphors make sense of this organisation's difficulties and concerns?

The tools provided by TSI to assist this process are "systems metaphors" described in section 4.5 above.

The outcome from this phase is a dominant metaphor which highlights the main interests and concerns and can become the basis for a choice of an appropriate intervention methodology. If all the metaphors reveal serious problems then the organisation is obviously in a crisis state.

Choice

The task during this phase is to choose an appropriate systems-based intervention methodology (or set of methodologies) to suit particular characteristics of the organisation's situation as revealed by the examination conducted in the creativity phase.

The tools provided by TSI to help with this phase are the guidelines of the "system of systems methodologies" as indicated in Table 4.3.

Table 4.3 A system of systems methodologies [Flood and Jackson (1991a)]

	UNITARY	PLURALIST	COERCIVE
SIMPLE	**S-U** * Operational research * Systems analysis * Systems engineering	**S-P** * Social systems design * Strategic assumption surfacing and testing	**S-C** * Critical systems heuristics
COMPLEX	**C-U** * Cybernetics * GST * Socio-tech * Contingency theory	**C-P** * Soft systems methodology * Interactive planning	**C-C**

In constructing the system of systems methodologies Flood and Jackson (1991b) suggest that it is necessary to unearth the assumptions underlying different systems approaches. This they propose, should be done by asking what each assumes about the system(s) with which it deals and about the relationship between the "actors" concerned with that system. Some common systems methodologies may be viewed as classified to a matrix in Table 4.4.

Table 4.4 Example of systems methodologies related to systems metaphors (Flood and Jackson 1991b)

Systems Methodology (examples)	**Assumption About Problem - contexts**	**Underlying Metaphors**
Operational research	S-U	Machine Team
Cybernetics	C-U	Organism Brain Team
SAST (strategic assumption surfacing and testing)	S-P	Machine Coalition Culture
Soft systems methodology	C-P	Organism Coalition Culture
Critical systems heuristics	S-C	Machine Organism Prison

Using the system of systems methodologies (Table 4.3), it is possible to relate individual methodologies to the systems metaphors described in section 4.5, as in Table 4.4.

The most probable outcome of the choice phase is that there will be a dominant methodology chosen.

Implementation

During this phase, the task is to employ a particular systems methodology (systems methodologies) to translate the dominant vision of the organisation, its culture, and the general orientation adopted to concerns and problems, into specific proposals for change.

The outcome of this phase is coordinated change brought about in those aspects of the organisation currently most vital for its effective and efficient functioning.

4.6 Which Theoretical Approach?

From the point of view of this research into the building process, it seems reasonable to assume that **technology** and **choice** have a role in determining the structure of an organization. This appears to be the case within the building process. Since it is not the role of this research to arbitrate between schools of thought within organization theory it will be assumed that both technology and individual choice can influence organization structure.

If technology and choice have a role in determining the structure of an organization, is it right to contend that there is a **"typical"** project management structure that could usefully be identified for construction projects? Brech (1975) gives an answer to this crucial question, by pointing out that, although there may be some groups of organizations which display outward signs said to be generally typical for a type of organization, within every organization the distribution of management and executive responsibility is unique. This argument is supported by Woodward (1965).

The fact that Brech and Woodward were discussing organizations generally, with particular reference to industrial and manufacturing organizations, and not referring directly to construction is not sufficient reason for rejecting their work. As will be demonstrated in chapter 5, there are positive basic similarities between construction and manufacturing industries both interms of procurement/organizational set-ups and quality management systems. Furthermore, project organization was found to be the primary indicator factor and the source of other sub-factors affecting quality in public building construction process.

The idea that there was one ideal organizational form was the motivation for much of the early work: if this ideal form could be put into practice then problems would disappear! (Hughes 1989:15). However, Flood and Jackson (1991a) and Lawrence and Lorsch (1967) agree, while using different terminologies directed at the same focus, that appropriate organizational structure will depend upon the *environmental demands* (Lawrence and Lorsch 1967) or *nature of messes* (Flood and Jackson 1991a) upon the organization. Thus it is the appropriateness that is the key. This is known as the Systems Approach (Systems Thinking). As a theoretical approach Systems Thinking seems to be especially appropriate to the problems of this research (Quality management problems). The current study will attempt to provide the tools for describing and analysing organizational structures of the building process in the management of Quality based upon the foundations laid by Systems theory writers: specifically those dealing with the current development of this theory (Flood and Jackson 1991b).

4.7 Summary

This chapter has reviewed organizational theory (primarily based on the findings of the pilot study in chapter 3) as a basis for establishing the relationship between organizational effectiveness and project outcome: focussing on project quality management.

It has been established that there is no single traditional organization theory model which *could adequately relate to all construction projects in terms of meeting client requirements*, hence the need to focus on appropriateness when selecting the model.

As a theoretical approach *Systems Theory through Creative Problem Solving* is considered as an appropriate vehicle to the problem of this research.

CHAPTER 5

ANALYSIS OF THE THEORY OF QUALITY MANAGEMENT

5.1 Introduction

This chapter reviews quality management theories both in the manufacturing and construction industries, and their related approaches, as a basis for addressing the factors affecting quality management as established in Chapter 3.

Those concerned with improving quality of buildings have drawn on the experience of manufacturing industry (for example Burati 1990, Burati and Matthews 1989, and Burati and Oswald 1992). The construction industry introduction of third party accreditation to BS 5750 Part 2 (for example) in the United Kingdom is one of those measures which are intended to help contractors to construct buildings which satisfy legitimate requirements of their clients. These measures ought to improve the situation but there is a danger that in the longer term client dissatisfaction will increase, unless these measures reflect the characteristics of the construction industry. The challenge that faces the building industry therefore, is to link the separate systems to **better assure quality in design and quality in (on site) construction** in the **separate organizations** that undertake these functions (Cheetham and Carter 1993).

In manufacturing there have been philosophical developments, attributed to Deming (1982) and Juran (1964) but developed by the Japanese, (see for instance Saski and Hutchins 1984, Robson 1986), that the primary responsibility for quality must lie with those doing the work. The responsibility of the management of an enterprise (or project) is to establish a system for verification of work and to educate the work force in its use. These innovative concepts need appropriate disections of traditional quality management theories both in the manufacturing and construction industries. Traditional approaches to quality management in these two industries also need to be highlighted.

5.2 Quality management in the manufacturing industry

Despite the interest of managers in the manufacturing industry, quality remains a term that is easily misunderstood. In everyday speech argues Garvin (1988), its synonyms range from **luxury and merit to excellence and value.** It is clouded with ambiguity and confusion, and this is evident from different firms which also appear to mean different things when they use the word, as do different groups within the same firm. Flood (1993) argues that, these ambiguities and confusions about quality are caused by some very basic misconceptions about quality itself, management and organisations. According to Garvin, without further refinement, continued ambiguity and confusion are inevitable.

5.2.1 Defining quality

The manufacturing-based definitions of quality, focus on the supply side of the equation and are primarily concerned with engineering and manufacturing practices. Virtually, they identify quality as **"conformance to requirements"** (Dodge 1944, Garvin 1988, JQCH 1988, Bessant 1991, Oakland 1993). Any deviation from an established design or specification implies a reduction in quality. According to Garvin, excellence is equated with meeting specifications and with **"making it right the first time."** In these terms, he contends, a well-made Mercedes is a high-quality automobile, as is a well-made Chevette. Flood (1993) gives a synthesis of ideas and gives the following statement about quality:

" Quality means meeting customers' (agreed) requirements, formal and informal, at lowest cost, first time every time. "

While the manufacturing-based definition recognizes the consumer' s (client/customer) interest in quality - a product or service that deviates from specifications is likely to be poorly made or unreliable, providing less satisfaction than one that is properly constructed or performed its primary focus is internal. There is very little attention paid to the link, in customers' minds, between quality and product characteristics other than conformance. Quality is defined in a manner that simplifies engineering and production control. Using Garvin's words:

" On the design side, that has led to an emphasis on reliability engineering. On the manufacturing side, it has meant an emphasis on statistical quality control. " Both techniques are designed to weed out deviations early, by analyzing a product's components, identifying possible failure modes, and then proposing alternative designs that enhance reliability; the latter, by employing statistical techniques to discover when a production process is performing outside acceptable limits.

According to Dodge (1969), each of these techniques is focused on the same end: **cost reduction.** Improvements in quality (equivalent to reductions in the number of deviations) lead to lower costs, for preventing defects is viewed as less expensive than repairing or reworking them. According to Abbott and Leaman (1944), firms are therefore assumed to be performing suboptimally. Were they only to increase their expenditures on prevention and inspection-testing prototypes more carefully or weeding out a larger number of defective components before they become part of fully assembled units they would find their rework, scrap, and warranty expenses falling by an even greater amount.

5.2.2 Fundamental principles of quality management

According to Oakland (1993) there are fundamental principles of quality management, and in order to understand these principles in manufacturing, it is important to consider the following:

(i) The production system

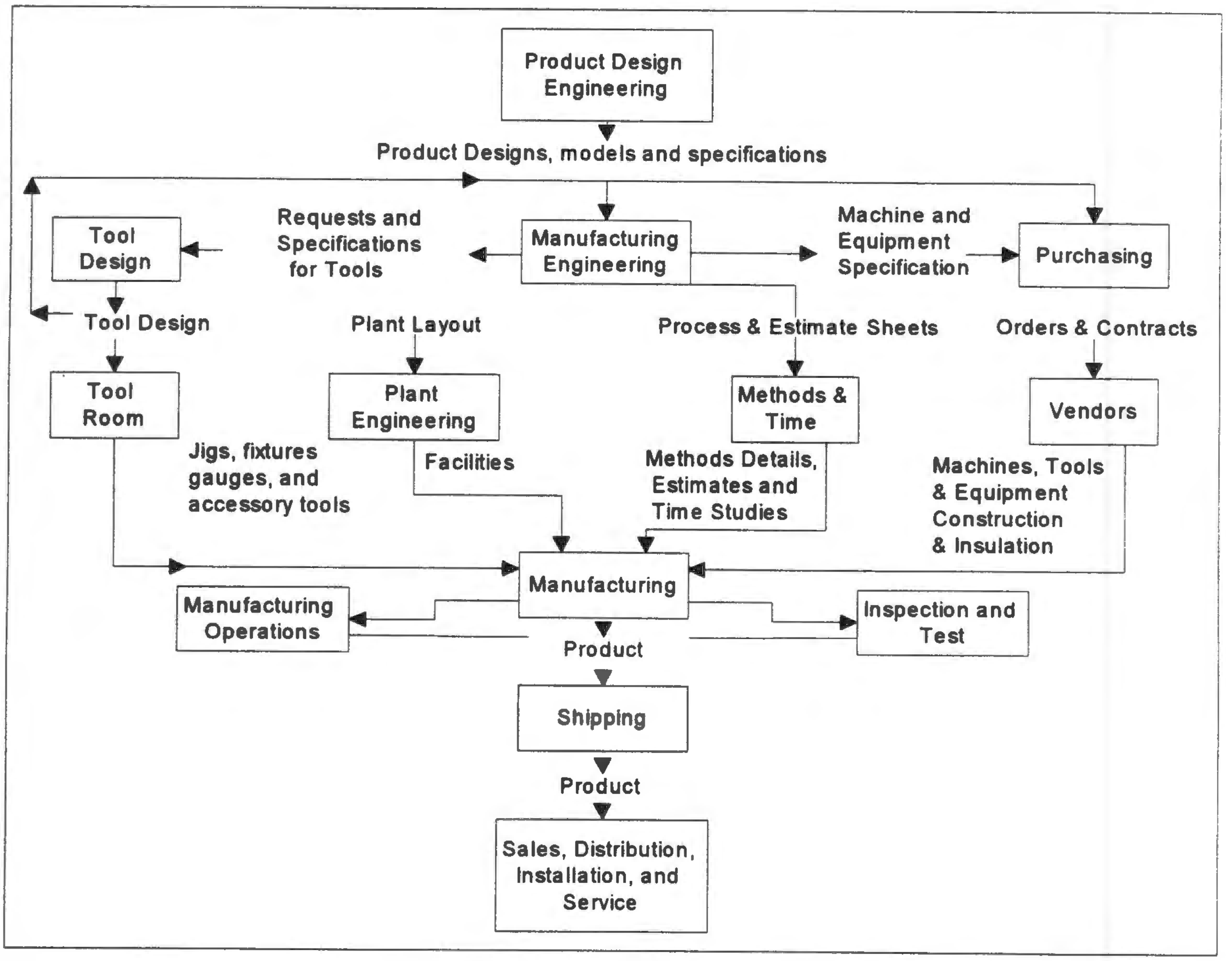
(ii) Control of product quality

(iii) The economics of quality of conformance

Quality and the production system

When considering the development of product quality, the entire production system must be considered. According to Kirkpatrick (1970), considerations should be from product design to manufacturing engineering to manufacturing operations, inspection, and test; to shipment, sales, and distribution of the product; and finally to installation and service in the field. He further argues that, the assurance of product quality involves a great deal more than the mere inspection of the product. Quality is the responsibility of every one in the organization.

Irrespective of the manufacturing operation in use, Oakland (1993) and Kirkpatrick (1970) suggest that, the production worker is the one who can most effectively control quality or make information available for remedial action to assure quality. They further contend that, the person who exercises the most influence over the worker is the first line supevisor or foreman. The responsibility for coordination, for quality, rest on the foreman. The foreman instructs, assists, and controls the production worker. In order to perform these tasks technical assistance is needed from quality control, process engineering, and product-design engineering.



. Figure 5.1 Production system (Kirkpatrick 1970)

Hence, *product-quality management*, referred to as *product-total quality management* by Oakland (1993), is an integral part of every level of the production system. In Figure 5.1, an example of a production system for a typical mechanical industries product is given, described by the schematic diagram

The production cycle starts with the customer. The sales department conducts market research analyses to determine customer needs and receptions of proposed new products and modifications of existing products. Sales forecasts are prepared and submitted to management. A production budget and estimates annual product-quantity requirements are prepared by the financial department, in cooperation with the production department. Product-design engineering prepares drawings, parts lists, and specifications. The production budget is then adjusted accordingly. Instructions specifying product quantities, delivery schedules, and so forth, are issued to manufacturing engineering. The technical information obtained from the product-design drawings, parts, specifications, and standards is made available to manufacturing engineering.

The next step is the determination of inventory levels, schedules for materials and standard-parts procurement, production schedules, and general plant utilization. Manufacturing engineering develops machine and equipment specifications, and requests for tools. The preparation of design drawings and specifications for the jigs, fixtures, gages and accessory tools that will be required falls under the tool design section. Purchasing chooses, contracts with, and retains vendors for materials, parts, machines, tools, and equipment. Complete detailed instructions are prepared regarding process operations and methods, machine loading and utilization, and production schedules. Shop orders are issued and manufacturing is authorized to start production.

Manufacturing operations together with inspection and test activities result in a product that is shipped to distributors and delivered to customers. In the final stage consumers use the product, and the experience of use becomes the basis for product redesign which, in part, starts the production cycle all over again. According to Kirkpatrick (1970), installation, maintenance, and servicing field data generate engineering changes in product specifications, which may affect any or all of the elements of the production system.

The production system described above rests on traditional management and organisation theories. According to Flood (1993), the theories referred to are scientific management (Frederick Taylor: Taylor 1947, and Aitken 1960) and bureaucracy theory (Max Weber: Weber 1930,1947, and 1948).

Scientific methods are used to design jobs and to calculate the most efficient way of doing things, hence the production system as indicated in Figure 5.1. The tasks of employees are broken down into parts. Flood argues that observation and measurement create physical descriptions of the **`the worker'** and **`the job'** . Therefore the management of the production system is the process of planning, organising, commanding, controlling and co-ordinating the parts. This requires a rational planning and efficient control of an organisation drawing upon engineering principles. The organisation is a closed system, and bureaucratic hierarchy defines lines of legitimate authority and power.

Looking at what is embedded in this sketch, Flood suggests that there are two fundamental visions of the nature of organisations. The first is a mechanical vision; the organisation operates like a machine and engineering principles are used to manage it. The second is what he calls 'political vision', where the organisation operates under a strict hierarchy of authority and control, the hierarchical tree showing nothing more than a power structure.

Control of product quality

In manufacturing the control of product quality is a function of two related activities of the production system. These activities are identified as:

(i) development of the general and technical specifications for the product, (ii) assurance of product conformance to technical specifications. This relationship is illustrated in Figure 5.2.

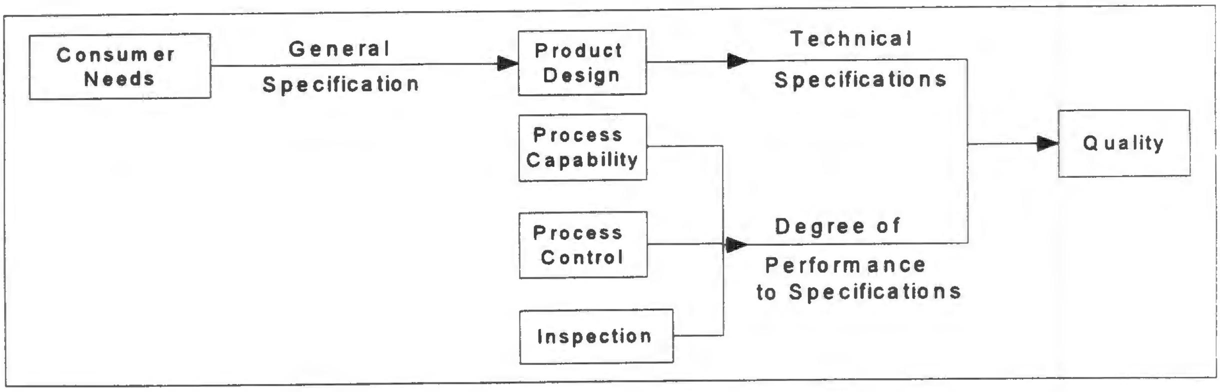


Figure 5.2 Specifications and quality (Kirkpakick 1970)

The needs and desires of consumers, Oakland (1993) and Kirkpakick (1970) argue, mainly determine the general specifications for the product. The technical specifications for particular designs depend on the functional requirements of the design components and, in part, on the availability and cost of processes and materials.

The assurance of product conformance to the technical specifications depends on process capability, process control, and inspection. Determining process capability is usually considered to be a quality-control function. Decisions concerning process capability feed back to the design process and influence the technical specifications for the product. Manufacturing supervision and quality control, are jointly responsible for process control procedures. In order to determine the degree to which production output conforms to established specifications, an inspection task should be carried out. Even though product parts are manufactured to the same specification, the degree of conformance to the specification varies from one part to another. Quoting Kirkpatrick (1970):

" Inspection procedures for assessing conformance range from a simple comparison of measurements of a unit of production output to the specifications, to life-testing a sample of output under actual operating conditions. "

As indicated in section 5.2.2, traditional management and organisation theories are dominant in the manufacturing industry. Control of product quality as indicated above, rests on customer requirements which must be met first time, every time. According to Flood (1993), there is a rigid notion of the objective goals to achieve in a strict internal order. There are punishments rather than rewards, and the requirements must be met otherwise demotion or dismissal may result.

Control of product quality requires the involvement of everybody from all levels and across all functions. Flood suggests that everyone is considered to be a cog in the machine and must work in unison strictly according to laws that must be obeyed, not necessarily because of the explicit will of some person/people, but because an organisation as a whole has a machine purpose that must be achieved; cogs (i.e., people) have no purpose.

Economics of quality of conformance

Quality management in manufacturing (referred to as *total quality management* by Oakland 1993, and *quality control* by Kirkpatrick (1970) is primarily concerned with product-output conformance to the technical-design specifications. There are two interrelated functions involved in quality management: (i) determining the capability of processes to assure conformance to specifications, and (ii) monitoring processes to assure conformance to specifications. Generally, a greater degree of conformance can be obtained by utilizing more costly processes which have better capabilities. As shown in Figure 5.3, the use of a more capable process usually results in decreasing quality losses at a decreasing rate. This suggests the possibility of there being an optimum to quality of conformance corresponding to a minimum point on the total cost curve. Using Oakland (1993), Crosby (1979) and Kirkpatrick's (1970) suggestions, total cost is considered to be the sum of the process-cost and quality-cost components, where quality cost refers to **scrap, rework, and rectifying inspection.**

Kirkpatrick (1970) defines rectifying inspection as 100% inspection of product output to assure product conformance to the design specifications. He suggests that it is a necessary inspection operation, since the process is not capable of attaining the quality level specified by design.

He further contends that it is possible to use processes that are too good. A process obtainable at a lower cost may result in a higher rate of defective output (i.e., lower quality of conformance). However, the cost of the rectifying inspection required to bring output to an acceptable quality level may be considerably less than the decrease in process cost. Hence the process with the lesser conformance may, in fact, be more economic.

On the other end, it may be economical to use a process which is too good for a given specification, when the alternative is a capital investment all out of proportion to the potential gain. Also, the cost of owned process, plus the cost of a rectifying-inspection operation, may be more economic than a capital investment to obtain a new process with adequate capability of meeting specifications.

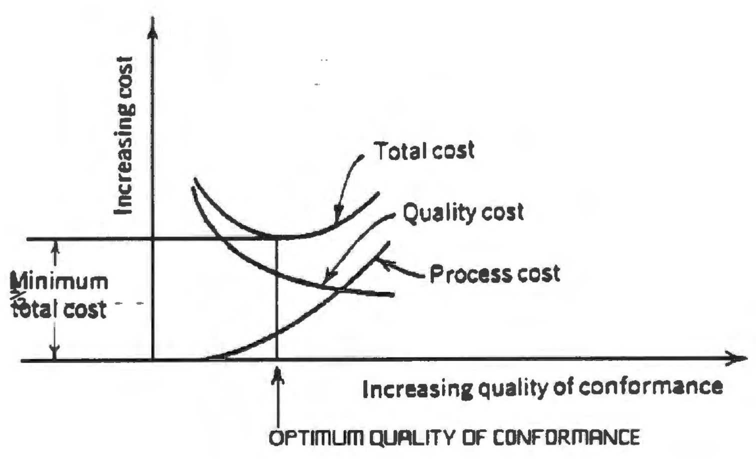


Figure 5.3 Quality of conformance (Kirkpatrick 1970)

Kirkpatrick's argument on what constitutes total costs of quality is challenged by Crosby (1979), he points out that those costs are just the tip of the iceberg. He argues that the true cost of quality is the total cost due to factors such as:

: disruption to production

: time and resources spent correcting mistakes

: materials, energy and resources wasted on producing the original mistake : investments in specialist functions to track and find quality problems

: warranty claims

: poor customer relations and consequent costs of advertising and so on to put that right

In other words, the true cost is not just the cost of putting things right (Bessant 1991). He argues further that overall quality costs are made up of two types; those incurred in prevention of mistakes and in checking for them, and those incurred through a failure of these procedures (either in the factory where the result is scrap or rework, or in the marketplace, where they lead to complaints, warranty costs, and so on). Although figures vary it is generally accepted that the costs of quality can be between 20 per cent and 40 per cent in manufacturing according to Bessant.

The economics of quality of conformance through traditional management and organisation, focuses on quality improvement in order to reduce waste and total cost. According to Flood (1993), cost reduction is persued as a goal, which means that people must work together as cogs much more efficiently; people must shake off what makes them unreliable (i.e., being human), there must be machine efficiency. There is a possibility of being economical due to less deliberation (lower cost), but higher cost could be incurred to police and supervise to achieve imposed rules. Interms of costs, suggests Flood, there will be beneficiaries and victims. He argues that the victims often will be the employees who come under increasing pressure to achieve quality targets.

5.2.3 The quality system

According to Kirkpatrick (1970), sales, purchasing, product design, process development, manufacturing, inspection, and so forth, are all different functions within the production system. Yet, each of these activities includes a sub-activity devoted to quality. A fundamental question is whether or not quality management is really only a label for a set of diverse activities. Or, is there some unifying physical or conceptual framework that makes quality management a separate function in its own right? Using an analogy between financial management (control) and quality management, Kirkpatrick (1970) looks at financial management problems which existed in the eighteenth- and nineteenth-centuries. He argues that a solution to the problems was the development of a unified approach to the many financial activities of the business. He further observes that some parallels to the financial-control (management) function could be established. Looking at the life of a business enterprise (say a manufacturing firm), Kirkpatrick argues that its life depends on maintaining a balance between incomes and expenses [i.e., financial control (management)]. He suggests that the quality-management function is also vital. Using his words:

"A company can remain in business only so long as the quality of its product is acceptable to the consumer."

Going back to financial management, he contends that incomes and expenses occur in every department of the business. Similarly, he suggests that every department in the company influences the quality of the company's product. The concept of financial control (management), he argues that is based on the identification and evaluation of all incomes and expenses. He suggests a corresponding conceptual approach to quality management. He argues that all efforts for achieving quality and all benefits derived from achieving quality need to be identified and evaluated. Efforts and benefits, in this connection, correspond to expenses and incomes (i.e., costs of achieving quality and cost reductions due to the achievement of quality). Quantitative tools which have been developed for quality control (management) include; process capability, control charts, sampling-inspection plans, and other statistical measures.

The benefits accruing from the above unified quality management effort will include:

(i) setting of over-all company quality policies,

(ii) defining specific quality objectives,

(iii) assigning quality responsibilities, and

(iv) developing a quality-management system whereby quality standards are defined and variances from the standards trigger corrective quality actions.

Quality management system

There are two faces of quality management system theories in the manufacturing industry. On one hand the quality management system rests behind traditional management and organisation theories, where management is the process of planning, organising, commanding, controlling and co-ordinating the parts (Flood 1993). Under this system internal customer requirements are considered, external requirements are not seen to be relevant in the view of the manufacturing firm management. According to Flood, the requirements are set internally at the top and imposed on lower levels. On the other hand the system rests on Viable System Model (VSM) as consolidated by Beer (1981). Under this system the process of management is considered to have five main functions; *implementation, co-ordination, control, intelligence and policy*.

Under traditional management and organisation theory, a system is a physical or conceptual entity comprised of interdependent parts that interact within boundaries established to achieve some common goal or goals. The quality management system in a manufacturing firm therefore is the network of administrative and technical operations required to manufacture a product of specified quality standards. Such a system is shown in Figure 5.4.

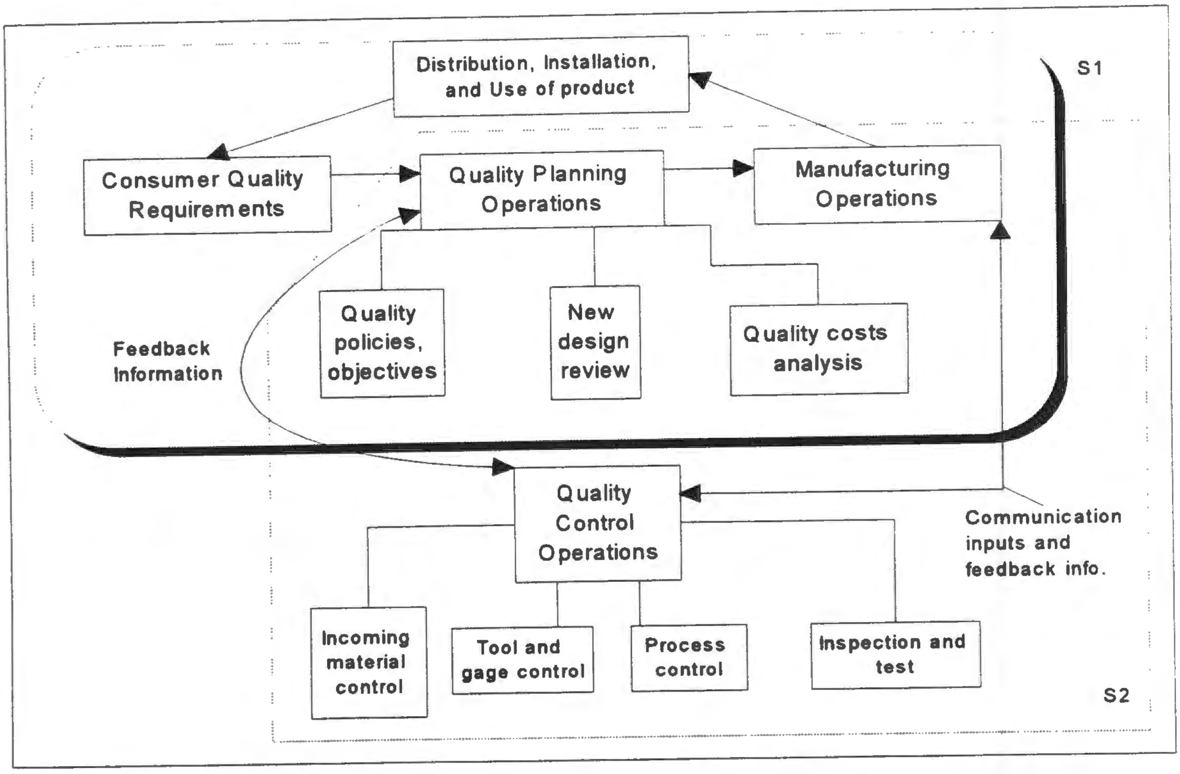


Figure 5.4 Quality management system (adapted from Kirkpatrick 1970)

Subsystem Sl is regarded as a communication system closed on the consumer's quality requirements. In this concept of the quality system, consumer needs and desires are assessed by the business organization. In order to effectively meet these needs and desires, products, processes, and distribution methods are planned. The planning information flows to manufacturing operations where the plans are carried out and the product is manufactured. Finally, the product is distributed to the consumer and the needs and desires of the consumer are filled.

The above closed-loop communication system, is supposed to operate continuously. Changes in consumer needs and desires should be detected as quickly as possible so plans can be promptly revised and operations changed accordingly. This brings in Kirkpatrick's concept of a business organization as a dynamic feedback system constantly "tuned in" to the consumer's needs clearly implies that the organization should be market oriented.

Quoting Kirkpatrick: ***"The organization continues in existence if it fills needs and desires of consumers, not if it produces products that are unattractive to the consumer."***

Subsystem S2 is a communication system closed on the quality planning function. From the standpoint of quality decision making, S2 is really a network of feedback systems. Oakland (1993) and Kirkpatrick (1970) suggest that the communications inputs to the quality-management operations are those from quality planning, manufacturing operations, and installations and servicing data from the field. He further suggests that these feedback systems must be well designed from the standpoint of: (i) prompt feedback so corrective action can be quickly applied, and (ii) continuing feedback, that is, the feedback network should not break down. The concept of self-correction should be incorporated into the design of the feedback network.

Quality management is primarily a planning and control, or feedback function. Kirkpatrick advocates less division of responsibilities, he argues that too much division of responsibility interferes with the basic purpose of the function. Figures 5.5 and 5 .6 indicate the difficulties that could develop.

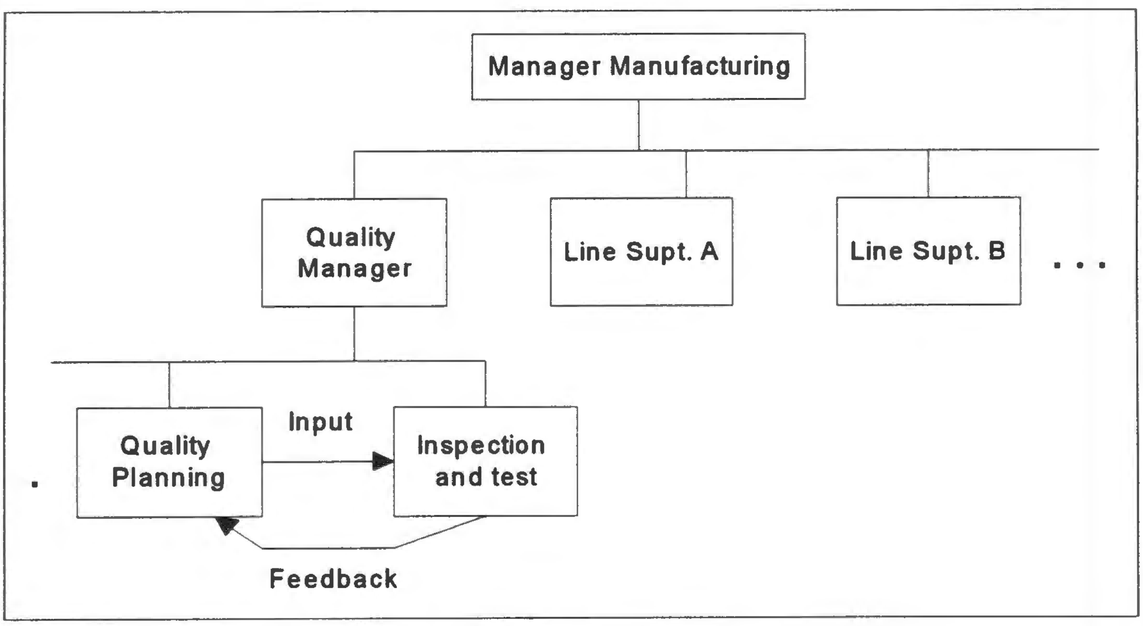


Figure 5.5 Centralized quality-management organization (Kirkpatrick 1970)

Figure 5.5 shows the short and direct feedback loops in a centralized quality-management organization. Prompt feedback of quality information and early corrective quality action are to be expected from such a feedback system.

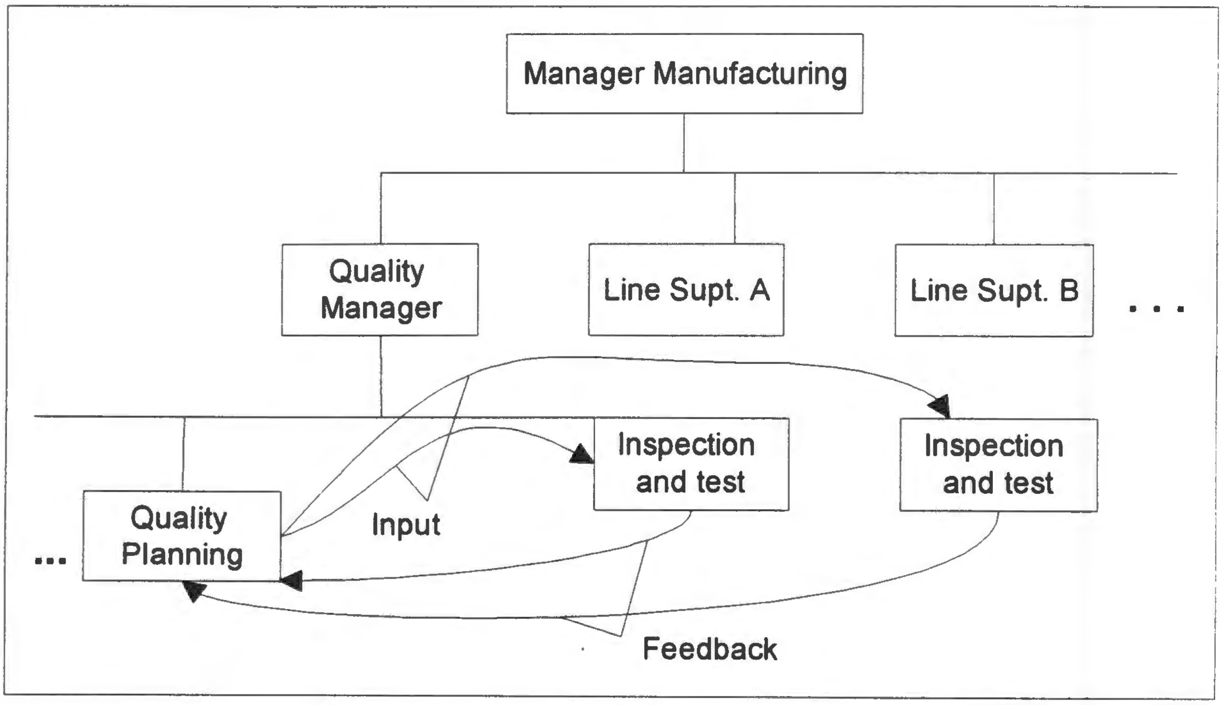


Figure 5.6 Divided quality-management organization (adapted from Kirkpatrick 1970)

Figure 5.6 illustrates what Kirkpatrick calls **"the longer loops"** and additional loops for feedback of quality information in a decentralized quality-management organization. The usual result of such a feedback system, is slow response in quality information feedback and corrective quality action. In addition, such a system frequently leads to what Kirkpatrick calls **"buck passing"** when product of poor quality is produced. Manufacturing supervision and quality management are each reluctant to accept responsibility for the poor quality product.

Quality planning

There are three principal quality activities which make the quality planning subsystem (see Figure 5.4):

(i) setting over-all quality policies and objectives for the business,

(ii) conducting new design reviews, and

(iii) carrying out quality-cost analyses.

(a) Quality policies and objectives

Some distinction must be made between the problem of establishing the company's broad objective of meeting the quality needs of its customers, and the much narrower technical objective of meeting the quality specifications (Oakland 1993, Kirkpatrick 1970). Setting company policies and establishing quality objectives is primarily a business problem. This is what Kirkpatrick calls *"broad planning for quality."* It involves the business, economic, and management activities associated with quality. In order to determine what constitutes *"market quality,"* what quality level is required to compete in the market, and whether or not this quality level will be affected by changes in competitors' quality levels or changes in customer preferences, reliable estimates must be carried out. It must be emphasized that when considering quality policies and objectives, factors of quality reputation and customer goodwill are also involved. Kirkpatrick argues for considerations which are business and economic in nature. He suggests the following questions:

(i) Should the company aim for quality leadership, a respectable quality grade, or merely marginal quality?

(ii) Will it be economic to strive for a positive quality reputation and use this as a weapon in advertising?

(iii) Should emphasis be placed on product guarantees to minimize losses to customers?

How these considerations are handled will vary considerably from one company to another, and with market conditions which change from one time period to another. Kirkpatrick suggests the following principal managerial activities pervasive to these consideration:

(i) setting over-all quality policies, (ii) establishing specific objectives, (iii) defining quality responsibilities, (iv) evaluating quality results, and (v) acting on quality deficiencies.

The above principal managerial activities conforms Flood's (1993) argument that the main quality protagonists (i.e., Kirkpatrick then) rely to a large extent on traditional scientific management and bureaucracy theory. The manager makes decisions and subordinates follows instructions. Using Flood' s words:

"...this principle is marginalised by machine thinking.....; creativity is divergent while mechanical goal-seeking is convergent.....it is unlikely that people will be creative when they are merely instruments serving other people's interests."

(b) New-design reviews

These are formal, documented, and systematic studies of new products designs by specialists from every department of the production system. An effective design review procedure accelerates the maturing of all elements of a design-function, reliability, value, and appearance (Jacobs 1967a, Oakland 1993, Kirkpatrick 1970). It must be emphasized that the cost of making changes may be a significant part of the total cost of producing and marketing a new product, this is mainly due to many design changes which occur routinely in the development of any new product. Figure 5.7 gives a typical comparative costs of making design changes with and without design reviews.

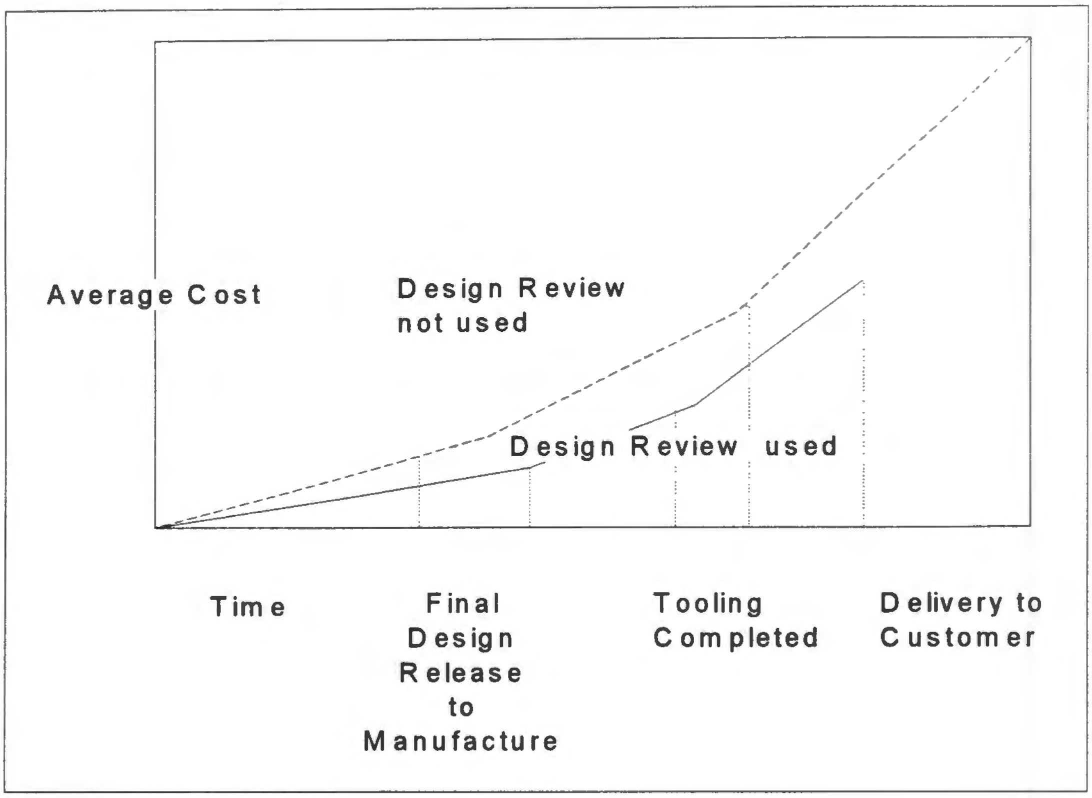


Figure 5.7 Relative average cost of making design changes with design reviews versus without design reviews (Jacobs 1967a)

It is usually desirable to have design reviews at more than one point in the design and development cycle of a new product Figure 5.8 indicates the points in the product's life cycle where design reviews are most productive.

During the review procedures, an analysis is made of all product functional, life, and interchangeability requirements and their associated technical specifications. This analysis leads to classification of all quality characteristics and definition of specific quality levels required and standards for checking product conformance to these levels.

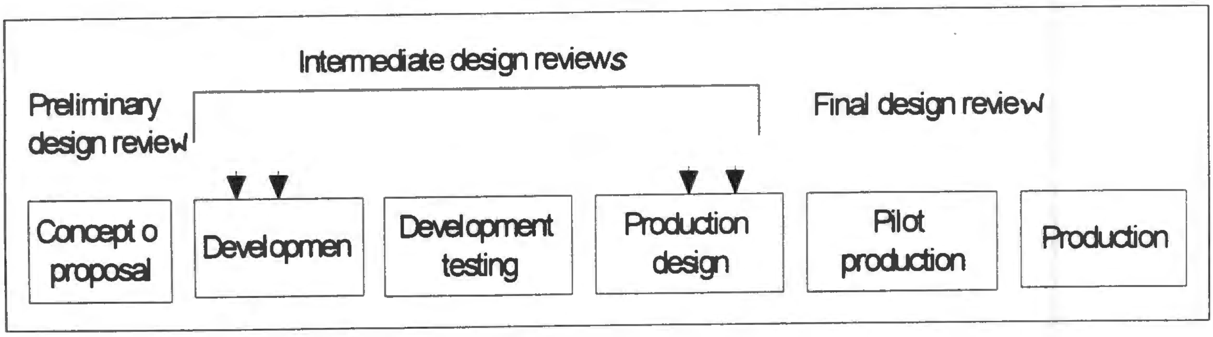


Figure 5.8 Product life cycle and design review schedule (Jacobs 1967b)

(c) Quality-cost analysis

There are two principal areas which should be examined when studying economic factors in quality management: (i) the broad business and management considerations associated with quality planning and (ii) the more detailed area of economic optimization in connection with specific operating quality costs. Following Kirkpatrick's argument, the former is concerned with quality-of-design alternatives, market quality considerations, return on the quality investment, quality budgets, and quality-cost control. The latter area includes all specific quality costs stemming from operations and decisions at the manufacturing-operations level.

Quality control

As indicated in Figure 5.4, the quality control subsystem includes the following quality activities: (i) incoming material control, (ii) tool and gage control, (iii) process control, and (iv) inspection and test.

(a) Incoming-material control

This includes all of the quality activities associated with the receiving and stocking of raw materials and finished product component parts and assemblies from sources outside of the manufacturing plant.

It must be noted that modern incoming-material control procedures emphasize control of material at its source. Receiving inspection by the purchasing firm is only a part of the incoming-material control routine. According to Kirkpatrick, further statistical sampling inspection plans are used as widely as possible to reduce the inspection time, labour, and cost.

The quality-control department works closely with the production-control and purchasing departments and the laboratory testing facilities of the manufacturing plant. This is very important in terms of making the planning and organizing function for incoming-material control effective (Bessant 1991, Kirkpatrick 1970).

(b) Tool-and-gage control

The quality of tools and gages used in the manufacturing and inspection operations, have great influence on product quality. The term 'tool' in the manufacturing industries refers to any device that is capable of working a material into a desired shape, holding the material while it is being worked on, or measuring the material when the work has been completed.

(c) Process control

In order to provide quality information and assistance to the production worker and his/her first-line supervisor so that product parts can be manufactured correctly, the principles of process control must be adhered to. The basic purpose of process control is not to be continually engaged in inspecting and sorting out defective product, but to prevent the occurence of defective product. Kirkpatrick suggests that whenever a manufacturing system attains an operative level of producing quality product parts a high percentage of the time, inspectors and quality-control staff can be released from corrective-action activities and put to work on the more positive prevention-of-defects activities of quality control. Kirkpatrick points out: **"Instead of operating as the policeman of manufacturing operations, inspection can become a real component of the process-control function."**

The summary of what could be detemined from process control is given by Kirkpatrick as: (i) process capabilities, (ii) degree of product conformance to technical specifications, (iii) sources of variation, (iv) causes of nonconformance to specifications, and (v) corrective actions required to eliminate or at least minimize variation effects that cause nonconformance.

It must be emphasized that modern process-control practices have been greatly influenced by quantitative methods, particularly the statistical methods utilizing control charts, sampling theory, and analysis-of-variance. An examination of these techniques are given some where (eg. Abbot and Leaman 1944, Bessant 1991, and Kirkpatrick 1970). Although these techniques are important in quality-control work, concludes Kirkpatrick, they are simply quantitative tools. The foundation of quality control is the technical specification. When quality troubles develop, quantitative tools represent an invaluable deagnostic aid in locating and identifying the quality-deficiency cause.

(d) Inspection and test

Inspection is primarily concerned with determining the degree to which production output conforms to the established technical specifications for the product (Bessant 1991, Kirkpatrick 1970). According to Kirkpatrick there are two purposes for which the resulting inspection information is used: (i) to control manufacturing operations and product quality characteristics, and (ii) to prepare quality audits to generate feedback information to the quality planning operations and upper-level management sections.

Based on the method of measurement-variables inspection and attributes inspection, the inspection operation may be classified in two categories. **Variables inspection** inludes any inspection operation where the gage indicates, on a continuous scale, deviations from the technical specification. With **attributes inspection,** the gage merely classifies the product into discrete categories. For example, the gage may classify product as being effective or defective. Another common classification is undersize, oversize, and within the specification limits. The categories into which the product is separated are discrete and usually few in number.

The inspection operation may also be classified in terrns of the proportion output which is actually inspected. A 100% **inspection** operation involves the exammation of every product item in the production batch. This type of inspection is called **screening or detailing.** It must be emphasized that the cost of 100% inspection is high, and sometimes prohibitively so.

Sampling inspection refers to the inspection of only n items of a product lot composed of N product items, where n is less than N. It should be clear that statistical sampling inspection plans are designed to facilitate decision making regarding the production lot. Decisions are based on the limited information available from a relatively small random sample taken from the lot. There are three primary reasons which may require sampling inspection to be employed: **(i) when the inspection operation destroys the product item being inspected; (ii) when production delay due to the inspection operation is not feasible; or (iii) when the cost of 100% inspection is prohibitive.**

Another way of inspection operation classification is based on the purpose of the product. **Acceptance sampling** inspection distinguishes acceptable production lots from nonacceptable lots. Acceptance sampling is used for (i) final inspection, where the product is moving from the producer to the distributor and to the customer; (ii) process inspection, where product parts are moving from one production department to another production department for further processing operations; and (iii) incoming or vendor inspection, where raw materials or finished product is moving from the vendor company to the purchaser company.

5.2.4 Quality management costs

Crosby (1979) and Bessant (1991) refers to quality management costs as `costs of quality,' and `quality costs' by Kirkpatrick (1970). As indicated (in section 5.2.2) overall quality management costs are made up of two types; those incurred in prevention of mistakes and checking for them, and those incurred through a failure of these procedures (either in the factory where the result is scrap or rework, or in the marketplace, where they lead to complaints, warranty costs, and so on). Kirkpatrick classifies these costs as capital costs and operating costs, as indicated in Figure 5.9.

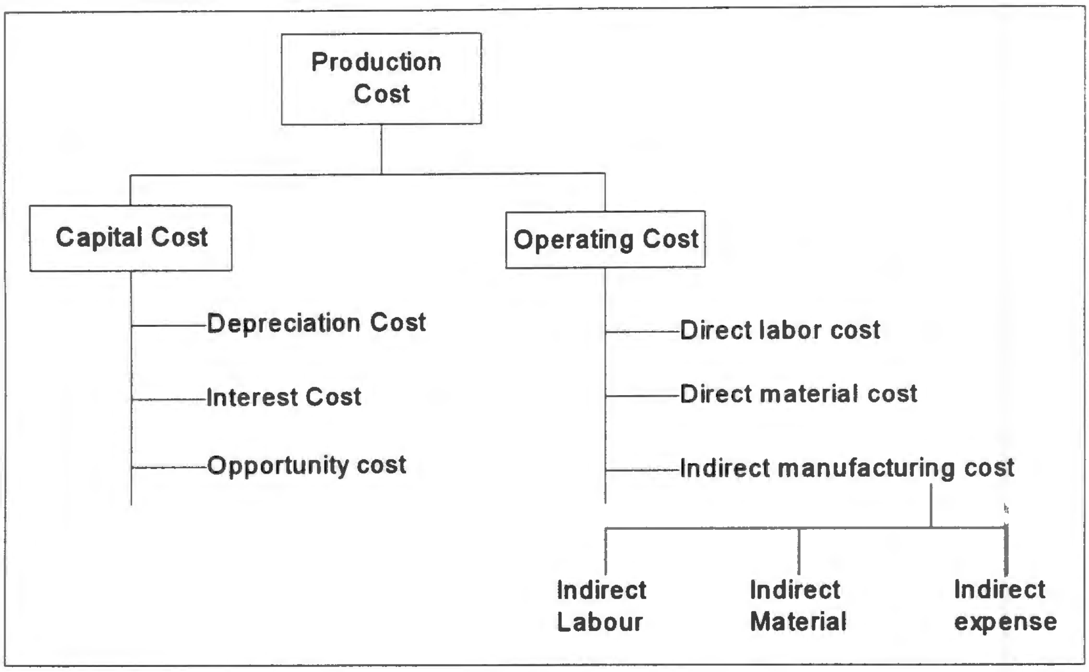


Figure 5.9 Quality management costs (adapted from Kirkpatrick 1970)

When looking at quality management costs, the starting point should be the classification of production costs, which include **capital costs and operating cost.** These could be referred to as **universal costs, and sub-costs** will include quality management costs under the same universal headings as indicated in Figure 5.9.

One of the sub-costs of capital costs are attributable to the quality effort. These are mainly expenditures for new gaging hardware and data processing equipment. To evaluate specific quality efforts, the necessary quality costs can be extracted from conventional accounting summaries.

The expenditures made in an effort to prevent poor quality are termed **prevention costs.** Typical elements included in this cost category are for the following quality management activities: quality planning, engineering, and adminstrative staff work; design and development of quality measuring equipment; quality training and preparation of instructional materials; and staff time involved in vendor surveys.

The costs of measuring quality characteristics to assure conformance to the technical specification are classified as **appraisal costs.** These include expenditure for all inspection labour and supervision and any indirect labour required, such as that used in receiving inspection of bulk raw materials. Also included according to Kirkpatrick are indirect labour charges for gage calibration and maintenance, indirect material charges for inspection and test supplies, laboratory test charges, and costs of outside certifications.

Expenses generated by product not meeting the quality requirements are termed as **failure costs.** There are two types of failure costs: internal failure cost, and external failure costs. All production losses fall under internal failure costs. Production losses include material, labour, and overhead charges on scrapped product, that is, expenses accumulated for a product item up to the time that nonconformance is detected. Other production losses are due to downtime in the production line caused by quality deficiences. These include material, labour, and overhead charges for rework operations, and labour charges. It must be noted that internal failure costs also include any engineering or quality management staff time required for corrective action to solve immediate quality problems that develop on the manufacturing floor. The other side of failure costs include all expenditures for handling customer complaints and performing field service required because of quality deficiencies, and these arec termed as external failure costs.

The remaining operating costs are the vendor's quality costs **(indirect quality management costs),** which are reflected in the purchase price of the materials and hence represent a quality cost to the purchaser firm.

Looking at the three sets of costs, prevention costs, appraisal costs, and failure costs, Kirkpatrick focuses on their typical contribution to the total quality management costs. He argues that prevention costs are (approx.) 10%, 25% for appraisal costs, and 50 to 75% for failure costs. He suggests that budgeting for quality follows the basic strategy of searching for an optimum balance between these three sets of costs, illustrated in Figure 5. 10.

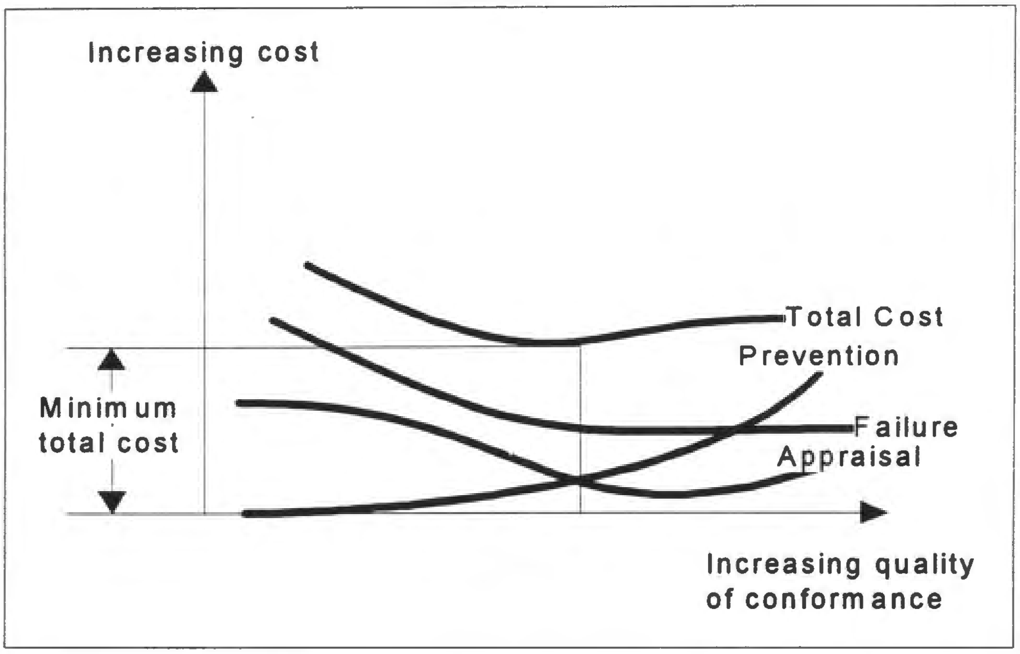


Figure 5.10 Prevention, appraisal, and failure costs (adapted from Kirkpatrick 1970)

The result of increases in prevention costs according to Kirkpatrick, usually result in better quality of conformance. With better quality of conformance, appraisal costs are likely to decrease, that is, less routine inspection is required since there are fewer defective in each manufacturing lot. Also, he argues that failure costs are expected to decrease. An increase in quality of conformance, nominal increase in prevention expenditure are accompanied by significant reductions in both failure and appraisal costs, resulting in a net decrease in total quality management cost (regarded here as the sum of the prevention, appraisal, and failure costs). There is an optimum quality of conformance level, q, where minimum total quality management cost is achieved.

5.2.5 The international organization for standardization(ISO 9000/9004)

As discussed above, a quality management system should intergrate all elements required by a project or an organization to continuously improve customer satisfaction through better products, service, and processes. There is no universal prescription, but the ISO series

9000/9004 provides benchmarks which provide operational definitions of total quality magement. Any industry outside manufacturing which wants to adopt excellent experiences of the manufacturing industry can now use the ISO 9000/9004 series (Sayle 1994, Flood 1993) to establish appropriate quality management approaches. In other words, it is argued that the openness of ISO 9000/9004 series allows the implementing industry a chance to question all stages of developing a quality management system, hence addressing the question of appropriateness. The ISO 9000/9004 provisions provides a general quality management system which represents all the main principles of TQM which have contributed to the success of the manufacturing industry in producing quality products. These main principles of TQM include:

(i) There must be agreed requirements, for both internal and external clients.

(ii) Clients' requirements must be met first time, every time.

(iii) Quality improvement will reduce waste and total costs.

(iv) There must be focus on the prevention of problems, rather than an acceptance to cope in a fire-fighting manner.

(v) Quality improvement can only result from planned management action.

(vi) Every job must add value.

(vii) Everybody must be involved, from all levels and across all functions.

(viii) There must be an emphasis on measurement to help to assess and meet requirements and objectives.

(ix) A culture of continuous improvement must be established (continuous includes the desirability of dramatic leaps forward as well as steady improvement)

(x) An emphasis should be placed on promoting creativity.

5.3 Quality management theory in the construction industry

Quality management (QM) has become one of the major challenges facing an increasing number of clients, professionals, contractors, researchers, and other interested parties in the construction industry (for example Burati *et al.* 1992, Ball 1988, Flanagan 1988, and Paulson 1988). Quality is a term that has been used so widely that it means different things to different people in the construction industry (Culp and Smith 1993).

Like in the manufacturing industry, the starting point in understanding quality management theory has been centred on the definition of quality. Flood's argument that, ambiguities and confusion about quality exists in the manufacturing and service industries is valid in the construction industry. His suggestion that these ambiguities and confusions about quality are caused by some very basic misconceptions about quality itself, management and organisations, is relevant to the construction industry (see for example Cornick 1991, Culp and Smith 1993, and Graves 1993).

5.3.1 Defining quality

Like the manufacturing-based definition, quality in construction is defined as the attainment of a desired level of excellence which has been clearly defined in terms of requirements for people, processes and finished product of the client's building (Cornick 1991, Griffith 1987). Ashford (1989) on defining quality uses the following words:

" . compliance with a defined requirement, of value for money, of fitness for purpose, or customer satisfaction. "

Baverstock (1992) demonstrates the supreme position of **client requirements,** by formulating what he calls **the QM regime** as indicated in Figure 5.11. The construction definition of quality conforms with the manufacturing definition as indicated in section 5.2.1.

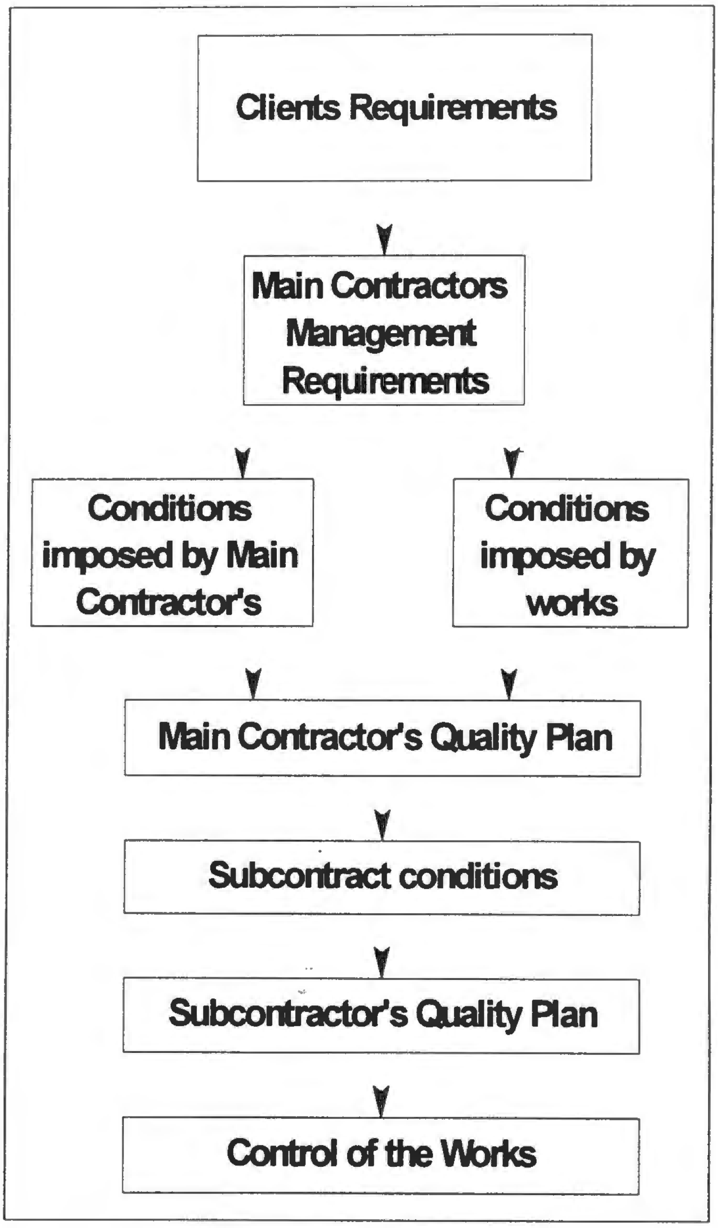


Figure 5.11 The QM Regime (adapted from Baverstock 1992)

5.3.2 Models of the building process

An examination of general organization theory in Chapter 4 was done in order to provide a basis for an examination of the building process, and specifically to aid in search for management actions or approaches that will lead to the acievement of one of the project objectives/parameters of increased performance.

Increased performance is a product of an appropriate quality management approach. Different models of the building process demands different quality management approaches. Before looking at the elements of quality management under a specific building process model predominant in the Botswana construction industry, it is important to focus on the global construction industry and briefly examine other models from past studies as a basis of examining the dominant building process model in Botswana.

(i) Baden's models

The relationships that exist between participants in the building process were described in Baden's models (Baden 1962, 1965a, 1965b). These models suggest communication relationships and authority relationships. However the models are considered to be partly helpful in this research because they show minimal appreciation of human well-being and emancipation especially the need for models to bring human issues into focus as technical concerns.

(ii) The Tavistock model

Higgin and Jessop (1965) and Crichton (1966) studied the U.K. building industry, and provided a conceptual descriptive model of the building process. Five closely locked subsystems were found to make the building process:

- a system of operations;
- a system of resource controllers;
- a system of formal controls (direct functions);
- a system of informal controls (adaptive functions);
- a system of social and personal relations.

This work shows promise by providing a description of a cross section of the building process, and it embraces both technical concerns and human issues of the building process. The human issues are not appropriately extended to a flexible model.

(iii) The RIBA plan of work

This is the best known and most comprehensive set of documentation within english speaking countries. This plan of work (RIBA 1967,1980) provides a detailed description of the building process from the architect's point of view, and even gives some description of alternative contractual arrangements. It is the intention of this model that by following the plan of work, "an architect may concentrate on architecture, rather than on management". The inception stage begins with the client considering the need to build, and setting up an organization with a chairperson to manage the project from the client's side. This model as will be demonstrated in section 5.3.3 dominates public building contracts in Botswana.

(iv) The Turin model

Under this model the building process is described in four process types. Here Turin (1968) shows the flow of decisions and the changing sources of authority during the process, for each of four fairly discrete process types. This work shows promise, but the researcher has not found a good balance between project technical concerns and human issues. The four process types appear too discrete to relate to each other and embrace both technical and human issues within the building process.

(v) The Honey model

Based on Bishop and Alsop's (1969) study, Honey (1969) provides a description of architectural design in flow chart form. The model provides a general description of the design process but, lacks an appropriate balance in looking at technical and human issues. Technical concerns appear to dominate the model with implied focus on human issues.

(vi) Napier's model

This was an attempt to extend the work of the Tavistock group. It provided a slightly more advanced descriptive model of resource controllers and their functions, the factors that affect decision makers and an idealised communication system. Like sister studies (Higgin and Jessop

1965 and Crichton 1966) this model falls short in embracing human issues appropriately when compared with the treatment it accords to technical concerns.

(vii) Baker, Murphy and Fisher

The focus of this model is in the field of project management, where the application of contingency management practices are studied (Baker, Murphy and Fisher 1976). A study was done of 650 projects and over 200 variables were measured on each. This model provide the concept of a link between actions and results, a problem that has existed if one attempts to use contractual arrangements and many other models that are primarily useful for describing the process. Although this model lacks a full appreciation of the need to maintain a systematic balance between technical and human issues its strong acknowledgement of these issues relates well with the intentions of this study. This research work will fit within the framework of this model and extend the concept developed.

(viii) Walker's model

Walker (Walker 1980) developed *Linear Responsibility Analysis* (LRA) from the works of Burns and Stalker (1966), Lawrence and Lorsch (1967), and others. This model contains the following propositions:

(a) The building process is divided into the systems of: *conception, inception, and realization* at primary decision points; and into sub-systems at the *key decision* and *operational decision* points.

(b) The *differentiation* of the system should be matched by a corresponding level of *integration* effort.

(c) The *managing system* and the *operating system* should be *differentiated.*

(d) The *managing system* itself should be *undifferentiated.*

(e) The *client* and the *building process* should be *integrated.*

This is an open systems model (see 4.5 above) and closely related to Flood and Jackson's model. It is one of the appropriate models from which to relate the current research work.

(ix) Hughes's model

This model provides a whole picture of the building process. Using Walker's model [5.3.2:(viii)] as a departure point, it encompasses the elements of construction management, i.e. the concepts of *activity, decisions, interdependence, differentiation, and integration*; and relate these to the environment of the project (Hughes 1989). The model proposes that a description of the organizational structure would consist of identifying and describing the following (Hughes 1989:80):

(a) the environment of the project;

(b) the objectives of the project;

(c) the control systems to be used;

(d) the incidence of decision points;

(e) the tasks to be undertaken;

(f) the relationships of the tasks to each other;

(g) the relationships of the contributors to their tasks;

(h) the relationships of the contributors to each other.

This model refines Walker's model, hence closer to Flood and Jackson's model (4.5.2).

(x) Cornick's model

This quality management model for building projects refines Walker and Hughes's models on one project parameter `quality'. It comprises the following:

(i) the critical phases and tasks needed in the building design and construction process based on the observation of practice;

(ii) a standard process model that can apply to any design or any other associated process in the project;

(iii) the application of the fundamental philosophy and mechanisms of quality.

Hence the most appropriate departure point for developing an analytical method for Botswana public building sector projects quality management. It needs refining in terms of embracing TSI (4.5.7, 4.5.8, 4.5.9 and 4.5.10).

(xi) Other models

Other building process models have been developed by Stocher (1972), Morris (1971, 1972, 1973, 1974a, 1974b, 1979), Markus (1976), Wearne (1973), Diepeveen (1976), Paulson (1976), Irwig (1980), Woodhead (1980), Walker (1981), Sidwell (1982), Ireland (1983),British Property Federation (BPF) (1983), Property Services Agency (PSA) (1984) and Austen and Neale (1984). Analysis of processes in other industries have been done by Trist and Bamforth (1951), Miller and Rice (1967) and Kingdon (1973). But all these do not contribute anything further.

5.3.3 Elements of quality management

In order to understand the elements of quality management in building construction, it is necessary to describe the building project and the building process, and the way in which the participants interact in the building team. The traditional project organisational system (TPOS) as suggested by Rowlinson (1988) will be used (see Figure 5.12), as it is the predominant system used in Botswana on public building projects. This system follows the RIBA model as indicated in section 5.3.2:(iii).

Under the TPOS, argues Rowlinson, the authority for design and that for construction are vested in the architect and contractor (builder) separately. The architect, whilst keeping a watching brief and monitoring construction (monitoring the three factors; **time, cost and quality)**, does not have any responsibility for the construction process: Rowlinson describes this as divided responsibility. Using the Botswana Government Agreement and Schedule of Conditions of Building Contract (BGA) as an example, Clause 1 and 3 sets out the contractor's obligations.

The primary obligation for the building contractor is **to execute and complete the Works in accordance with Drawings and Bills of Quantities** (contract documents). The Permanent Secretary (P.S.) - usually represented by the Architect, cannot demand better quality than is stated in the Drawings and Bills of Quantities (BOQs), as amended by the P.S. instructions

(architect's instructions) regarding quality, etc. According to Clause 3, design responsibility is excluded on the part of the contractor. The contractor undertakes to complete the Works in accordance with the supplied design. Quoting from Clause 3:
" *----if the contractor finds any discrepancy there in (in the Drawings and BOQs) he shall immediately and in writing refer the same to the P.S. who shall decide the procedure.* " This implies that the contractor is regarded as an expert in construction and so any design matter that the contractor **considers dubious** should be queried by him or her, in writing to the P.S. (architect), requesting his or her instructions and indicating the possible construction problems and / or possible subsequent failure.

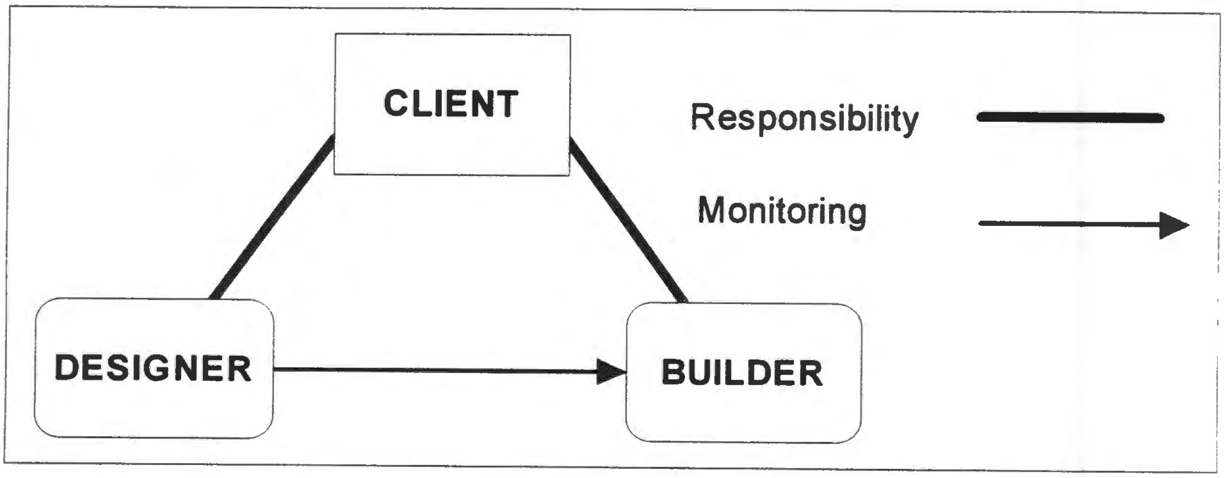


Figure 5.12 Traditional organisation system (adapted from Rowlinson 1988)

Projects carried out through the Botswana Housing Corporation (BHC), a government parastatal follow a standard form similar to the BGA: Agreement and Schedule of Building Contract (BIDPF).

Looking at the traditional organisation system, from the **construction contract** view, Ashford (1989), illustrates what he calls **"conventional construction contracts"** in Figure 5.13. The party to a construction contract who makes the payment is the client (employer). This may be a private individual, a limited liability company, a local authority, a government department or any other incorporated or unincorporated body. The other party to the contract, who is to carry out the works, is the contractor (builder), building contractor or civil engineering contractor. The client (employer) and the contractor are two parties to the main contract, which usually follows one of the standard forms of contract in common use within the industry (BGA and BIDPF).

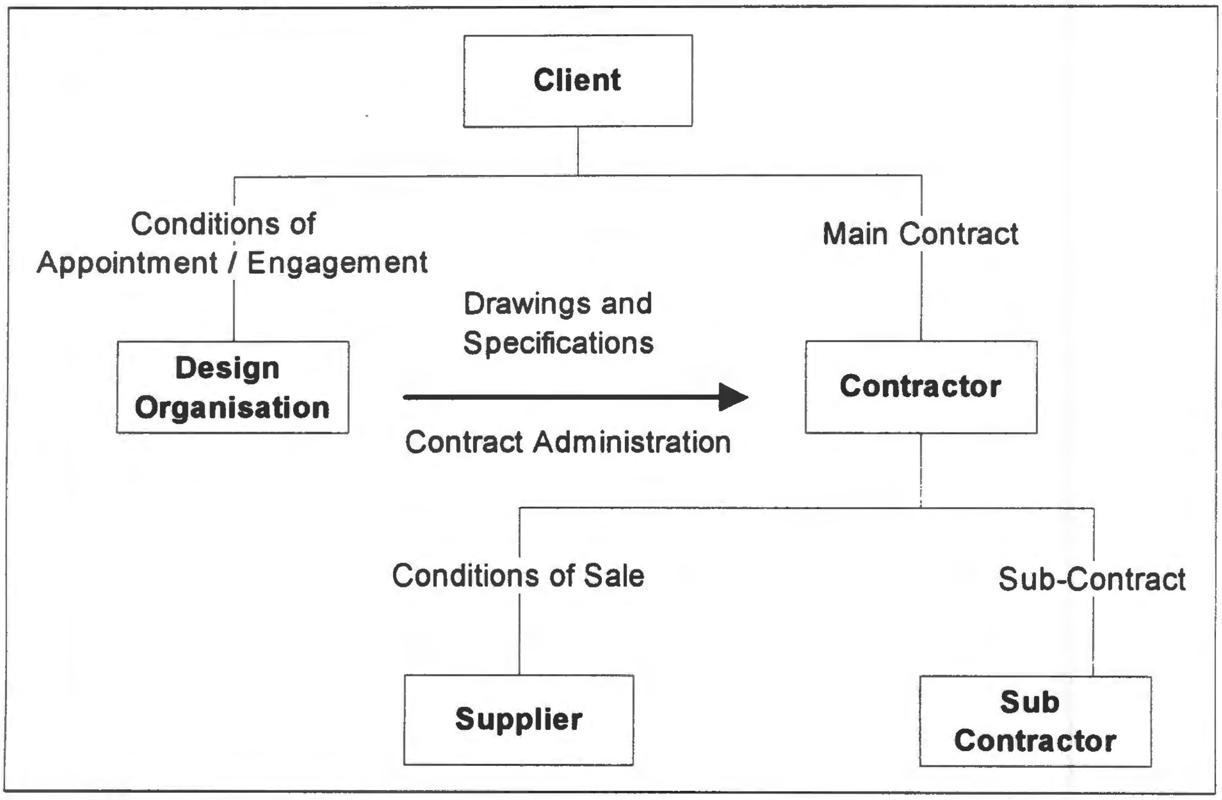


Figure 5.13 Conventional (Traditional) construction contract (Ashford 1989)

Looking at the agreement between the two parties to the contract, Ashford suggest that there must be a mutual understanding between the two parties to the main contract (the client and the contractor) as to what is to be built in return for the agreed consideration. This, argues Ashford, requires that the contract should incorporate a set of drawings and specifications. For a clients having architectural (design) or expertise within their own organizations, the client consultants within their firms will prepare the necessary documents and seek tenders from interested contractors. However, clients who only rarely enter market for construction projects are not likely to have these resources at their disposal and they will find it necessary to enter into a separate contract with an architect (a designer), or a consulting engineer, or perhaps both to carry out the design work and to assist in supervising the execution of the main contract. There are standard forms of contract for the engagement of architects (designers) and these stipulate the role and responsibilities of the person or persons engaged.

In Botswana the majority of public building contracts are managed through private consulting firms, either under the Department of Architecture and Building Services (DABS) or Botswana Housing Corporation (BHC). Architectural, Engineering and Quantity Surveying expertise within these organizations is limited to handle small building projects. Private consulting firms are usually commissioned to design and supervise most of the projects under close supervision of DABS or BHC.

Managing quality in the briefing and designing phases

According to Cornick (1991), briefing is recognized as the critical activity that begins the building project process. The Royal Institute of British Architects (RIBA) Plan of Work [see 5.3.1:(iii)], is the primary model of most Architectural practices within the English Commonwealth Countries (Botswana included). It emphasizes that the architect as building designer must elicit the brief from the client before any design activity can begin (Royal Institute of British Architects 1989). Many clients are not expert in expressing their requirements to the architects (or designers) that they have engaged for a construction project. Using Stevens (1979) words:

"They believe that to be an important, if not the most cogent reason, for commissioning knowledgeable people to help make the necessary decisions." This puts the architect in a very demanding situation of guiding the client, hence it will not always be sufficient merely to accept the client's instructions. The architect must know the client's objectives, his or her ambitions, so far as the client can reveal and articulate them. Stevens suggest that it will pay to find out what level of quality the client will regard as normal, in the performance of his or her designers and in the design of his or her project. In all this, Stevens contends, that **the skill and experience** of the architect (designer) is of the utmost importance. It must be emphasized

that such knowledge will facilitate the interpretation that the architect must put upon the instructions he or she receives, so that the brief is an adequate reflection of the clients intentions. The aspect of conformance to client's brief which forms the backbone of quality management is further advanced by Stevens (1979). He suggests that in the interpretation of the client brief, the architect (designer) should, as far as possible, tailor his or her attitudes and approaches to suit those of the client. It is a design management responsibility to see that the client brief and its interpretation reaches those in the design team who need to know, in a form they can understand. Design cannot proceed effectively unless that happens. Stevens argues for the time factor to be considered by design management, he suggests that both objectives and attitudes change with time, hence the need to review the process in the currency of the project.

Teams of designers in construction often collaborate with designers in associated disciplines (for example structural designers, service designers etc.), and with others with no design function. Such teams rely on each other for an understanding and explanation of the information exchanged, to satisfy the client requirements/project requirements. The design management has got a responsibility of aiding the process by seeking to understand the attitudes, and the aims of collaborating designers, and the difficulties they encounter in their work.

Design managers must always remember, that design, cannot successfully proceed behind the closed doors of the drawing office. The managers should take account of the external environment: external requirements must be well expressed, so that they are understood properly, and that the client makes the best decisions and grants correct and timely authority.

After confirmation of feasibility, and receipt of client authority to proceed, the next step is the development of the design in proposals and subsequently in more detail. Here judgement and experience of the design team is required in order to narrow the field to those proposals most likely, on detailed examination, to prove most suitable. Stevens argues for the demands of associated disciplines which may govern, he suggests that these must be taken into account at the right time. Design management should aim at providing the optimum proposals for the project as a whole, and this should be put forward for the client's approval on grounds of suitability for purpose and of specification and cost (conformance to client's brief). Good design management will produce a proposal which provides for all factors of significance, on which the client can confer a lasting and confident approval.

All the above stages lead to the making of contract documents (which contains the **planned quality standards**), and the calling of tenders and the letting of contracts to build, prior to the construction phase.

Quality management in the construction phase

Ideally, all design and specification has been completed and verified for its capability of being produced to the cost, time and quality set in the briefing phase. According to Cheetham and Carter (1993), the architect's (designer) objective during construction is to ensure that what is constructed satisfies the client's needs, while the contractor's objective is to construct the building in accordance with drawings, specifications and other instructions provided to make a profit.

According to Ferguson and Mitchell (1986) achieving quality during the construction phase is very largely to do with communication, between client and designer (architect), between client, designer and builder, and within the building organisation itself. It is normally assumed that the agreed quality levels are clearly expressed down the chains of command, in a form related to the needs of each individual and project organisation (see Figure 5.14).

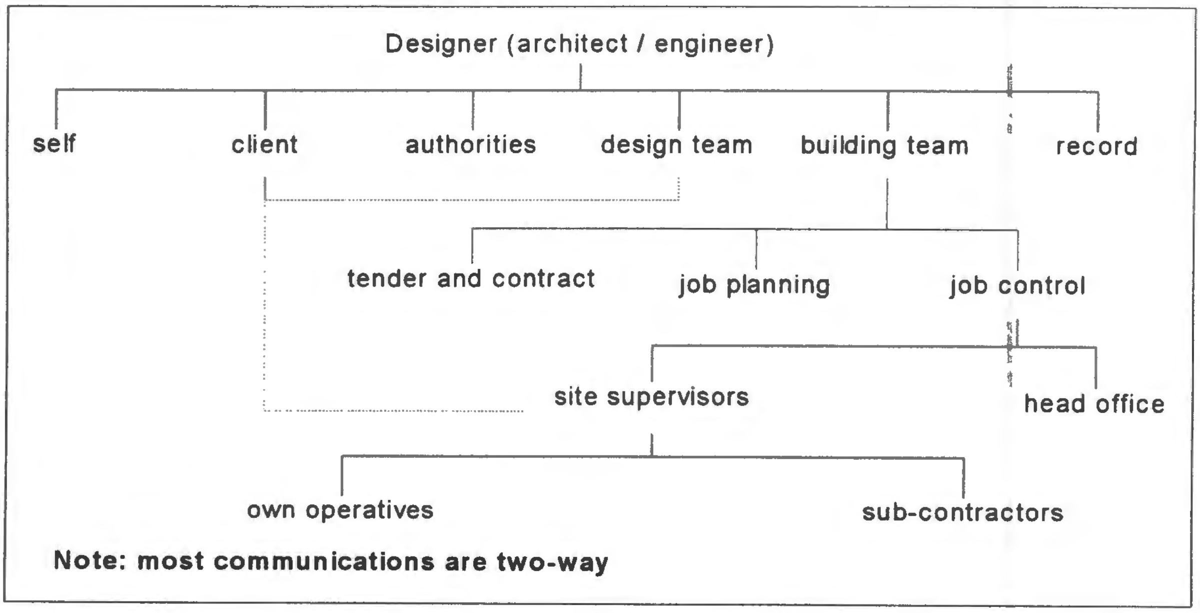


Figure 5.14 Project communication hierarchy (Ferguson and Mitchell 1986)

Under the traditional construction contracts, there are opportunities for checking the correctness of instructions and for inputs to be made at each stage in the interest of efficiency and progress. The procedure is illustrated in Figure 5.15. The contractor (builder) transmits the agreed quality level (embodied in the contract drawings, specifications etc.) to a site team capable of building at the appropriate level. Thus, in Figure 5.15, `Sl' represents the team belonging to the best builder capable of working to the highest standards (conforming to client brief) and therefore at the top of the 'quality gradient' whilst `S4' represents the team working at the lowest acceptable standard. The team chosen according to Ferguson and Mitchell, may fall somewhere between these extremes, its choice governed by availability and price in addition to the ability to satisfy the quality standards for the job.

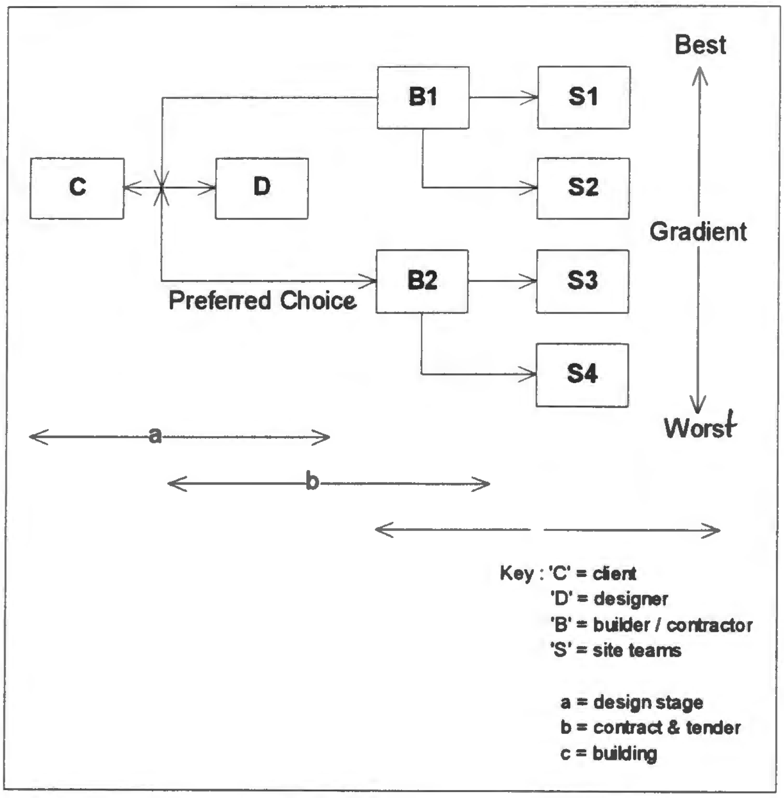


Figure 5.15 Quality gradient (Ferguson and Mitchell 1986)

At this stage the drawings, written descriptions and references must help the contractor in understanding the design and in ordering materials and components. If a drawing contains information affecting the work of several different trades, these must be separated out like strands in a rope to see what the work content of each is; it is also necessary to examine the interface between trades, to assess likely interference and the consequent need for a higher level of management input. It is worth noting that defining of standards is by reference to lists of Codes of Practice and Standards applicable for that particular project. It is on the basis of the drawings, written descriptions and references that the contractor makes key management decisions, such as what skill level of site manager to appoint and which sub-contractor to choose. The requirements for production documentation at construction stage according to Ferguson and Mitchell can be summarised as follows:

:The operatives' needs - information is passed from the designer (architect) to the contractor, and the contractor passes the information to the site team capable of working at the agreed quality levels. The site manager or agent is the recipient of this information and has the primary responsibility for interpreting it and transmitting it to the operatives. To enable the site manager to build the building, the following documentation is essential:

:Drawings - all drawings necessary for the work. The traditional construction contracts are based on the requirement that the design should be complete at the time of selecting the contractor (Hughes 1992). This is one of the requirements of traditional construction contracts which most projects have failed to achieve. Rwelamila (1992), for example, surveyed 12 general contractors in Botswana (Gaborone case study) on the factors affecting productivity, 80 percent of the construction managers surveyed were of the opinion that the separation of design and construction results in considerable time wastages, waiting for drawings on sites and rework due to changes in design.

:Specifications- written descriptions and references to quality standards. For example Clause 6 of the Botswana Goverment Agreement Schedule of Conditions of Building Contract (BGA) sets out the requirement for the Bills of Quantities to act as the specification document in describing all materials, goods and workmanship. Based on this clause the P.S. (architect) may require the contractor to provide vouchers to ensure or prove that the goods and materials comply with the specified requirements.

:Bills of Quantities/or Schedule of Rates - listing materials, components and work required in terms of quantity and price and defining any special contract conditions **:Orders** - copies of orders already placed by head office, method of placing orders: for materials, components, sub-contractors and plant. Clause 11 of BGA refer to quality and quantity of work to be that set out in the BOQs, and all the measurements pertaining to contract works shall be measured from the BOQs.

:Programme - programme of work in bar chart, line of balance or network form etc.

:Statutory documents - accident book, registers of inspection for excavations, scaffolds, etc. In order to be effective, the site manager must be aware of the quality standards to which he or she is expected to work. These will be defined partly by the documents above, in terms of the building's purpose, technical performance and appearance, and partly by the accepted standards in the construction firm itself.

After the assimilation of documentation by the site agent, the relevant information must be passed on to the operatives. The methods of doing this will vary. Ferguson and Mitchell suggest the following examples:
(i) **Meetings:** these can be held and information transmitted verbally; on larger contracts it is especially important to hold regular meetings with trades supervisors at which to review progress, plan future work, pass on instructions and information and generally to ensure that trades are working effectively together.
(ii) **Mock-ups and sample panels:** these should be built for approval by the site manager.
(iii) **Drawings:** drawing of difficult details could be simplified.

In addition to selecting the right methods for transmitting quality instructions initially, quality management must be exercised over the period of the contract. On day to day basis, this will be the responsibility of trade supevisors, site agent and clerk of works, on a weekly basis by the contracts manager or job architect and on an occasional and random basis by senior management and principal consultants.

For sub-contractor's work which is of unusual or difficult nature, specialised supervision must be provided. Ultimately, according to Ferguson and Mitchell (1986) the quality on site is controlled by the person on the job. There is an inbuilt requirement in a traditional contract system, that the person on the job is expected to be properly trained, and all time motivated, because if this is not the case, quality levels will fall, regardless of supervision (Bentley 1981).

There are two other factors which may require specialised documentation and sensitive transmission of information. These are: (i) the use of sub-contractors and (ii) changes in design during the course of the work.

Ferguson and Mitchell, look at a situation where sub-contractors may have their own methods of working and be differently motivated, expecting to work to their own standards of quality and (say) over shorter or longer time scales than the remainder of the work-force. They argue that this situation may affect the drawings and instructions issued to sub-contractors. These may have to be more specific or different in emphasis from those required for a contractor's own people. Different types of drawings and instructions may be given, and regular meetings to explain the conventions in use by the general contractor and designer on that particular job may be necessary.

There is a possibility that changes in design during the course of the job could disrupt working patterns and sequences and de-motivate both supervisors and operatives. Ferguson and Mitchell (1986) site an example where, (say) in a weekly visit, a designer condemns a piece of brickwork, issuing an instruction for the work to be rebuilt. Whatever the reason for that nonconformance, a lack of clarity about design intention and of acceptable quality standards can create annoyance and frustration, thereby risking not only poor performance, but also increased costs and delays in completion. A traditional contract system works on the premise that procedures for dealing with changes in design should be established at the beginning of the contract, and that changes should be instructed in writing and for all variations in the work to be dealt with by the contractor in a systematic manner which does not `raise the temperature' of the site.

The above arguments are supported by Gunning (1983), that in order to ensure good quality during the construction process, you need a system which will closely monitor and manage site resources. This is illustrated in Figure 5.16.

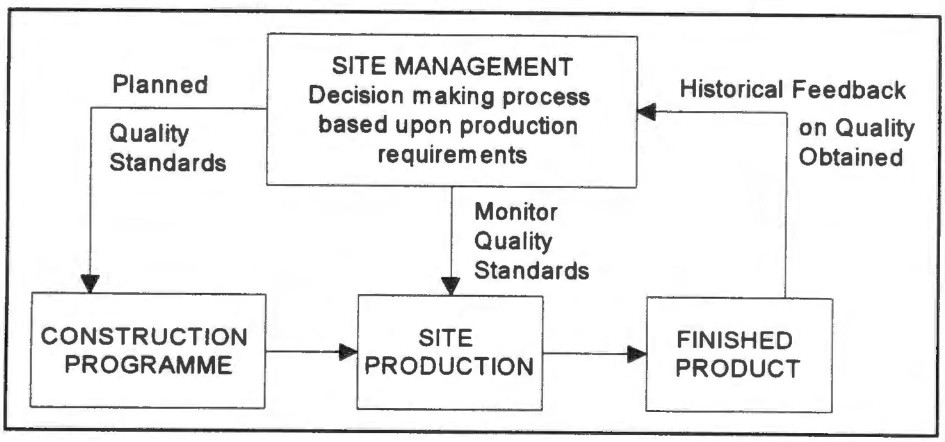


Figure 5.16 The Requirements for maintaining quality on site (Gunning 1983)

From Figure 5.16, the site manager/agent executes day-to-day management of construction, making production decisions based upon past, current and expected future performance. The role and function of a site manager, is very complex it involves keeping fully abreast of, for example, the performance of new materials and updated use of components. According to Griffith (1987), quality management is only one activity of many the site manager must accomplish. He argues for `**Formal**' quality management mechanisms in order to have managerial effectiveness in handling what he calls `quality conundrum'(or quality problems). The traditional contract system doesn't follow formal quality management, and the argument behind this is that construction work is not particularly conducive to such procedures. For example,the rejection of work often appears to be a little known practice. According to Griffith, pre-occupation with fulfilling production output appears to take clear precedence over maintaining the quality of output.

While `**formal**' quality management as is known from manufacturing does not exist in construction under a traditional contract system, the built in `**informal**' quality management system allows inspection as an essential part of the construction process. It is through inspection that quality is assured (Griffith 1987 and Ellis 1990).

Even though inspection is known to be a key element in the construction process under a traditional contract system, the cost aspects of construction inspection are frequently not given appropriate consideration. According to Ellis (1990), inspection costs can be significant. He argues for a need to estimate inspection costs and for efficient accounting of actual inspection costs. Also, he suggests that an appropriate method in which optimum levels of inspection and testing could be selected, need to be established.

Looking at an inspection cost equation, Ellis argues that this equation is similar to a general construction cost equation. Inspection may require labour, equipment, sub-contractors, and in some cases, materials. Normally, Ellis suggests, both direct and indirect or general expenses must be considered. The construction inspection process, for the most part, remains a human function. Labour costs represent the major part of the total cost.

Most inspection involve a physical examination or observation of the work and a comparison of the actual work to the specified standard. The inspection is performed by a person who has been trained to inspect the particular work being performed (i.e. masonry, concrete, carpentry and joinery work inspectors etc.). Depending upon the scope of work involved in a project, inspectors with different qualifications may be required.

As indicated in Figure 5.17, the cost of inspection (curve A), increases as the level of inspection effort increases. However, the cost of substandard work (curve B), decreases as the level of inspection effort increases. The net cost shown by curve C, is the sum of these costs. The optimum level of inspection effort with regard to cost occurs at the lowest cost point on curve C.

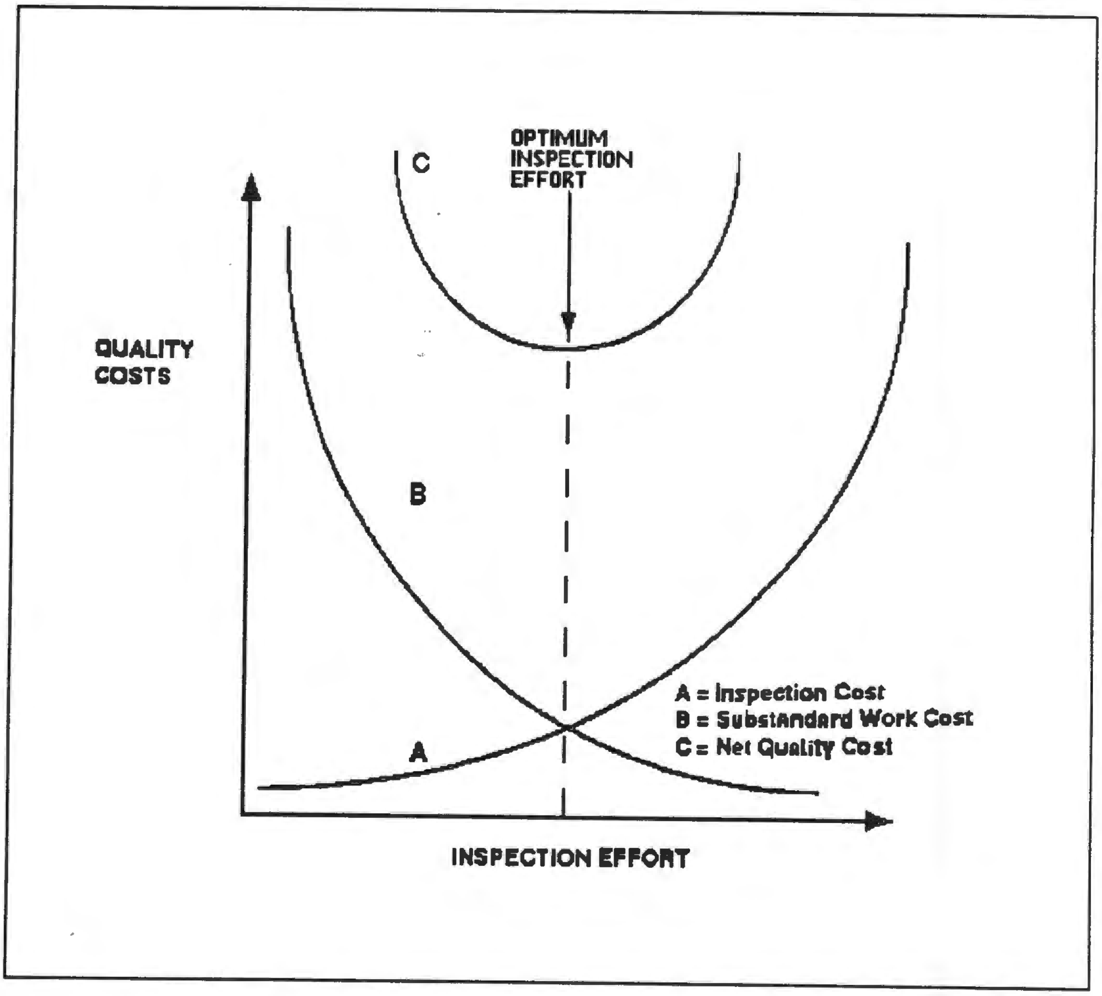


Figure 5.17 The relationship between quality and cost inspection effort (Ellis 1990)

The relationship between quality cost and the level of inspection effort is based on the assumption that increasing frequency of testing and inspection results in an improvement in work quality. According to Ellis, it is assumed that inspection results will provide motivation and technical information will improve subsequent work.

5.4 Differences between manufacturing and construction industries

While the evolution of quality management in manufacturing is parallel to that of the construction industry, the extensive documented development work on quality management as discussed in chapter 2, 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.

Although clear parallels are visible between manufacturing and construction industries, there are many dissimilar characteristics which distinguish the two industries. These differences, some of them significant, must be considered when applying a manufacturing quality management model to construction (Rounds and Chi 1985):

(i) Almost all construction projects are unique. They are single-order, single production products.

(ii) Unlike manufacturing industries, which usually have a fixed site with similar conditions for production, construction production sites are always unique.

(iii) The life-cycles of construction projects are much longer than in any other production industry, so that projects evolve according to time and circumstances throughout the life-cycles.

(iv) There is no clear, uniform evaluation standard in overall construction quality as there is in manufactured items and materials; thus, construction projects usually are evaluated objectively.

(v) Since construction projects are a single-order design product, the client usually directly influences the production.

(vi) The project participants-client, designer(s), quantity surveyors, general contractor, subcontractor(s), material supplier(s), etc.-almost all differ for each project (Araki 1980).

The above realities undoubtedly make the introduction of appropriate quality management approaches more difficult than in manufacturing industries. But if it is true that the management of construction sites is a uniquely formidable task, it makes sense to follow in the examples in the United States of America, Japan, Germany, France and the United Kingdom of adapting to construction the quality management principles previously discussed in section 5.2. These principles have been relatively employed successfully in manufacturing (Rounds and Chi 1985). Instead of trying to focus on some successful sectors in manufacturing industry, towards adapting the main principles of TQM, ISO 9000/9004 series provides these principles in a way which does not ignore the differences between manufacturing and construction.

5.5 A general critique of the traditional theories in quality management

Traditional quality management theories both in the manufacturing and construction industries rest behind traditional management organisation theories (Flood 1993). These theories have been shaped by the quality `gurus'(Deming, Juran, Crosby, Shingo, Taguchi, Ishikawa, and Feigenbaum) philosophies, principles and methods, through history as described in chapter 2 and elsewhere (Flood 1993 - Chapter 2).

Based on Flood's arguments, these theories have provided well for the technical mechanistic needs. They cover technical needs from design right through to inspection of final product. There is very little in these theories in respect to organisational design. Flood contends that the organisational hierarchical tree (see Figures 5.5, 5.6, 5.12, and 5.14) is implicitly assumed under these theories in most circumstances. There is a thin thread within these theories on the systematic nature of organisations, this gap needs attention.

Flood looks at an obvious gap in these theories, where management of the human dimension of organisations is not at all clearly provided for. There is a declaration of interest in managing people in the philosophies of these theories, but on analysis there are few tangible principles and virtually no usable methods.

A further disection of these theories by Flood, looks at one dimension not dealt with under these theories, beyond simple comment, nor indeed adequately covered in popular management theory is what Flood calls **"the political and coercive character of organisational decision making."** This leads to Flood's question: " **Whose interests are being served?"**

Flood gives a speculating answer that probably the pressure is on to please the powerful to ensure that something gets done. This, he contends is despite the likelihood that on many occasions the dominant wisdom would not lead to the greatest benefits overall, as indicated in Chapters 1 and 2.

On the basis of the above overview and critique, this research must strongly advance an argument that traditional theories are not really adequate, and in Flood's (1993) words, they **"restrict what can be achieved with quality innovation."** It will therefore specifically highlight weaknesses in traditional quality management theories, and show the value of bringing in new more appropriate ones. It will explain and illustrate how viability and culture can step in when traditional ideas fail, to revitalise quality in management.

5.6 Summary

5.6.1 Manufacturing industry

1. Quality is defined as conformance to client's requirements.
2. Quality of design is in concept an economic decision.
3. Quality of conformance involves three principal quality activities: process capability, process control, and inspection, and each quality characteristic is defined by a specification.
4. Quality management is a planning and control, or feedback function.
5. The quality control subsystem is composed of incoming material control, tool and gage control, process control, and inspection and test operations.
6. Efforts to improve product quality are either income expansion or cost-reduction.
7. Operating quality management costs are classified as prevention, appraisal, or failure costs, and the collection of information on quality management costs due to rejected product is essential to any programme of defect prevention.

8. The ISO 9000/9004 series embraces all the main principles of TQM, hence an important document for any sector within manufacturing and construction industries trying to establish appropriate quality management systems.

5.6.2 Construction industry

1. Quality is defined as conformance to client's brief (requirements).
2. Quality management approaches vary according to the respective model of the construction process.
3. Various models of the construction process have several abstract concepts in common; packages of work need to be undertaken, the work has to be managed, decisions have to be made, and individuals' relationships to projects are variable.
4. Most of the models are descriptive (they list activities and roles), very few are analytical. The most significant analytical ones are: Walker (1980) and Hughes (1989).
5. The achievement of quality can result only from a team effort and from attention to detail at every stage of the project cycle. Concern must begin from the very inception of the project, from the appointment of the consultants and the drawing up of the brief. The onus rests on the architect (designer) as the principal agent representing the client.
6. The design intentions (by the designer) must be passed down the communications hierarchy to the contractor's (builder) office and on from him or her to the site, where they must be translated into building by operatives, working under the direction of their supervisor.
7. Managers, supervisors and operatives capable of understanding and applying the information at the agreed quality levels should be approved by the principal agent.
8. Once the decision is taken to build and work starts on site, many aspects of the work, which make a direct impact upon quality should not be overlooked. These may include forming good relationships between all those who will be working together, especially the contractor's site manager (site agent), the Clerk of Works if appointed and the subcontractors, the correct method of establishing the site, etc.
9. Quality management is only one activity of many the site manager must accomplish.
10. Inspection and performance testing are an essential element in all quality management programmes, and the cost of inspection is significant.

5.6.3 The differences between the two industries

There are differences between construction and the manufacturing industry. These differences should be taken into consideration when adapting quality management principles from the manufacturing to the construction industry. Briefly these differences include: the uniqueness of almost all construction projects, construction production sites are always unique (unfixed sites), life-cycles of construction projects are much longer than in manufacturing, there is no clear, uniform evaluation standard in overall construction quality as there is in manufactured items, almost all construction projects are single-order design product and in construction project participants almost differ for each project. The ISO 9000/9004 series provides an appropriate model which takes these differences into consideration when establishing an appropriate quality management system.

A critique

1. Quality management theories, in the manufacturing and construction industries are based on traditional mechanical-coercive vision of organisations held in early scientific management bureaucracy theory.
2. Two vital ingredients are missing in these theories. Viability and culture are missing.
3. There is need to develop a theory for the practice of quality management that ensures human freedom.

CHAPTER SIX

SAMPLING AND MEASUREMENT OF VARIABLES

6.1 Introduction

In Chapter two, the historical development of quality management was explored. Chapter three reported on the pilot study where the indicator factors, contributing to poor quality management, were established. Based on these findings the following research hypotheses were established:

Hypothesis 1 (HYP1):

"Quality problems related to public building construction processes are primarily due to an inappropriate project organizational structure."

Hypothesis 2 (HYP2):

" The traditional building procurement system provides a poor quality management system."

Hypothesis 3 (HYP3):

" The traditional building procurement system is incapable of facilitating derived quality levels as defined by contract drawings and specifications."

Chapter five reviewed quality management theories in the construction and manufacturing industries. This review will help to establish what is considered to be an appropriate quality management system model based on an appropriate project organizational structure in the construction industry. The next stage is to sample and measure variables in current practice of quality management, and through a systematic research method test the ideas generated and ultimately present results which support or disprove the validity of the hypotheses.

This chapter describes the development of the methods adopted to collect data and how they are used to test the hypotheses.

The first section provides the basis of formulating the research method and a summary of methods adopted. The subsequent sections discuss the reasoning behind the selection of these methods by comparing and contrasting the alternatives that were considered for key parts of the research design. These are: participant selection, data collection techniques, data coding and processing procedures and data analysis methods.

6.2 Research method

In this section the final research method adopted for this investigation based on Table 1.1 (Phases 2, 3, and 4) established in Chapter 1 is summarised. The reason for outlining the method at this point in the thesis is to enable the reader to see the overall research concept.

The argument presented by Leedy (1993) concerning method is used as a starting point, where consideration is given to the aspects of solving a problem, and of reaching an objective.

Methodology is provided with a strong base from Dubin's (1969) argument who stated that the aim of research must be assumed to further one's understanding of relationships, events and processes. Leedy (1993) argues that the research methodology must help to explain what the nature of the data is, and what method is used to process them to arrive at conclusions. He further argues that a pragmatic presentation regarding the data may be perhaps most expeditiously handled if the following four principal questions with respect to research data are answered (Leedy 1993:145):

(i) *"What data do you need?"*
(ii) *"Where are the data located?"*
(iii) *"How do you intend to get the data?"*
(iv) *"Precisely and in detail, what do you intend to do with the data?"*

For any research undertaking to be useful, the hypothesis must be seen as the guide for the research in that it must depict and describe the method to be followed in studying the problem (Verma and Beard 1981). The research test of the hypothetical statement then provides a feedback to the model from which it is derived, either to substantiate the model's continued viability or to require its modification.

In this study, the traditional building procurement system as described in section 1.1.1 in chapter 1, (Figure 1.1) and with its management structure as indicated in Figure 1.2 forms the theoretical model of the existing situation in the Botswana public building sector. It is this model which the research hypotheses as restated under section 6.1 above *must substantiate its continued viability or require its modifications*.

6.2.1 Provision of a basis on which to build

From the foregoing arguments it is intended that this study should attempt to provide a basis on which others can build by concentrating on understanding. The notion that a number of managerial actions, which are independent of a rigid traditional building procurement system/or any other building procurement system in the construction industry, can affect the achievement of increased quality has not been systematically explored before. Therefore, if a basis can be established for doing this by developing a flexible approach in establishing a a quality management system in the Botswana public building sector, a useful contribution will have been made.

The subsequent sections discuss the reasoning behind the selection of research methods and techniques to be used for the balance of this study.

6.2.2 Sources of data

An identical questionnaire was sent to three different construction professions, and different questionnaires to construction firms executives and their respective principal employees dealing directly with construction projects. A series of project specification surveys, involving perusing through project documents (in progress and completed projects) and relating the established requirements with the actual work done. Two site case studies involving interviews of site personnel, and observations. Interviews to two main client representatives.

6.2.3 Research subjects

(i) Client representatives of organisations which commission more than 95% of new public building stock in Botswana.

(ii) Construction professionals representing: architects, consulting engineers (civil, structural and services), quantity surveyors, contracts managers, site managers and technologists or technicians at various levels of project organization.

(iii) Contract documents used on a number of completed and projects in progress.

(iv) Construction firm representatives (a construction firm senior executive who is not a contracts manager) of randomly selected firms.

6.3 Research participant identification/selection process

In order to test the hypotheses it was necessary to identify and select a number of projects, client representatives, and professionals in order to conduct a survey.

Project registers at client representatives offices were used to identify projects for analysis (both documentation and site visit case studies). The identification was done randomly. Twelve case studies were conducted.

Names of consulting firms representing three disciplines: architecture, quantity surveying and structural engineering were obtained from The Botswana Institute of Development Professions (BIPD) Directory (1992-93). Letters and questionnaires were sent to all registered architects (13 in number), quantity surveyors (11 in number) and structural engineers (11 in number). The response from these consulting firms was extremely good. 10, 9, and 9 completed questionnaires were received from architects, quantity surveyors and engineers respectively.

The identification of construction firms participants was carried out through a random selection from the Botswana Central Tender Board Secretariat list of Contractors/Consultants (dated 2nd March 1992). Out of 82 Gaborone based construction firms 60 were identified, and each firm was sent 5 different questionnaires (for the senior executive, contracts manager, site manager, trade foreman, and skilled tradesperson). Completed questionnaires were received from: senior executives (34), contracts managers (34), site managers (34), trade foremen (34) and skilled tradespersons (34). Further details of all research participants, are given in Chapter 7.

6.4 Data collection procedure

6.4.1 Use of questionnaires

With the decision to use questionnaires as one of the main sources of data to be collected, the merits and demerits of this method need to be considered.

As a research tool, a questionnaire is subject to various kinds of limitations from several sources (social desirability, anonymity, socio-economic and educational differentials, and so on). These limitations were considered during questionnaire design. Respondents were not required to state their names, and they were assured that the results of the survey were going to be used in aggregate form. Questionnaires were designed to reflect appropriate levels of the respondent's understanding.

Nonresponse to mailed questionnaires is a significant factor that seriously limits the generalization of findings from any study using the questionnaire as a primary data-gathering instrument. In order to address this problem, other methods of data gathering were used (interviews, and case studies) as supplements.

Questionnaire design: One of the primary concerns here was the degree of structure to impose on the person's responses. A combination of three types of questions range from unstructured to structured response formats were used:

(i) **Open-ended questions**: respondents were given an opportunity to provide their own answers to the questions. These questions were included because the author did not anticipate probable replies from respondents on certain issues. Secondly, these questions were included in order to provide insights, side comments, and explanations in order to develop a "feel" for the research findings on various aspects of the study.

(ii) **Multiple-Choice questions**: respondents were given an opportunity to choose an answer from among a list provided in the question proper or following the question. Lists of answers were established from various sources on quality management theory and general management. It was considered necessary that these questions could reduce the researcher bias in formulating questions, and the cost and time associated with data processing.

(iii) **Dichotomous questions**: These are extreme forms of multiple-choice questions which allow the respondent only two responses, such as yes-no, did-did not, agree-disagree, and so on. These were used on the basis of the same reasons for multiple-choice questions. In addition it was considered that the interviewers will find them quick and easy to administer, less chance of respondent bias, and responses are easy to code, process, and analyze. Further more, their risk in assuming that the respondent group approaches the topic of the research in dichotomous terms when, in reality, there may be many grades of feeling or indecision, and the possibility of forcing respondents to express their views in a dichotomous manner when they are not polarized were considered, and their impact was considered very minor.

Another aspect which was considered in the preparation of questionnaires was the response rate. The following factors were taken into consideration:

(i) **Questionnaire length**: Shorter questionnaires will be returned or completed more often than longer ones (Belson 1981). Within the context of what the questionnaires were designed to establish, this factor was considered in establishing the final draft of the questionnaires.

(ii) **Questionnaire content**: Since quality management issues are directly related to construction firms, and construction consultant's business future, in terms of getting more projects, and hence business survival, controversial questions, questions asking respondents to reveal intimate details of their businesses were avoided.

(iii) **Anonymity**: Persons are more likely to respond to a questionnaire to the degree that their anonymity is maintained or guaranteed. A statement was included as the first section of each questionnaire guaranteeing the respondents of their anonymity.

In order to evaluate project consultants on particular issues which were established from the case study (Chapter 3) in terms of their responsibilities in managing quality within their areas of expertise and project responsibilities, an identical questionnaire was designed (see Appendix VIII). Table 6.1 shows the main question areas for consulting architects, quantity surveyors and engineers. Each question was structured to attract responses on factors which are considered to affect quality management on a construction site.

Table 6.1 Consultants Questionnaire Survey Synopsis

Question Areas	Number of Questions
Consultant's identity	4
Incidences of quality problems	4
Major problems concerning quality	1
Project value	1
Time on specific management functions	2
Immediate subordinate staff	1
Specifications planning and write-up	7
Project procurement systems	1

Based on the premise that main contractors decide on tendering for projects from their business strategies point of view, issues related to project quality management must be taken into consideration from firm top executive levels to most junior personnel levels. It was therefore necessary to send a questionnaire (see Appendix III) to randomly selected construction firm executives. Table 6.2 shows the main question areas of the questionnaire.

Table 6.2 Construction Firm Executive Questionnaire Survey Synopsis

Question Areas	Number of Questions
Construction firm executive's identity	4
Incidence of problems concerning quality	4
Major problems concerning quality	1
Project value	1
Time on specific management functions	2
Immediate subordinate staff	1
Project procurement systems	1

Following a typical construction firm management structure, the second level of project management from the top executive is a contracts manager. A questionnaire was sent to contracts managers (see Appendix IV) from the same randomly selected construction firms as indicated above (section 6.3). Table 6.3 shows the main question areas sent to contracts managers.

Table 6.3 Contracts Manager Questionnaire Survey Synopsis

Question Areas	Number of Questions
Contracts manager's identity	3
Experience in current responsibility	1
Scope of responsibility on projects	3
Communication procedures for projects	1
Quality of workmanship	2
Quality management information flow	3
Incidence of quality problems	4
Major quality problems	1
Project value	1
Time on specific management functions	2
Project procurement systems	1
Immediate subordinate involvement in projects	3

The third management level of a typical construction firm deals with the management of various projects under the contracts manager. A questionnaire (see Appendix V) was designed to evaluate the site manager's role in the whole system of quality management on site. Table 6.4 shows the site manager's main question areas.

Table 6.4 Site Manager Questionnaire Synopsis

Question Areas	Number of Questions
Site manager's identity	3
Experience in current responsibility	1
Extent of early involvement in project matters	2
Immediate superior involvement in current project	2
Availability of primary and secondary contract documents on site	3
Instruction to subordinates	1
Quality management information flow	3
Primary and secondary specification documents at a firm level	1
Quality of workmanship	2
The importance of communication in quality management	1
Incidence of problems concerning quality	4
Major problems concerning quality	1
Project value	1
Time on specific management functions	2
Project procurement systems	1

In a building project the role of a site manager is partly to coordinate various activities of specialist trades (eg. brickwork, plastering, concreting etc.). These building trades are normally directly managed by trade foremen. In order to establish the role of a foreman, and hence evaluate the quality management function at trade management level a trade foreman questionnaire was designed (see Appendix VI). Table 6.5 shows the trade foreman main question areas.

Table 6.5 Trade Foreman Questionnaire Survey Synopsis

Question Areas	Number of Questions
Trade foreman's identity	4
Experience in current responsibility	1
Extent of early involvement in project matters	1
Immediate superior involvement in the current project	1
Previous work relationship with current immediate superior	1
Availability of specification on site	2
Factors affecting quality of supervision	1
Site quality management information	2
Quality of workmanship	1
Quality management inspection role	1
The importance of communication in quality management	1
Time on specific management functions	2
Project procurement systems	1

The direct producers of work are skilled, semiskilled, and non skilled workers on site. From this group it was decided to approach the leading worker, who is normally a skilled trade tradesperson. A questionnaire was designed (see Appendix VII) to evaluate the role of workers in the "site floor." Table 6.6 shows the main question areas for skilled tradespersons.

Table 6.6 Skilled Trade Person Survey Synopsis

Question Areas	Number of Questions
Trade person's identity	4
Supervision from top managers	4
Influences on quality	5
Causes of poor quality	1
Opinion on a specific quality aspect	1

6.4.2 Use of interviews

In order to supplement other methods of collecting data used in this thesis (questionnaires and observations), semi-structured interviews were conducted separately between the author and two representatives of two organisations representing the public building client (Government). This method of data collection was selected after considering its merits and demerits.

According to Bouchard (1969) and Green and Taber (1980), the primary disadvantage of interviews is the frequently cited effect on participants of being observed in a laboratory setting rather than in their own natural environment.

Although the ideal situation would have been to observe public client representatives during their normal (`natural') daily activities of managing projects, such an arrangement raised certain practical and methodological issues when the main research objectives were considered. These respondents were responsible for projects throughout the country (Botswana), and interviewing them during their normal activities could have involved travelling to various regions of the country. Secondly, because the research is focusing on quality management problems facing among others, the public client representatives, and how project consultants and construction firms interact, interviewing them in either party's projects was considered to be problematic. Firstly, the researcher would have no control over how interviews are conducted both in terms of the number of people involved in each project and the timescale of them due to other activities which the respondent will have to attend to on site. A valid conclusion would be difficult to produce because of the lack of control over many variables which are characteristics of construction projects on site. Therefore an interview methodology was developed so that valid comparisons could be made between client representatives responses, and other respondents (project consultants and contractor personnel).

The decision was made that the interviews would be conducted in `a laboratory type setting', which is a well established research method in the field of counselling psychology. A semi-structured interview document (Appendix XI) was used with a primary purpose of maintaining uniformity in terms of the main issues of the study. Although the use of a semi-structured interview document might be considered to be `unnatural' the nature of discussions along the established themes during the interviews remained as open as possible.

The setting, in which the interviews took place, was another factor which was standardised as much as possible, with a consistent setting being provided. A number of studies have been conducted into different settings in which interviews take place (for example Bloom *et al.* 1977, Kerr and Dell 1976, White 1953). Widgery and Stackpole's (1972) study found that there was a significant interaction effect between interviewers desk position and interviewee anxiety level. Taking this into account the setting of the interviews was standardised so that the interviewee's sitting position influenced the interviewer's chair position. Room arrangement consisted of a desk, with two opposite chairs for the interviewer and interviewee. No other parties were allowed during the interviews.

6.4.3 Use of case studies

The observation method was used in gathering information through case studies. The merits of this method, according to IPR-UPE (1992) are that, it does not rely on the respondent's willingness to provide the desired data. Secondly, the potential bias caused by the interviewer and the interviewing process is reduced or eliminated. Thirdly, certain types of data can be collected only by observation. Those behaviour patterns of which the respondent is not aware can be recorded only by observation.

The observation method has two major disadvantages which limits its use: first is the inability to observe such things as awareness, beliefs and preferences. Secondly, the observed behaviour patterns must be of short duration, occur frequently, or be reasonably predictable if data collection costs and time requirements are to be competitive with other data collection techniques. These disadvantages were considered to be insignificant because this method was adopted as a supplement to other methods indicated above. This argument is supported by IPR-UPE (1992:G22):

> *"In practice, observational techniques are used in conjunction with other data collection techniques."*

Two types of case study approaches were adopted in gathering information on quality management to supplement questionnaire, and interview surveys:

(i) Site management and contract documents observation

Under this approach two construction sites were randomly selected, and observations were centred on the research hypotheses as indicated in chapter 1 (section 1.3) and chapter 3 findings.

(ii) Contract documents observation

Specifications and drawings of ten completed projects were observed. Observations were based on the pilot study statement that:

> *"Specifications are generally considered to be poorly written, ambiguous, obsolete, unclear and irrelevant."*

Specification were observed on the basis of this statement, and documented defects were identified and compared with respective physical conditions of buildings in question.

6.5 Different levels within the model

Taking a project organizational form as a building project management model/procurement system. This could be described by the three hypotheses established in chapter 3:

6.5.1 Level 1 (HYP1)

The hypothesis establishes the basis that the use of an inappropriate organizational structure potentially affects the Quality of public buildings in Botswana.

6.5.2 Level 2 (HYP2)

The hypothesis establishes that the traditional building procurement system provides a poor quality management system.

6.5.3 Level 3 (HYP3)

The hypothesis establishes that the traditional building procurement system is incapable of facilitating derived quality levels as defined by project contract documents.

6.6 A Contribution to knowledge

The provision of supporting evidence for HYP1 above, is considered to be a useful contribution to knowledge. If it could be shown that the relationship between the achievement of quality and choice / or establishment of a project organizational structure / building procurement system is a good basis of a more general model for quality management decisions in building projects it would be worthwhile. This would be so even if the effect of particular project managerial actions had not been established.

Providing supporting evidence for the effects on quality of the traditional building procurement system described by HYP2, would be a useful contribution to knowledge as the author is not aware of any systematic testing of the traditional building procurement system and its relative effects on the achievement of Quality during the construction process.

Closely related to HYP2, is the third hypothesis. The provision of supporting evidence for HYP3, is considered to be a useful contribution to knowledge. If it could be proved that there is evidence to support or to refute the relationship between the traditional building procurement system and its ability to facilitate derived quality levels would be a positive contribution to knowledge.

It must be argued that the development of a methodology on which further work might be based is useful. This will be done through the development of a framework for measuring quality and the identification and use of various methods of testing data that are appropriate for this and future work.

Beyond works which are referred to in chapter 1 and 3, one is left with many journal articles and what Ireland calls "common knowledge". However the "common knowledge" is not generally accepted.

The only other knowledge on which one can build is a group of industry assumptions that, as far as the writer is aware, have not been proven, as discussed in Chapter 3 and 5.

Although organization theory as discussed in Chapter 4 is used as a tool in this research, no attempt will be made to contribute to knowledge in that discipline. The attempted contribution to knowledge is in the broad area of the built environment and specifically in the management of public building projects in the construction phase. However, the application of organization theory to this type of problem may contribute to knowledge.

6.7 Summary

This chapter has explained the basic propositions from the hypotheses, and how the data collection has been carried out, in order to understand the analysis in later chapters. It has discussed the various methods used for conducting the data collection. Questionnaires, interviews and observations have been selected.

CHAPTER 7

THE CURRENT PRACTICE OF QUALITY MANAGEMENT: A QUESTIONNAIRE SURVEY

7.1 Introduction

Thus far, with the exception of chapter 3, quality management has been discussed in general terms. The previous five chapters have examined the history, theory and meaning of quality management with little attention, other than general examples, to specific issues in the Botswana public building sector. A broad quality management conceptual framework has been the goal. How that framework translates into the day-to-day realities of the the construction process of various projects has been sketched only briefly.

For these reasons, this chapter and the next chapter are devoted to reporting the results of empirical surveys, case studies and interviews undertaken in the Botswana public building sector.

This chapter reports the results of questionnaire surveys to architects, quantity surveyors, engineers, construction firm executives, site managers, trade managers and skilled operatives; discussion of these results and their implications and relationship to case studies and interviews discussed in chapter 8 will follow in chapter 9.

For the exact wording of the questions, reference should be made to the appropriate questionnaire in **Appendices II-VIII**. Questions specific to a particular group of respondents (e.g., construction firm executives, question number 1) are identified by the appropriate prefixes (e.g., CFE:1).

Associated with each question listed in the questionnaire, there exists a number of variables. Within each variable, a number of options are provided against which respondents were requested to insert information. Thus, the following response rates refer to individual response rates which were received for different questions. In general, the percentages associated with various forms of opinion option are given, but where these results are misleading, this is explicitly stated. Hence, unless otherwise stated, where the term `respondents' is used, it refers to item respondents as opposed to the overall response rate to the survey.

7.1.1 Survey response

The number of respondents who replied by the due date, stipulated in the covering letter accompanying the questionnaires, was very good. A response rate of approximately 50% for each of the eight groups canvassed was achieved. This is depicted in Table 7.1a.

Table 7.1a Response rates

	CF (N=369)		CM (N=123)		SM (N=492)		TF (N=615)		ST (N=2460)		AR (N=13)		QS (N=11)		EN (N=11)	
Descrip.	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Total actual sample	60	100	60	100	60	100	60	100	60	100	13	100	11	100	11	100
Total responses	30	50	35	58	28	47	32	53	25	42	10	77	8	73	9	82

CF= Construction Firm executive, CM= Contracts Manager, SM= Site Manager, TF= Trade Foreman, ST= Skilled Tradesman, AR= Architect, QS= Quantity Surveyor, EN= Engineer

A number of questionnaires were `returned to sender'. Upon investigation, it was established that the Botswana construction industry was going through recession, and many construction firms and consultancy firms were either relocating outside Botswana or were under liquidation. These reasons were noted and inserted against the relevant organisation on the mailing list, and are depicted in Table 7.1b.

Table 7.1b Analysis of non-response to questionnaire survey

	CF	CM	SM	TF	ST	AR	QS	EN
Total dispatched	60	60	60	60	60	13	11	11
Less:								
Under liquidation	16	16	16	16	16	0	1	0
No longer in Botswana	10	10	10	10	10	2	1	2
Reason(s) not known	4	4	4	4	4	1	1	0
Total non response	30	30	30	30	30	3	3	2

CFE=Construction firm executive, CM=Construction manager, SM=Site manager, TF=Trade foreman, ARCH=Architect, QS=Quantity Surveyor, ENG=Engineer

7.2 Construction firm executive respondents (n=30)

The questionnaire survey synopsis details relating to the construction firm executives' questionnaire are tabulated in Table 6.2 in chapter 6.

Seventy and thirty percent of construction firm executives reported that they were in the 40-49 and 30-39 years age group respectively. There were no respondents who were below 30 and older than 50 years (see question CFE:2).

Seventy per cent of respondents (see question CFE:3) have construction experience of between ten to twenty years, and ten percent have more than twenty years. The remaining twenty percent have construction experience between 5 to 9 years. From the above figures it can be deduced that construction firm executives appear to be highly experienced in construction business.

The majority of construction firm executives (85%) reported that they were either Polytechnic or University graduates, and the remaining fifteen percent were qualified through apprenticeship or through brigades (see question CFE:4 and Figure 7.1).

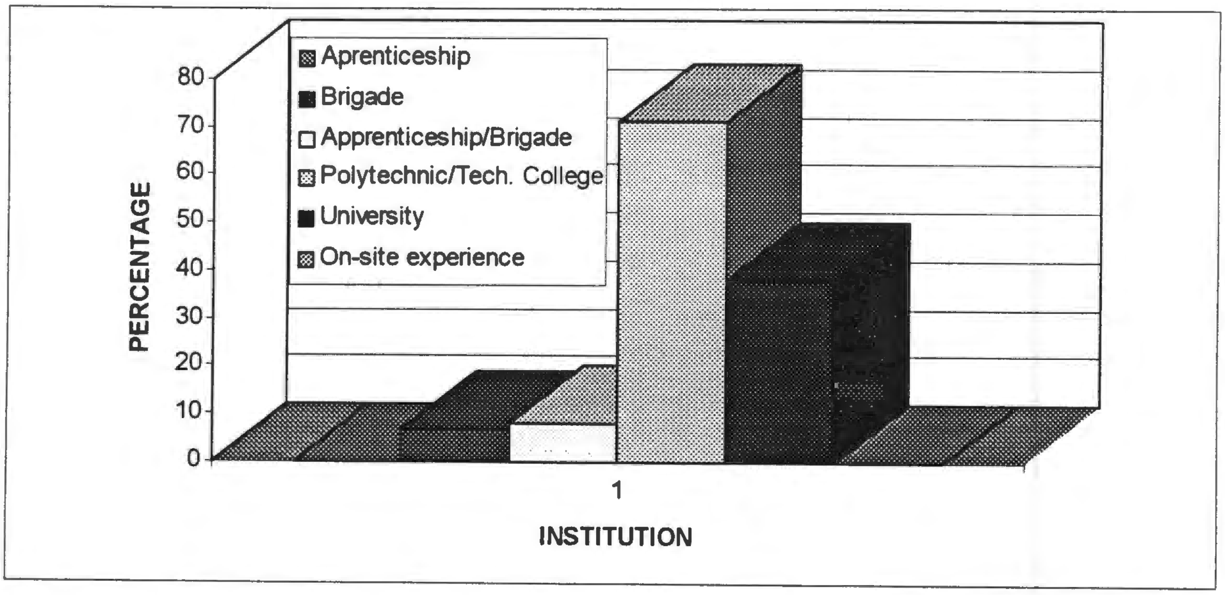


Fig. 7.1 Education of construction firm executives

Construction firm executive respondents reported incidence of problems concerning quality associated with various building trades (see question CFE:5). *Concrete, formwork, plastering, floor finishes, painting and decoration,* were considered to have high incidences of problems concerning quality. Mean values (combining very high and fairly high percentages), results to 48%, 44%, 37%, 41% and 41% respectively. *Brickwork and blockwork, asphalt work, joinery, plumbing, heating and ventilating and electrical* were generally considered to have low incidences of quality problems. Table 7.1 depicts the relative incidence of problems concerning quality.

Table 7.1 Construction firm executives' opinions regarding relative incidence of problems concerning quality (by trades) (n=30)

	Very High	Fairly High	Fairly Low	Very Low
Excavation	0%	18%	70%	12%
Concrete	58%	38%	4%	0%
Formwork	42%	45%	13%	0%
Reinforcement	38%	23%	23%	16%
Brickwork and Blockwork	10%	13%	71%	6%
Asphalt work	8%	14%	44%	34%
Roofing	0%	21%	45%	34%
Carpentry	6%	12%	43%	39%
Joinery	5%	26%	31%	38%
Plastering	12%	61%	27%	0%
Floor finishing	8%	73%	19%	0%
Plumbing	18%	10%	30%	42%
Heating and Ventialating	6%	11%	19%	64%
Electrical	0%	20%	12%	68%
Glazing	0%	5%	25%	70%
Painting and Decorating	0%	82%	9%	9%

Table 7.2 depicts the relative incidence of problems concerning quality, associated with various types of operatives (see question CFE:6).

Table 7.2 Construction firm executives' opinions regarding relative incidence of quality problems (by type of operatives) (n=30)

Type of operatives	Very High	Fairly High	Fairly Low	Very Low
Direct employees-Craftsmen	10%	10%	70%	10%
Direct employees-Labourers	10%	37%	45%	8%
Subcontractors-Labour and Materials	0%	40%	50%	10%
Subcontractors-Labour only	19%	32%	49%	0%

According to the respondents to question CFE:6, *subcontractors-labour only*, are considered (on average) to have a high incidence of quality problems (26%). *Direct employees-labourers, direct employees-craftsmen and subcontractors-labour and materials* are considered (on average, combining fairly low and very low values) to have a low incidence of quality problems (27%, 40% and 30% respectively).

From Table 7.2 it can be deduced that, employing labour only subcontractors will result in high incidences of quality problems.

Respondents reported high incidences of quality problems in structural work located below ground level and internal finishes (see question CFE:7). *Work on roof covering, structural work from ground floor level and above* were considered to have low incidences of quality problems. The results of this are shown in Table 7.3.

Table 7.3 Construction firm executives' opinions regarding relative incidence of problems concerning quality (by location) (n=30)

Building location	Very High	Fairly High	Fairly Low	Very low
Structural-below ground level	62%	20%	13%	5%
Structural-ground floor and above	5%	10%	85%	0%
External cladding	0%	40%	52%	8%
External finishing	5%	38%	57%	0%
Roof coverings	0%	6%	51%	43%
Internal finishings	9%	58%	33%	0%
Services	9%	24%	12%	55%
External works	0%	13%	25%	62%

Construction firm executives (65%) consider conventional buildings to have relatively very low incidences of quality problems, when compared with industrialised and system buildings and alterations work (see question CFE:8). 59% and 58% of respondents consider industrialised and system building and alterations work to have fairly low incidences of problems concerning quality. The responses are shown in Table 7.4.

Table 7.4 Construction firm executives' opinion regarding relative incidence of problems concerning quality (by type of work)

Type of building work	Very High	Fairly High	Fairly Low	Very Low
Conventional building	11%	11%	13%	65%
Industrialised and system building	11%	22%	59%	8%
Alterations	12%	30%	58%	0%

To establish what construction firm executives consider to be major problems concerning quality, respondents were asked to list three major quality problems in order of importance (see question CFE:9). These major problems are listed in Table 7.5.

Table 7.5 Construction firm executives' opinions regarding major problems concerning quality in order of importance (n=30)

Major problems concerning quality	Listed:first	Listed:second	Listed:third
Lack of qualified operatives.	60%	20%	5%
Communication breakdown: the management knows but operatives don't.	5%	0%	0%
Missing specifications.	5%	20%	25%
Lack of pride of workers.	5%	0%	0%
Time restraints.	0%	5%	0%
Architect's poor supervision.	5%	0%	0%
General organization of projects very poor.	10%	30%	20%
Attitude of operatives on site very negative.	0%	0%	5%
New materials	0%	0%	5%

Three problems are considered to be dominant among nine major problems concerning quality listed by construction firm executives. These are, *lack of qualified operatives, missing specifications, general organization of projects very poor.* Sixty per cent of the respondents report that lack of qualified operatives is the first major problem concerning quality, 10% and 5% of respondents list *poor project organization* and *missing specifications* as their first problem respectively .

To establish the work load of construction firms, as well as approximate values of project(s) in hand, respondents were requested to insert the number of projects in the various range of contract sums (see question CFE:10). The majority of construction firm executives (60%) reported having at least two projects of over 4 million Pula (approximately over 5.72 million Rands) in value. 55% reported having at least two projects of between 2-4 million Pula (approximately 2.86-5.72 million Rands) in value. Only 10% of the respondents had four projects of between 0.9-2 million Pula (approximately 1.29-2.86 million Rands) in value. These results are reflected in Table 7.6.

Table 7.6 Number and approximate value of current project (n=30)

	Number of Projects				
Value of current project	1	2	3	4	>4
(a) Less than P 150,000	10%	15%	0%	0%	0%
(b) P 150,000-P 450,000	5%	25%	20%	0%	0%
(c) P 450,000-P 900,000	10%	35%	10%	0%	0%
(d) P 900,000-P2,000,000	15%	25%	30%	10%	0%
(e) P2,000,000-P4,000,000	35%	55%	0%	0%	0%
(f) Over P4,000,000	20%	60%	0%	0%	0%

Construction firm executives were asked to state the approximate proportion of time, in an average working week, spent on activities which are primarily and directly concerned with achieving a specified level of quality (see question CFE:11). The analysis of responses proved to be very difficult. A range of percentages were stated, ranging from 1% to 70%, without a significant number of respondents in a particular range. The highest percentage of respondents (15%) stated that they spent 40% of their time on activities which are primarily and directly concerned with achieving quality. Thus, the statistics derived from construction firm executives responses do not bring any significant conclusion.

An attempt was made to establish the approximate proportion of the time stated in question CFE:11, that respondents spend on various activities (see question CFE:12). The results relating to this issue are shown in Table 7.7.

Table 7.7 Approximate time spent on various activities (proportion of time in question CFE:11) (n=30)

	Percentage (%)					
Management activities	**100-80**	**79-60**	**59-40**	**39-20**	**19-1**	**0**
Inspection	5%	5%	0%	0%	10%	0%
Supervision	0%	10%	5%	5%	15%	0%
Verbal instruction	5%	5%	0%	10%	35%	0%
Written instruction	5%	5%	0%	10%	35%	0%
Discussion	0%	0%	5%	20%	25%	0%
Assistance	0%	0%	5%	5%	25%	0%
Correspondence	0%	5%	5%	5%	40%	0%
Report Writing	5%	0%	5%	5%	40%	5%
Travelling	0%	10%	0%	10%	50%	0%
Other (specify)	0%	0%	0%	0%	0%	0%

Although question number 12 results in Table 7.7 could not be linked directly to the responses in question CFE:11 as intended because of a stretched list of percentages without a significant number of respondents in a particular range, there is a point worthy of note. A significant proportion of construction firms executives spend between 1-19% of their quality management time on travelling (50%), report writing (40%), corresponding (40%), making verbal (35%) and written (35%) instructions.

When asked to state the average number of persons who directly report to them, 70% of the construction firm executives stated that they were directly managing between 15 to 40 employees, 25% between 2 to 12 and 5% between 40- to 100 employees.

As reported in Chapter 1 (sub-section 1.1.1), the dominant project organization/or project procurement system in the Botswana public building sector is the traditional procurement system. This system was discussed in detail in Chapter 5. Because so little exists to confirm the general use of a traditional procurement system, beside using traditional standard contract forms and traditional project management structures, where such a procurement system ought to be used, it was necessary to examine the circumstances where it is used in practice in the Botswana public building sector. The circumstances (statements) where the traditional procurement system is likely to be successful as advocated by Franks (1984) and Hughes (1992) were tabulated, and construction firm executives were asked to indicate how true those statements were applicable to most of their public building projects undertaken within the last 6 years (see question CFE:14). The results relating to this issue are shown in Table 7.8.

Construction firm executives agree (Table 7.8:point 1) that in their projects, clients commission, and take responsibility for the design of the work (100% response). By this is meant that the client commissions the design **[this point is also advanced by JCT (1988)]** and therefore, has responsibility for that design when appointing a contractor to produce it. This client-sponsored design is the most distinctive feature of the "pure" traditional procurement system. It means that the contractor is **only** responsible for production.

The 100% respondents acceptance of Table 7.8: points 3,5,6,7and 9 project circumstances (statements) appears to confirm a trend towards the use of the traditional procurement system in the Botswana public building sector. But the 100% rejection of two primary requirements of a traditional procurement system (Table 7.8: points 2 and 8), that *the design is not complete* *at the time of selecting the contractor and that there is no acceptable negotiated project contract form used in order to ensure a fair and familiar distribution of risk*, suggest a fundamental departure from the basic (`pure') traditional procurement system to an adjusted version of the system. The term chosen for an adjusted version of a procurement system is a *`hybrid version'* of the basic (`pure') procurement system, hence in this case the respondents responses suggest the use of *a hybrid version of the traditional procurement system in the Botswana public buiding sector* (Hindle and Rwelamila, 1993:69).

Table 7.8 Construction firm executives' opinions regarding the characteristics of their projects (n=30)

Project characteristics	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works	100%				
2. The design is complete at the time of selecting the contractor					100%
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum	100%				
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication			90%		10%
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect	100%				
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices	100%				
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)	100%				
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk					100%
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue	100%				

Summary of 7.2:

In summary, it appears that the majority of construction firm executives are highly educated (85%) and experienced (75%) in construction business. Furthermore the majority of executives agree that there are high incidences of quality problems within the Botswana public building sector. Concrete, formwork, plastering, floor finishes, painting and decoration are considered to have high incidences of quality problems.

More than 50% of construction firm executives claim that *subcontractors-labour only* have high incidences of quality problems. Nearly 65% of executives claim that direct employees-labourers, direct employees-craftsmen and subcontractors-labour and materials have low incidences of quality problems.

Traditional buildings are considered by construction firm executives to have relatively very low incidences of quality problems when compared with other types of building work. Furthermore, three problems are considered to be dominant by construction firm executives when focusing on quality problems. These are, *lack of qualified operatives, missing specifications and poor general project organization.*

70% of construction firm executives claim that they directly manage between 15 to 40 employees. Furthermore, 25% of executives claim that they manage between 2 to 12 people.

Contrary to general information as discussed in Chapter 1 (sub-section 1.1.1) that the traditional procurement system is the dominant system in the Botswana public building sector, 100% of the construction firm executives report that `a hybrid version' of the traditional procurement system is used in the public building sector of the Botswana construction industry.

7.3 Contracts manager respondents (n=30)

Table 6.3 in chapter 6 depicts the contracts manager questionnaire synopsis. The responses received from contracts managers are reported in chapter 6 (section 6.3).

The majority of contracts managers (65%) are within 40-49 years age group. 35% of the respondents reported that they fall within 30-39 years age group. Furthermore, there were no contracts manager respondents who reported to be less than 30 years old and older than 50 years. These results are commensurate with construction firm executives results.

Contracts managers reported being highly experienced. 70% of respondents (see question CM:2) have construction experience of between ten to twenty years, 15% between 5 to 9% years and the remaining 15% over 20 years experience. These statistics are commensurate with those reported by construction firm executives. Beside those respondents who reported to be have experience of over 20 years, contracts managers results are commensurate with those of construction firm executives.

The majority of contracts managers (65%), as the majority (85%) of construction firm executives reported that they were polytechnic/technical college graduates, and 35% were university graduates (see question CM:3). In contrast to the construction firm executives, there were no contracts managers who qualified through apprenticeship or brigades (see Figure 7.2).

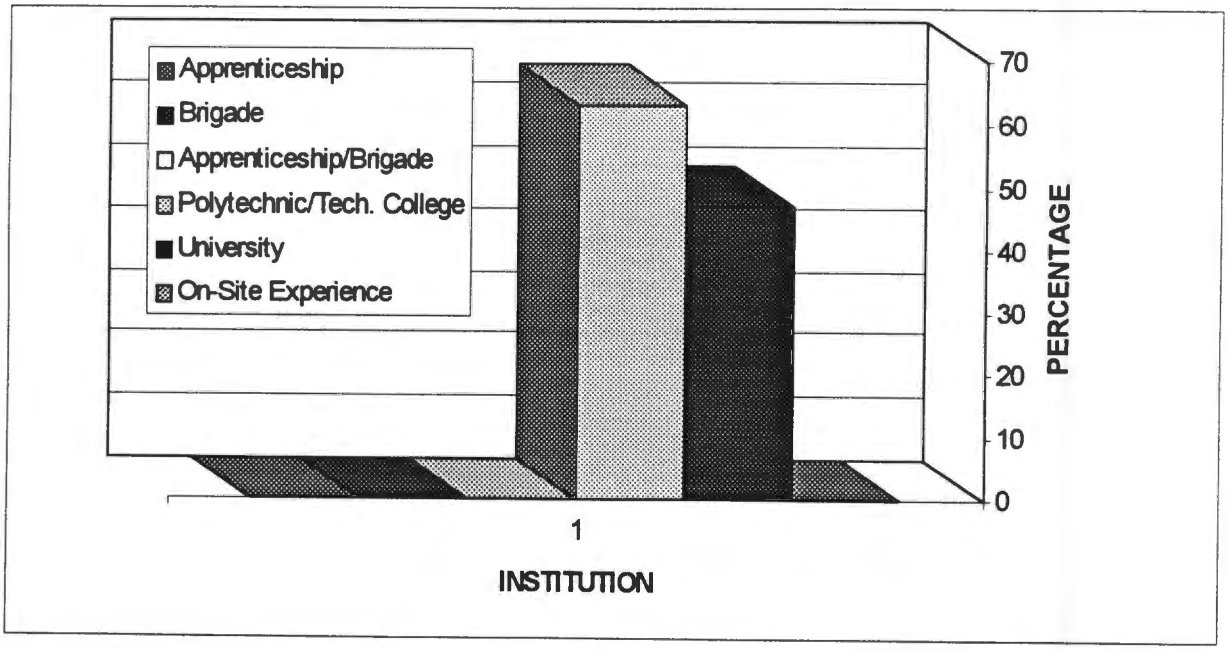


Fig. 7.2 Education of contracts managers

The majority of contracts managers (65%) reported being on their current status or role for more than 5 years, less than 5 years (29%) and less than two years (6%). These results suggest that most respondents were experienced contracts managers (see question CM:4).

Linked to the contracts managers' current status, is the extent of their responsibilities in terms of number of projects they were responsible for. The respondents were asked to state the number of project contracts they were responsible for (see question CM:5). 40% of the respondents reported that they were responsible for 4 projects, others were responsible for 2 projects (7%), 3 projects (26%), 5 projects (7%) and more than 5 projects (20%).

The majority of contracts managers (95%) reported that they were normally involved with new projects at pre-tender stage (see question CM:7). Surprisingly, 5% of the respondents reported that they were normally involved with new projects at commencement date.

All respondents reported that they normally allow site managers/agents to spend less than two weeks on a new project prior to commencement on site (see question CM:8).

All respondents were in complete agreement that, the project architect/engineer or project supervising officer decides the communications procedures for the project. Insofar as the authority of the project architect is concerned, construction firm executives and contracts managers appear to agree (see section 7.2: Table 7.8 and section 7.3 question CM:9).

The majority of contracts managers (75%) appear to favour written instructions to their site managers with regard to project specified requirement (see question CM:10), with other means of instructing: *verbally, respond to request* and *helping themselves from documents available* accounting for 60%, 35% and 30% respectively.

In an attempt to establish the basis of assessing sub-contractors quality of workmanship, contracts managers were asked to place in order of importance the three criterion as indicated in Tables 7.9 and 7.10 (see questions CM:11 and CM:12).

7.9 Contracts managers' criteria for assessing quality of workmanship when using domestic sub-contractors (n=30)

Assessment Criterion	First Criterion	Second Criterion	Third Criterion
Construction firm requirements	67%	27%	7%
Extract from specifications and drawings	67%	33%	0%
The sub-contractors' expertise	0%	13%	87%

7.10 Contracts managers' criteria for assessing quality of workmanship when using nominated sub-contractors (n=30)

Assessment Criterion	First criterion	Second criterion	Third criterion
Construction firm requirements	0%	33%	7%
Extract from specifications and drawings	93%	7%	0%
The sub-contractors' expertise	20%	0%	13%

Most contracts managers claim that *extracts from specifications and drawings* forms the first basis when assessing domestic sub-contractors and nominated sub-contractors (with 67% and 93% respectively). Although the *construction firm requirements* criterion is considered as the first criterion with *extracts from specifications and drawings* criterion when assessing domestic sub-contractors, there is a general agreement in the order of importance of the three criteria given in Tables 7.9 and 7.10 for two types of sub-contractors (see questions CM:11 and CM:12). *Extracts from specifications and drawings, construction firm requirements and the sub-contractors' expertise* are placed first, second and third respectively.

The majority of contracts managers (80%) claim that they depend on receiving reports from others when checking that information has been received on site and is being used to give intended results (see question CM:13). Site personal visits were ranked second by respondents (73%). Surprisingly, some contracts managers reported that there were no checks necessary to confirm the flow of information on site.

When comparing questions CM:13 and CM:14 results, it is clear that the contracts managers response of *`no check'* response (7%), could be explained by question CM:14 results in Table 7.11. **Always** respondents receive reports from others in order to check that head office information has been received on site and is being used to give intended results, they **often** have personal visit (67%), reports from others (7%) and no checks (7%).

Table 7.11 Method of checking information on site by contracts managers (n=30)

Method of Checking Information	Always	Often	Sometimes	Never
Personal visit	20%	67%	14%	0%
Reports from others	80%	7%	0%	0%
No check	0%	7%	14%	14%
Others	0%	0%	0%	0%

Insofar as the relative frequency of factors concerning quality information as contributory causes of unacceptable quality work is concerned, Table 7.12 depicts the opinions of contracts managers (see question CM:15). From the results shown in Table 7.12, it is clear that contracts managers feel that *inaccurate* (84%) and *incomplete* (50%) information are significant contributory factors to causes of unacceptable quality work. Furthermore, 57% of contracts managers claim that there is a fairly high frequency of *late quality information* contributing to causes of unacceptable quality work.

Contracts managers, on the other hand, state that the relative frequency of *complicated* (difficulty) and *poorly presented quality information* as contributory causes of unacceptable quality work is low.

Table 7.12 Contracts managers' opinions regarding quality information as contributory causes of unacceptable quality work (n=30)

Quality of information	Very high	Fairly high	Fairly low	Very low
Late information	17%	57%	20%	0%
Inaccurate	84%	9%	9%	0%
Incomplete	50%	50%	0%	0%
Difficult to understand	0%	0%	12%	40%
Poorly presented	0%	0%	0%	0%
Others	0%	0%	0%	0%

Insofar as the extent of project communication contributing to the quality of the finished building is concerned, all respondents agree that communication contributes a lot (see question CM:16).

Contracts manager respondents were asked to report on incidence of problems concerning quality associated with various trades (see question CM:17). Like constrution firm executives' results, *concrete, formwork, plastering, floor finishes, painting and decoration*, were considered to have high incidences of problems concerning quality. Mean values (combining very high and fairly high percentages), results to 45%, 49%, 45%, 45% and 45% respectively. *Excavation, brickwork and blockwork, asphalt work, joinery, plumbing, heating and ventilating* were generally considered to have low incidences of quality problems. These results are commensurate with those reported by construction firm executives. Table 7.13 depicts these results.

Table 7.13 Contracts managers' opinions regarding relative incidence of problems concerning quality (by trades) (n=30)

Building Trades	Very High	Fairly High	Fairly Low	Very Low
Excavation	10%	15%	75%	0%
Concrete	60%	30%	0%	0%
Formwork	52%	45%	10%	0%
Reinforcement	30%	25%	25%	15%
Brickwork and Blockwork	10%	10%	65%	10%
Asphalt work	0%	20%	50%	30%
Roofing	0%	0%	60%	20%
Carpentry	0%	10%	45%	40%
Joinery	0%	15%	40%	35%
Plastering	20%	70%	0%	0%
Floor Finishing	30%	60%	5%	0%
Plumbing	5%	15%	45%	20%
Heating and Ventilating	0%	15%	10%	75%
Electrical	0%	10%	20%	55%
Glazing	0%	15%	0%	80%
Painting & Decorating	80%	0%	0%	0%
Other (Please specify)	0%	0%	0%	0%

According to contracts manager respondents, *subcontractors-labour only* and *direct employees-labourers*, are considered to have *fairly high incidence* of quality problems (45% and 50% respectively). While contracts manager respondents survey results on subcontractors-labour only are commensurate with construction firm executives results, they differ on the relative of incidence of quality problems by direct *employees-labourers. Direct employees-craftsmen* and *subcontractors-labourers and materials* are considered to have a fairly low incidence of quality problems (65% and 60% respectively). Table 7.14 depicts the opinions of contracts managers regarding relative incidence of quality problems by types of operatives (see question CM:18).

Table 7.14 Contracts managers' opinion regarding relative incidence of quality problems (by type of operative) (n=30)

Type of Operatives	Very High	Fairly High	Fairly Low	Very Low
Direct employees-Craftsmen	0%	20%	65%	0%
Direct employees-Labourers	0%	50%	40%	0%
Subcontractors-Labour and Materials	0%	20%	60%	10%
Subcontractor-Labour only	20%	45%	35%	0%

From Table 7.14 it can be deduced that, employing direct employees-labourers and subcontractors-labour only will result in fairly high incidences of quality problems.

Like construction firm executives, contracts manager respondents reported high incidences of quality problems in *structural work located below ground level* and *internal finishes* (see question CM:19). Furthermore, external cladding was considered by a substantial percentage of contracts managers (45%) to have a fairly high incidence of problems concerning quality. The results of this are shown in Table 7.15.

Table 7.15 Contracts managers' opinions regarding relative incidence of problems concerning quality associated with different locations (n=30)

Building Locations	Very High	Fairly High	Fairly Low	Very Low
Structural-below ground level	70%	15%	5%	5%
Structural-ground floor and above	0%	10%	75%	10%
External cladding	0%	45%	40%	10%
External finishing	0%	30%	35%	25%
Roof coverings	0%	10%	40%	40%
Internal finishings	15%	60%	10%	0%
Services	10%	20%	20%	45%
External works	10%	0%	35%	40%

The majority of contracts manager respondents (55%, 70% and 55% respectively) reported that three types of of work: *conventional buildings, industrialised building and alterations* have fairly low incidences of problems concerning quality (see question CM:20). Generally, these results are commensurate with the construction firm executive respondents results. Table 7.16 depicts these results.

Table 7.16 Contracts managers' opinions regarding relative incidence of problems concerning quality associated with different types of work (n=30)

Type of Work	Very High	Fairly High	Fairly Low	Very Low
Conventional Building	10%	25%	55%	0%
Industrialised and System Building	5%	20%	70%	0%
Alterations	0%	30%	55%	10%
Other	0%	0%	0%	0%

Contracts manager respondents were asked to list in order of importance **three** major problems concering quality (see question CM:21). Question CM:21, was an open ended one, where respondents used their own words in giving their opinions regarding major problems concerning quality. In order to have an appropriate analysis of the question, identical/ same meaning answers were put in the same category. Answers with the same wording from respondents are presented with invited commas. The responses are shown in Table 7.17.

Table 7.17 Contracts managers' opinions regarding three major problems concerning quality in order of importance (n=30)

Major Problems	Listed:first	Listed:second	Listed:third
"Architects are poor supervisors"	30%	35%	15%
"The general organization of ptrojects is very poor"	30%	40%	20%
Lack of qualified operatives	20%	5%	15%
"Communication breakdown: the top project management knows but operatives do not"	0%	0%	0%
"Missing specifications"	10%	10%	30%
Lack of pride of workers	10%	5%	0%
Time restraints	0%	5%	20%

As indicated in Table 7.17, three problems are reported by contracts managers to be dominant (those listed first) among seven major problems listed. These are: *architects' poor supervision* (30%), *general organization of projects very poor* (30%) and *lack of qualified operatives* (20%). When these results are compared with construction firm executives results, two problems are commensurate: these are *lack of qualified operatives* and *general organization of projects very poor.*

To establish the work load of construction firms, as well as approximate values of projects(s) in hand, contracts manager respondents were requested to report on the number of projects in various ranges of contract sums (see question CM:22). The majority of contracts managers (60%) reported having at least two projects of between 2-4 million Pula (approximately 2.86-5.72 million Rands) in value. 55% reported having at least two projects of over 4 million Pula (approximately over 5.72 million Rands). Only 10% of the respondents had four projects of between 150,000 Pula to 450,000 Pula in value. These results are reflected in Table 7.18.

Table 7.18 Number and approximate value of current projects as reported by contracts managers (n=30)

	Number of Projects				
Value of Current Projects	1	2	3	4	>4
(a) Less than P 150,000	20%	20%	10%	0%	0%
(b) P 150,000-P 450,000	15%	30%	25%	10%	0%
(c) P 450,000-P 900,000	0%	25%	20%	0%	0%
(d) P 900,000-P2,000,000	0%	15%	20%	0%	0%
(e) P2,000,000-P4,000,000	20%	60%	15%	0%	0%
(f) Over P4,000,000	20%	55%	0%	0%	0%

Like the results from construction firm executives regarding the approximate proportion of time, in an average working week, the analysis of responses was very difficult (see question CM:23). The highest percentage of respondents (25%) stated that they spent 40% of their time on activities which are primarily and directly concerned with achieving quality.

When an attempt was made to establish the approximate proportion of time stated in question CM:23, that respondents spend on various activities (see question CM:24), 50% of the respondents reported that they spend 39-20% of their approximate time in an average week *giving written instructions*, on activities which are primarily and directly concerned with achieving a specified level of quality. Furthermore, a significant number of contracts managers spend between 19-1% of their quality management time on *discussion* (45%), *correspondence* (55%), *report writing* (60%) and *travelling* (50%). These results are partly commensurate with construction firm executives results on three activities: *travelling, making correspondence and written instructions*. These results are depicted in Table 7.19.

Table 7.19 Approximate time spent by contracts managers on various activities (proportion of time in question CM:23) (n=30)

	Percentage (%)					
Activities	**100-80**	**79-60**	**59-40**	**39-20**	**19-1**	**0**
Inspection	0%	0%	0%	20%	0%	0%
Supervision	0%	5%	0%	10%	20%	0%
Verbal instruction	0%	0%	0%	35%	10%	0%
Written instruction	0%	0%	0%	50%	0%	0%
Discussion	0%	0%	0%	0%	45%	0%
Assistance	0%	0%	0%	0%	15%	0%
Correspondence	0%	0%	0%	0%	55%	0%
Report Writing	0%	0%	0%	0%	60%	0%
Travelling	0%	0%	0%	0%	50%	0%
Other (specify)	0%	0%	0%	0%	0%	0%

It has been established that most contracts managers are not usually involved in a basic (`pure') traditional procurement system in the Botswana public building sector. The respondents agree that some characteristics of a `pure' traditional procurement system exists in most of their projects, but one of the primary characteristics, of a `pure' traditional procurement system, that of *having completed design at the time of selecting the contractor* does not form one of the characteristics of their projects. Thus, a `hybrid version' of the traditional procurement system is normally used. The opinions of contracts managers concerning the characteristics of their projects were sought (see question CM:25). The results of this are shown in Table 7.20.

It is clear from Table 7.20 that, the majority of traditional procurement system characteristics (Table 7.20: points 1, 3, 5, 6, 7 and 9) are considered by contracts managers to be part and parcel of their project characteristics. Clearly, construction firm executives and contracts managers are almost in complete agreement that, in the majority of their projects, characteristics 1, 3, 5, 6, 7, and 9 relate to their public building projects.

While all construction firm executives were not sure about the *adequacy of the architects' experience to cope with the coordination of the design team to lead the design effort , and to co-ordinate the interface between design and fabrication* (see Table 7.8), the majority of contracts managers (70%) reported that they were certain that *architects were not adequately experienced to deal with the same responsibilities* (see Table 7.20). 20% and 10% of the contracts managers reported that *it was a difficult statement to comment on* and that *the statement was more false than true* respectively.

Table 7.20 Contracts managers' opinions regarding the characteristics of their projects (n=30)

Project characteristics	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works	90%		5%		
2. The design is complete at the time of selecting the contractor					100%
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum	85%		10%		
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication			20%	10%	70%
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect	80%		20%		
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices	100%				
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)	100%				
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk				25%	70%
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue	75%		20%		

In conclusion, it appears that construction firms employ contracts managers who are highly experienced, and trained through formal institutions. The majority of respondent contracts managers may be described as experienced in their roles as contracts managers.

The respondent contracts managers are normally involved in quality management issues affecting their public building projects. Furthermore, what is normally referred to as `pure' traditional procurement system is not normally used in public building procurement in Botswana. A `hybrid version' of the traditional procurement system is normally used.

7.4 Site manager respondents (n=30)

The responses received from site managers suggest that most respondents were between the ages 30 to 39 (59%), 30% were between 40 to 49 years old and 11% were less than 30 years old. No respondents were more than 50 years (see question SM:1). Generally, these results are commensurate with those received from construction firm executives and contracts managers, but in contrast on less than 30 years age group. There were no construction firm executive and contracts manager respondents who reported to be within the less than 30 years age group.

Fifty eight per cent of respondents (see question 2) have construction experience between ten to twenty years, 30% more than 20 years and 12% between five and nine years construction experience. From these results, it can be deduced that site manager respondents are highly experienced in construction business, hence generally commensurate with the results received from construction firm executive and contracts manager respondents.

The majority of site managers (70%) reported that they were university graduates, and 30% were polytechnic or technical college graduates. In contrast to construction firm executives, there were no site managers who qualified through apprenticeship or brigades (see question SM:3 and Figure 7.3). These results are commensurate with those received from contracts managers.

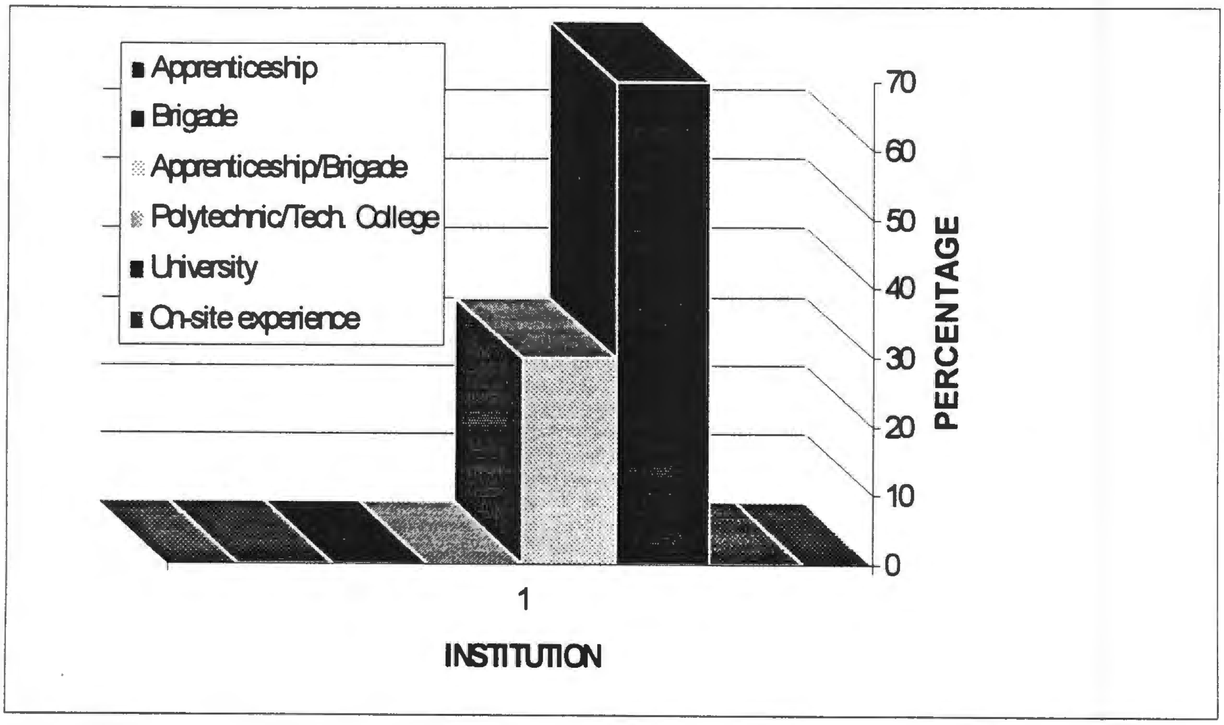


Fig. 7.3 Education of site managers

Clearly, contracts managers and site managers are almost graduates of same level of tertiary institutions, they were either qualified through university or polytechnic/technical college. However, only 35% of contracts managers and 70% of site managers were university graduates, and 65% of contracts managers and 30% of site managers qualified through polytechnics or technical colleges.

The majority of site manager respondents (58%) indicated that, they were on their current positions for more than 5 years, less than 1, 2 and 5 years (14% each respectively). These results suggest that the majority of respondents were experienced in their positions.

Seventy per cent of site manager respondents claimed that they were involved in their respective roles since the project started, and thirty per cent were not (see question SM:5). Interestingly, the majority of respondents (70%) claimed that they have worked for the same immediate superiors prior to the currency projects, and 30% have not (see question SM:6).

Linked to the provision of stable management in a project, is the issue of retaining the same key project management staff throughout the project duration. Site managers were asked to indicate if their current immediate superiors were involved with same projects prior to their involvements (see question SM:7). Fifty nine per cent of the respondents reported that their immediate superiors were *involved with same projects prior to their involvements*, and 41% reported that they were not.

The majority of site manager respondents (59%) reported that they spent *more than two weeks on their current project prior to commencing work on site* (see question SM:8). Twenty five per cent *spent less than two weeks* and sixteen per cent *had no preparatory time allowance before commencing work on site.*

It is important that the site manager be in possession of quality documents on site in order to meet the required project quality. The site managers were asked to indicate if they had *project specifications, bills of quantities, working drawings, and the project programme*. All (100%) respondents claimed that they were in possession of these documents (see question SM:9). Furthermore, when asked if they had current British or South African standards and codes of practice, 72% had less than five of these documents, 15% had more than ten and 13% had none at all (see question SM:10).

Given the importance of adhering to specific local standards, the respondents were asked to confirm if they were in possession of Botswana building regulations and DABS standard specifications (see question SM:11). Eighty six per cent of the respondents were in possession of these documents and 14% were not.

When asked to indicate, how they instruct their site supervisors with regard to specified requirements, the site manager respondents methods of instructions appeared to be wide spread, with 100% claiming to issue their instructions in *writing*, 86% *verbally*, 14% *only when requested* and 42% *let their supervisors help themselves from documents available* (see question SM:12). These results, partly agree with the opinions of construction firm executives (Table 7.7), where 40%, 35% and 35% of construction firm executives claim that they spend 1-19% of their quality management time on report writing, verbal and written instructions respectively. Furthermore, the above results accord most closely with those of the contracts managers (see the analysis of question CM:10), that 75% and 60% of contracts managers favour written and verbal methods of instructions to their site managers.

Site manager respondents reported that information from the project architect, engineer or supervising officer reach them either *directly* or *via head office* (see question SM:13).

Seventy two per cent of site managers claim that their companies possess libraries or current British or South African standards, codes of practice and manufacturers' literature, and surprisingly, 29% claimed that they didn't know if their companies were in possession of these documents (see question SM:14).

The majority of site managers (57%) always make *personal visits* in order to check that project information has been received and is being used. Furthermore, 42% of the respondents reported that sometimes they get report from others (see question SM:15 and Table 7.14). As one might expect, site managers (57%) favour personal visits, because they are most of the time supposed to stay on site (see Table 7.21) and contracts managers (80%) favour getting reports from others, because they are normally based at their firms' head offices coordinating various projects (see Table 7.11).

Table 7.21 Site managers' opinions on how they check that project information has been received and is being used (n=30)

Method of Checking	Always	Often	Sometimes	Never
Personal visit	57%	42%	0%	0%
Reports from others	0%	29%	42%	14%
No check	0%	0%	0%	42%
Other (specify)	0%	0%	0%	0%

Site managers were asked to give their opinions on the the relative frequency of factors concerning quality information as contributory causes of unacceptable quality work (see question SM:16). Forty-two per cent of the respondents reported that *incomplete quality information* has a **very high frequency** in contributing to causes of unacceptable quality work. Other respondents cited *poorly presented quality information* (42% - fairly high), *inaccurate information* (30% - fairly high), *information which is difficult to understand* (30% - fairly high) and *late information* (30% - fairly high). These assertions are tabulated in Table 7.22.

Table 7.22 Site managers' opinion regarding the factors concerning quality information and how they contribute to causes of unacceptable quality work (n=30)

Factors	Very high	Fairly high	Fairly low	Very low
Late information	0%	30%	17%	17%
Inaccurate	13%	30%	30%	0%
Incomplete	42%	12%	31%	0%
Difficult to understand	0%	30%	30%	0%
Poorly presented	12%	42%	30%	0%
Other (please specify)	0%	0%	0%	0%

Insofar as assessment of quality of workmanship of sub-contractors by site managers is concerned, Tables 7.23 and 7.24 reflect the opinions of site managers. Table 7.23 concerns the criteria of assessing domestic sub-contractors' quality of workmanship (see question SM:17), whereas Table 7.24 deals with the assessment of nominated sub-contractors' quality of workmanship (see question SM:18). These issues are important in that the criteria used to assess the quality of workmanship forms an acid test in establishing the appropriateness of the quality management system.

Site managers appear to use the same criteria when assessing quality of workamanship of domestic sub-contractors and nominated sub-contractors. Clearly, the majority of site managers (56%) appear to use both, *extracts from specifications and drawings* and *sub-contractors' expertise* when assessing domestic sub-contractors' quality of workmanship, and 43% of the respondents use the same criteria in assessing nominated sub-contractors' quality of workmanship. Contracts managers and site managers agree over only one criteria (within the first criterion) that of assessing both sub-contractors, by using *extract from specifications and drawings*.

Table 7.23 Site managers' criteria for assessing quality of workmanship when using domestic sub-contractors (n=30)

Assessment Criterion	First	Second	Third
Your company's requirements	28%	14%	42%
Extracts from specifications and drawings	56%	28%	14%
The sub-contractors' expertise	56%	28%	14%

Table 7.24 Site managers' criteria for assessing quality of workmanship when using nominated sub-contractors (n=30)

Assessment Criterion	First	Second	Third
Your companys' requirements	43%	14%	28%
Extracts from specifications and drawings	43%	28%	14%
The sub-contractor's expertise	43%	28%	28%

Like contracts manager respondents, all site managers were in agreement that *communication among project stake holders* contributes a lot to the quality of the finished building (see question SM:19).

Like construction firm executives and contracts managers, *concrete, formwork, plastering, floor finishings and painting and decorating* were reported by site managers to have high incidences of problems concerning quality (with mean values of 48%, 38%, 33%, 40% and 50% respectively). In addition, 45% of the respondents reported that reinforcement have a very high relative incidence of problems concerning quality. Furthermore, commensurate with results from construction firm executives and contracts managers, *excavation, brickwork and blockwork, asphalt work, joinery, plumbing and heating and ventilating* were reported to have low incidences of quality problems. These results are depicted in Table 7.25.

7.25 Site managers' opinions regarding relative incidence of problems concerning quality (by trades) (n=30)

Trades	Very High	Fairly High	Fairly Low	Very Low
Excavation	0%	25%	75%	0%
Concrete	55%	40%	5%	0%
Formwork	35%	40%	25%	0%
Reinforcement	45%	20%	25%	10%
Brickwork and Blockwork	20%	15%	60%	5%
Asphalt work	15%	15%	65%	5%
Roofing	10%	10%	50%	30%
Carpentry	0%	15%	45%	40%
Joinery	0%	20%	35%	45%
Plastering	10%	55%	35%	0%
Floor Finishing	10%	70%	20%	0%
Plumbing	10%	0%	45%	45%
Heating and Ventilating	0%	15%	15%	70%
Electrical	0%	30%	0%	70%
Glazing	0%	0%	20%	80%
Painting and Decorating	15%	85%	0%	0%
Other	0%	0%	0%	0%

Site managers opinions regarding the relative incidence of problems concerning quality, associated with various types of operatives, were commensurate with contracts manager respondents results (see question SM:21). *Direct employees-labourers* (45%) and *subcontractors-labour only* (50%) were reported by site managers to have a fairly high incidence of problems concerning quality. Like contracts manager respondents results, site managers survey results are commensurate with construction firm executives results, in that a significant number of them consider *subcontractors-labour only* to have **a high incidence of quality problems.** *Direct employees-craftsmen* and *subcontractors-labourers and materials* are considered to have a fairly low incidence of quality problems (65% and 60% respectively). The opinions of site managers on these results are in agreement with those of the construction firm executives and contracts managers. Table 7.26 depicts these results.

Table 7.26 Site managers' opinions regarding relative incidence of quality problems (by type of operative) (n=30)

Type of Operative	Very High	Fairly High	Fairly Low	Very Low
Direct employees-Craftsmen	0%	20%	65%	15%
Direct employees-Labourers	10%	45%	35%	10%
Subcontractors-Labour and Materials	0%	30%	60%	10%
Subcontractors-Labour only	20%	50%	30%	0%

Like construction firm executives and contracts managers, site managers reported that *structural work located below ground level* **(80%- very high)** and *internal finishes* **(70%-fairly high)** have high incidences of problems concerning quality. Furthermore, external cladding (45%) and external finishings (40%) were reported to have a fairly high incidence of problems concerning quality (see question SM:22). These results are shown in Table 7.27.

Table 7.27 Site managers' opinions regarding relative incidence of problems concerning quality associated with different locations (n=30)

Building Location	Very High	Fairly High	Fairly Low	Very Low
Structural-below ground level	80%	15%	5%	0%
Structural-ground floor and above	15%	20%	65%	0%
External cladding	10%	45%	40%	5%
External finishings	0%	40%	60%	0%
Roof coverings	5%	0%	45%	50%
Internal finishings	10%	70%	20%	0%
Services	0%	15%	15%	70%
External works	0%	5%	15%	80%

Site manager respondents (80%, 60% and 60% respectively) reported that *conventional buildings, industrialised and system buildings* and *alterations* have low incidences of quality problems (see question SM:23). Interestingly, these results are commensurate with the construction firm executives and contracts managers results. These results are depicted in Table 7.28.

Table 7.28 Site managers' opinions regarding relative incidence of problems concerning quality associated with types of work (n=30)

Type of Work	Very High	Fairly High	Fairly Low	Very Low
Conventional Building	0%	20%	0%	80%
Industrialised and System Building	15%	25%	60%	0%
Alterations	0%	35%	60%	5%
Other	0%	0%	0%	0%

In question SM:24, site managers were asked to list in order of importance **three** major problems concerning quality. Their responses are depicted in Table 7.29.

Table 7.29 Site managers' opinions regarding major problems concerning quality in order of importance (n=30)

Major Problems	Listed:first	Listed:second	Listed:third
Architects' poor supervision	40%	45%	20%
General organization of projects very poor	30%	35%	25%
Lack of qualified operatives	20%	10%	10%
Communication breakdown: the management knows but operatives do not	0%	0%	10%
Missing specifications	10%	10%	10%
Lack of pride of workers	0%	0%	5%
Time restraints	0%	5%	20%

As indicated in Table 7.29, there are four problems which are considered by site managers to be dominant (those listed first). These are: *architects' poor project supervision* (40%), *general organization of projects very poor* (30%), *lack of qualified operatives* (20%) and *missing specifications* (10%). When these results are compared with construction firm executives and contracts managers results, they are in agreement on two problems, which are: *the lack of qualified operatives* and *general organization of projects very poor.*

In order to establish the current work load of construction firms and the approximate values of project(s) in hand, site managers were asked to report on the number of projects their employers hands (see question SM:25 and Table 7.29a). The majority of site managers (70%) reported that their employers had at least two projects of between 2-4 million Pula (approximately 2.86-5.72 million Rands). Furthermore, 65% of the respondents reported their employers having at least two projects of over 4 million Pula (approximately over 5.72 million Rands). These results are commensurate with the contracts manager respondents results. An important observation could be deduced from these results, the majority of contracts manager and site manager respondents employers were managing projects in the over 2 million Pula (approximately 2.86 million Rands) contracts sum category. This observation is commensurate with the construction executives results. A significant number of site managers (40%) reported that their empoloyers had at least two projects of between 150,000 to 450,000 Pula each in value. These results are shown in Table 7.29a.

Table 7.29a Number and approximate value of current projects as reported by site managers (n=30)

	Number of Projects				
Approximate Value of Projects	1	2	3	4	>4
(a) Less than P 150,000	0%	25%	20%	0%	0%
(b) P 150,000-P 450,000	10%	40%	25%	15%	0%
(c) P 450,000-P 900,000	0%	30%	15%	0%	0%
(d) P 900,000-P2,000,000	0%	20%	20%	0%	0%
(e) P2,000,000-P4,000,000	25%	70%	10%	0%	0%
(f) Over P4,000,000	15%	65%	0%	0%	0%

A significant number of site managers (70%) spend 60% of their time on activities which are primarily and directly concerned with achieving quality. These results are in contrast with the results which were received from construction firm executives and contracts managers. While the construction firm executive and contracts manager respondents results were not easy to analyse because a range of percentages were stated ranging from 1% to 70%, the site managers were mostly clear that they spend approximately 60% of their time in average week on activities which are primarily and directly concerned with achieving a specified level of quality (see question SM:26).

Site managers were asked to state the approximate proportion of the time stated in question SM:26 that they spend on various activities (see question SM:27). The majority of site manager respondents (70%) reported that they spend 39-20% of the time stated in question SM:26 on *verbal instructions*. Furthermore, 45%, 40%, 35% spend 39-20% of the time stated in question SM:26 on *supervision, written instruction* and *discussion* respectively. A significant number of site manager respondents (45%) reported that they spend 19-1% of their time on *report writing*. With the exception of report writing, these results are in contrast with the construction executives results. These results are significantly commensurate with those received from contracts managers on *verbal instruction, written instruction, discussion* and *report writing*. These results are depicted in Table 7.29b.

Table 7.29b Approximate time spent on various activities (proportion of time stated in question SM:26) by site managers (n=30)

	Percentage (%)					
Activities	**100-80**	**79-60**	**59-40**	**39-20**	**19-1**	**0**
(a) Inspection	0%	0%	0%	45%	15%	0%
(b) Supervision	0%	10%	0%	45%	10%	0%
(c) Verbal instruction	0%	0%	0%	70%	0%	0%
(d) Written instruction	0%	0%	0%	40%	20%	0%
(e) Discussion	0%	0%	0%	35%	20%	0%
(f) Assistance	0%	0%	0%	10%	35%	0%
(g) Correspondence	0%	0%	0%	0%	20%	0%
(h) Report Writing	0%	0%	0%	15%	45%	0%
(i) Travelling	0%	0%	0%	0%	0%	0%
(j) Other (specify)	0%	0%	0%	0%	0%	0%

The majority of site manager respondents (average 88%) reported that the majority of traditional procurement system characteristics (Table 7.30: points 1,3,5,6 and 8) are part and parcel of their project characteristics. Site managers, construction firm executives and contracts managers are in complete agreement that, `pure' traditional procurement system characteristics 1,3,5,6, and 9 directly relate to their public building projects (see question SM:28).

While construction firm executives were not sure about the adequacy of the architects' experience to cope with the coordination of the design team to lead the design effort, and to co-ordinate the interface between design and fabrication (see Table 7.8), contracts managers (70%) and site managers (80%) agree that architects are not adequately experienced to deal with the same responsibilities (see Table 7.20 and 7.30).

In agreement with construction executives and contracts managers, site managers endorse Hindle and Rwelamilas' (1993:69) argument that a `hybrid version' of the basic (`pure') traditional procurement system was in use.

Table 7.30 Site managers' opinions regarding the characteristics of their projects (n=30)

Project Characteristics	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works	85%		15%		
2. The design is complete at the time of selecting the contractor				5%	95%
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum	80%		20%		
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication			15%	5%	80%
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect	90%		10%		
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices	100%				
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)	95%		5%		
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk				15%	85%
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue	80%		20%		

Summary of 7.4:

It appears that nearly 50% (on average) of site managers have construction experience of more than ten years. Furthermore, 70% and 30% of site managers claim that they are university graduates and polytechnic or technical college graduates respectively.

The majority of site managers (58%) report that they have been on their current positions for more than 5 years. Furthermore, the majority of site managers (70%) have been involved in their respective roles since the project started and they have worked for the same immediate superior prior to the current project.

All site manager respondents are in possession of quality management documents: project specifications, bills of quantities, working drawings and the project programme. Only 72% of site managers are in possession of less than five British or South African standards and codes of practice documents.

All site manager respondents are in favour of written instructions to their site supervisors, 86% use verbal methods of instructions to their supervisors. Furthermore, the majority of site managers claim that they are in favour of personal visit to work places on site when checking that project information has been received and is being used.

The majority of site managers claim that they use both, extracts from specifications and drawings and subcontractors' expertise as criterion when assessing domestic and nominated sub-contractors' quality of workmanship.

The majority of site managers (80%) claim that architects are not adequately experienced to cope with the coordination of the design team to lead the design effort, and to co-ordinate the interface between design and fabrication.

Site managers report that, what is normally referred to as `pure' traditional procurement system in the Botswana public building sector is actually a `hybrid version' of the traditional procurement system.

7.5 Trade foreman respondents (n=30)

Table 6.5 in Chapter 6 depicts the synopsis of the trade foreman questionnaire and section 6.3 in Chapter 6 depicts the response to the questionnaires received from trade foremen in Gaborone, Botswana.

The majority of trade foreman respondents (59%) reported that they were between *thirty to thirty nine years*, 30% and 11% were *between forty to forty-nine* and *above 50 years* old respectively (see question TF:2). These results are partially identical to site manager respondents results as follows: same percentage (59%) *30 to 39 years age group* and same percentage (30%) for *age group of 40 to 49*. While no site manager respondents were more than 50 years old, 11% of trade foreman respondents were in the same age group.

The majority of trade foreman respondents (50%) reported that they had construction experience *between ten to twenty years*, whilst 9%, 30% and 11% had construction experience between *2-4 years, 5-9 years* and *more than 20 years respectively* (see question TF:3). Clearly, these statistics are commensurate with those reported by site managers, construction firm executives and contracts managers.

The majority of trade foreman respondents (70%) indicate that they were *polytechnic or technical college graduates* (see question TF:4). Furthermore, 8%, 9% and 13% went through *apprenticeship, combination of apprenticeship and brigades and on-site experience.* As one might expect, there were no respondents claiming to be university graduates as universities train people beyond trade specialist levels (see Figure 7.4).

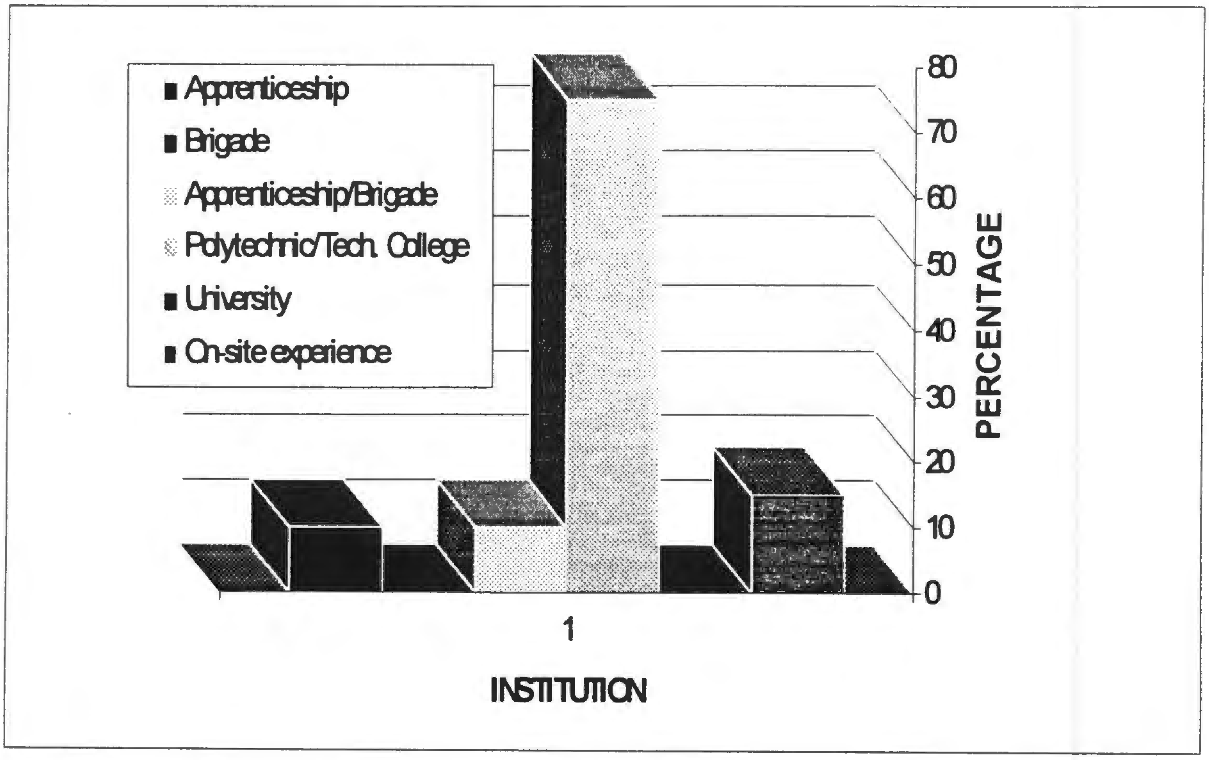


Fig. 7.4 Education of trade foremen

Seventy per cent of trade foremen claimed that, they were on their positions for more than *five years*, while 10% and 20% claimed that they were in their positions for *less than two and five years* (see question TF:5). These results suggest that most respondents were experienced in their positions.

All respondents claimed that they were involved in their respective roles since the project started (see question TF:6). These results are in contrast with site managers results where only 70% of site managers claimed the same.

Clearly, trade foreman respondents and site managers are in agreement that, the majority of them (70%) have worked for the same immediate superiors prior to their current projects, and 30% have not (see question TF:7).

Like site managers, trade foreman respondents were asked to to indicate if their current immediate superiors were involved with the same projects prior to their involvements (see question TF:8). Seventy nine per cent of respondents reported that their immediate superiors were involved with same projects prior to their involvement, and twenty one per cent reported that they were not. These results are commensurate with site manager respondents results.

When asked to indicate if there were any unusual requirements with regard to specifications and/or tolerances on their current projects, the majority of trade foremen (71%) reported that there were no unusual requirements, while 21% and 8% claimed that there *were unusual problems* and others claimed that *they did not know* respectively (see question TF:9).

Given the importance of using quality documents as reference documents when performing the control function of a quality management system, trade foremen were asked to confirm if they were in *possession of*, or *have access to quality documents*. All respondents claimed that they were *either in possession or had access to project drawings*, but only 57%, 43% and 25% cited *short-term programmes*, *specifications* and *bills of quantities* respectively (see question TF:10). These results are in contrast with site managers results, because all site managers claimed that they were in possession of all the documents (see question SM:9).

All trade foreman respondents reported that the quality of their supervision of work was most dependent upon *specifications and drawings*. Furthermore, 79%, 7% and 93% cited *verbal instructions from their supervisors, written instructions from their supervisors and their experiences* respectively (see question TF:11).

Trade foreman respondents were asked to give their opinions on how they check that trade information has been received and is being used (see question TF:12). All respondents reported that they always make *personal visits*, 14% claimed that they always *use reports from others* and 28% of the respondents reported that it *was never possible not to check that information has been received and is being used to give intended results*. These particular assertions are tabulated in Table 7.31. These results are understandably partially commensurate with site managers' results on the importance of personal visits on site. Trade foremen are normally supposed to be very close to operatives on site, hence in favour of *personal visits* over *other methods*, and site managers as over-all supervisors on site are naturally in favour of both *personal visits and reports from others*.

Table 7.31 Trade foremen opinions on how they check that trade information has been received and is being used (n=30)

Method of Checking	Always	Often	Sometimes	Never
Personal visit	100%	0%	0%	0%
Reports from others	14%	0%	14%	0%
No check	0%	0%	0%	28%
Other (specify)	0%	0%	0%	0%

Seventy per cent of the respondents reported that incomplete quality information has a **fairly high frequency** in contributing to causes of unacceptable quality work (see question TF:13 and Table 7.32). Other respondents were partially in agreement with site mmanagers (see Table 7.22), they cited *inaccurate information* (50%) - fairly high) and *late information* (59% - fairly high).

Table 7.32 Trade foremen opinions regarding the factors concerning quality information and how they contribute to causes of unacceptable quality work (n=30)

Factors Concerning Quality Information	Very high	Fairly high	Fairly low	Very low
Late information	0%	59%	9%	0%
Inaccurate information	8%	50%	7%	7%
Incomplete information	8%	70%	0%	8%
Information difficult to understand	0%	8%	17%	9%
Other (specify)	0%	0%	0%	0%

The majority of trade foreman respondents (72%) reported that their managers (general foremen or site managers) were responsible for determining the standard of quality or tolerance of workmanship on their current project. Furthermore, 43% and and 22% reported that they were *themselves responsible* and *others* were responsible for determining the standard of quality or tolerance of workmanship respectively (see question TF:14).

All trade foremen agreed that the standard of quality of their work referred to in question TF:12 was normally checked by another person. When asked to state the title of this person, various titles were given, 22%, 14%, 22% and 7% cited *consultants, manager, general foreman and contracts manager* respectively (see question TF:15).

Like contracts managers and site managers, all trade foremen were in agreement that communication among project stake holders contributes to the quality of the finished building (see question TF:16).

The majority of trade foremen (75%) reported that they spend 80% of the approximate proportion of time, in an average working week, on activities which are primarily and directly concerned with achieving quality. 25% of trade foreman respondents were in agreement with construction firm executives and contracts managers. They reported that they spent 40% of their time on activities which are primarily and directly concerned with achieving quality (see question TF:17).

An attempt was made to establish the approximate proportion of time stated in question TF:17, that respondents spend on various activities (see question TF:18). 70% of the respondents reported that they spend **39-20%** of their approximate time in average week on *inspection* and *verbal instructions* respectively. Furthermore, 60%, 55%, 70%, 65% and 60% of trade foreman respondents reported that they spend between **19-1%** of their quality management time on *written instruction, discussion, assistance, correspondence* and *report writing* respectively. These results are commensurate with construction firm executives, contracts managers and site managers results on two activities: *making correspondences* and *written instructions*. Interestingly, the trade foreman respondents results are commensurate with site managers' results on three activities: *discussion, correspondence and report writing*. These results are depicted in Table 7.33.

Table 7.33 Trade foremans' opinions regarding approximate proportion of the time stated in question TF:17. spent on various activities (n=30)

	Percentage (%)					
Activities	**100-80**	**79-60**	**59-40**	**39-20**	**19-1**	**0**
Inspection	5%	15%	10%	70%	25%	0%
Supervision	0%	0%	0%	15%	20%	0%
Verbal instruction	0%	0%	0%	70%	0%	0%
Written instruction	0%	0%	0%	0%	60%	0%
Discussion	0%	0%	0%	0%	55%	0%
Assistance	0%	0%	0%	0%	70%	0%
Correspondence	0%	0%	0%	0%	65%	0%
Report Writing	0%	0%	0%	0%	60%	0%
Travelling	0%	0%	0%	0%	20%	0%
Other (specify)	0%	0%	0%	0%	0%	0%

Trade foreman respondents, like construction firm executives, contracts managers and site managers reported that a hybrid version of the basic (`pure') traditional procurement system was in use in the Botswana public building sector (see question TF:19). Table 7.34: points 1, 3, 5, 6, 7, and 9 were accepted by the majority of respondents (98%, 88%, 100%, 95%, 85% and 65% respectively) as true characteristics of projects which they have involved in. Interestingly, 40% of trade foreman respondents reported that it was difficult to say if architects appointed by clients in various types of projects could be described as adequately experienced to cope with the coordination of the design teams, to lead design efforts, and co-ordinate the interface between design and fabrication. 60% of the respondents reported that architects were not adequately experienced to render those services.

Table 7.34 Trade foremen opinions regarding the characteristics of their projects (n=30)

Project Characteristics	True	More true than false	Difficul t to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works	98%		2%		
2. The design is complete at the time of selecting the contractor			5%		95%
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum	88%		12%		
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication			40%		60%
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect	100%				
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices	95%		5%		
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)	85%		15%		
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk					100%
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue	65%		15%		20%

Summary of 7.5:

It appears that trade foreman respondents are highly experienced, with construction experience of between ten to twenty years, while 30% and 11% have experience of between 5 to 9 and more than 20 years respectively. These results are commensurate with those reported by site managers, construction firm executives and contracts managers.

All trade foremen surveyed are either in possession of, or have access to project drawings, but only 57%, 43% and 25% are in possession or have access to short-term programmes, specifications and bill of quantities respectively. These results are understandably in contrast with site managers results who claim to have all the documents, because it is likely that the arrangement could be that the site manager will keep all the documents and trade foremen will contact the site manager for reference purposes .

Personal visits when checking that building trade information has been received and is being used is the most favoured method by trade foremen. Another common method used is using reports from others. Interestingly 28% of the trade foremen are of the opinion that checking that information has been received and is being used to give intended results is an important function of their work which they must perform. These results are partially commensurate with site managers' results, specifically on the importance of personal site visits.

Like construction firm executives, contracts managers and site managers, trade foremen agree that the dominant procurement system in the Botswana public building sector is `a hybrid version' of the traditional procurement system.

7.6 Skilled tradeperson respondents (n=30)

The questionnaire synopsis of skilled tradeperson is given in Table 6.6 in Chapter 6.

Fifty-nine per cent of skilled tradeperson respondents reported that they were between 40 to 49 years age group, 18% and 23% were less than 30 years and between 30 to 39 years old respectively (see question ST:1). The age distribution of skilled tradeperson respondents is in contrast with site manager respondents. While the majority of site managers (59%) were in the 30 to 39 age group, the majority of skilled tradeperson respondents were in the 40 to 49 age group.

The majority of skilled tradesmen (70%) claimed to have construction experience between 10 to 20 years, 15% each claimed to have between 5 to 9 and more than 20 years construction experience respectively (see question ST:3). These results are commensurate with site manager respondents results.

Skilled tradesmen reported that they were either qualified through apprenticeship or graduates of polytechnic or technical colleges (see question ST:4). Seventy per cent of the tradesmen claimed that they were polytechnic or technical college graduates and 30% qualified through the apprenticeship system. Like the trade foremen results, no respondent claimed to have trained through the university. This is understandable because universities train people to occupy higher specialist positions above tradesmen levels.

In an attempt to establish how skilled tradesmen receive information towards meeting required quality of work, respondents were asked to indicate from six possible possibilities of work instructions (see question ST:5). These results are shown in Table 7.35.

Table 7.35 Skilled tradesmen opinions on how they are usually informed of acceptable standard of quality work required for a job (n=30)

Method of Information	Always	Often	Sometimes	Never
Architects/Engineers drawings	18%	23%	23%	23%
Architect/Engineers specifications	10%	10%	10%	22%
Written instructions	41%	8%	8%	18%
Verbal instructions	90%	0%	8%	0%
Samples of work	18%	23%	23%	18%
No information received	0%	0%	0%	23%
Other (state)	0%	0%	0%	0%

Ninety per cent of skilled tradesmen reported that they were *always* informed of the acceptable standard of quality work *verbally* by their superiors. Only 41% claim that they *always* receive *written instructions* from their superiors. While 23% of respondents claimed that they *often* use *architects or engineers drawings*, the same percentage of the respondents reported that sometimes they received information from *architects or engineers drawings* (see Table 7.35).

Linked to how skilled tradesmen receive information of the acceptable standard of quality of work, is the relative value of the instruction method or documentation as indicated in question ST:5. Respondents were asked to value the methods of instructions or documentation used on their trades (see question ST:6). These results are shown in Table 7.36.

Table 7.36 Skilled tradesmen opinions on the relative value of work instructions or documentation (n=30)

Instructions/Documentation	Great	Considerable	Little	None
Architects/Engineers drawings	32%	18%	24%	0%
Architects/Engineers specifications	18%	10%	10%	0%
Written instructions	32%	22%	10%	0%
Verbal instructions	81%	0%	9%	0%
Samples of work	23%	23%	8%	30%
Other (specify)	0%	0%	0%	0%

Given the majority of skilled tradesmen (90%) in Table 7.35, that they were receiving *verbal instructions* from their superiors informing them about the acceptable standard of quality of work, it is interesting to note that verbal instructions are relatively valued by the majority (81%) of respondents. Surprisingly, 30% of the respondents feel that samples do not have value in assisting them to produce work of acceptable quality, but 23% of respondents feel that there is great value in using samples of work (see Table 7.36).

Responses on supervision or inspection of skilled tradesmen appears to reflect the nature and scope of the level of work performed by skilled tradesmen (see question ST:7 and Table 7.37). The majority of tradesmen (77%) reported that they were directly supervised or inspected for quality by their trade foremen for approximately 25% of the time during an average working week. Furthermore, 68% of the respondents claim that they were directly supervised or inspected by a clerk of works for approximately 25% of the time during an average week. As was expected, 40% of skilled tradesmen claim that they were not directly supervised or inspected by an architect or engineer (see Table 7.37).

Table 7.37 Approximate proportion of time, during an average working week, that skilled tradesmen work is directly supervised or inspected for quality (n=30)

Inspection/Supervision	25%	20%	15%	10%	5%	0%
By an architect/Engineer	18%	10%	10%	0%	40%	10%
By a clerk of works	68%	8%	0%	0%	18%	10%
By your supervisor	77%	10%	0%	10%	0%	0%
By other (specify)	0%	0%	0%	0%	0%	0%

In an attempt to establish the perception of skilled tradesmen on the impact of productivity bonus schemes on the quality of their work, respondents were asked to give their opinions on the effect of productivity bonus schemes on the quality of their work (see question ST:9). Fifty per cent, 42% and 8% of the respondents claim that productivity bonus schemes have a *very small*, *fairly small* and *fairly large* effect in reducing the quality of their work.

When asked to give their opinions, as to which the quality of their finished work is influenced by quality of building materials compared with quality of workmanship, thirty-two per cent, 16%, 32% and 16% of the skilled tradesmen reported that there was a *fairly small*, *very small*, *fairly large* and *very large* effect by quality of materials compared with quality of workmanship on their finished work respectively.

Sixty-eight per cent of skilled tradesmen reported that *appearance of finished surface* has a *very high frequency* of being reasons for rejection of unacceptable quality work in their trades after inspection (see question ST:11). Furthermore, 18% and 32% cited *dimensions* (with very high and fairly high frequency respectively), 41% of respondents reported that *performance or function* has a *fairly high frequency* of being a reason for rejection of work. As might be expected, some respondents, 10%, 37% and 22% indicated that *dimensions, performance or function and appearance* respectively have a *fairly low frequency* of being reasons for rejection of unacceptable work (see Table 7.38).

Table 7.38 The relative frequency in the skilled tradesmen opinion that the following are reasons for rejection of unacceptable quality work in their trade after inspection (n=30)

Reasons for Rejection of Work	Very high	Fairly high	Fairly low	Very low
Dimensions	18%	32%	10%	22%
Performance or function	10%	41%	37%	18%
Appearance of finished surface	68%	0%	22%	10%
Other (specify)	0%	0%	0%	0%

In an attempt to establish whether or not skilled tradesmen consider factors outside their control as contributory reasons for rejection of unacceptable quality work in their respective trades, respondents were asked to comment on a group of factors (see question ST:12). These results are shown in Table 7.39.

Table 7.39 The skilled tradespersons' opinion that the following factors outside their control are contributory reasons for rejection of unacceptable quality work (n=30)

Reasons for Rejection of Work	Very high	Fairly high	Fairly low	Very low
Damage	22%	18%	32%	10%
Materials	10%	19%	36%	36%
Information	32%	40%	18%	10%
Work of other trades	40%	40%	18%	0%
Other (specify)	0%	0%	0%	0%

The majority of skilled tradesmen (40%) consider *information* and *work of other trades* outside their control to have a *fairly high frequency* to be contributory reasons for rejection of unacceptable work in their trades. Other respondents, 22%, 32%, consider *damage* to have a *very high* and *fairly low frequency* respectively as contributory reasons for rejection of the same.

Insofar as the personal factors of the operative are concerned in influencing the quality of work, Table 7.40 reflect the opinions of the skilled tradesmen (see question ST:13).

Table 7.40 Skilled tradesmens' opinions regarding the relative influence of various factors on the quality of work (n=30)

Factors	Very high	Fairly high	Fairly low	Very low
Natural ability	18%	41%	22%	10%
Training and skills	81%	10%	10%	0%
Attitude towards employer or job	18%	76%	10%	0%
Other (specify)	0%	0%	0%	0%

Eighty-one per cent of skilled tradesmen claim that *training and skills* have a *very high* influence on the quality of their work. Furthermore, 76% of respondents claim that *attitude towards employer or job* have a *fairly high* influence on the quality of their work. Forty one per cent of the respondents are of the opinion that *natural ability* have a *fairly high* influence on the quality of their work.

Skilled tradesmen were asked to state what they consider to be **three major causes** of unacceptable quality of work (see question ST:14). The results of this are shown in Table 7.41.

Every respondent listed **poor artisan training** and **poor site supervision** among their three major causes of unacceptable quality work (see Table 7.41). As many as 32% of respondents listed **low morale due to low wages**, and 16% reported **poor contractors' attitude to artisans** and **general inadequacy of training in the Botswana construction industry**.

The above survey results (see Table 7.41) are in agreement with Table 7.40 results where **training and skills** and **attitude towards employer or job** were cited by skilled tradesmen as dominant factors influencing the quality of work.

Table 7.41 Major causes of unacceptable quality work as suggested by skilled tradesmen (n=30)

Major causes of unacceptable quality work	Frequency of response (%)
Poor artisan training	100%
Poor site supervision	100%
Poor contractors' attitudes to artisan	16%
Lack of project morale	7%
General inadequacy of training in the industry	16%
Poorly organised construction industry	7%
Low morale due to low payment	32%
Wrong dimensions	7%
Poor workmanship	7%
Lack of artisans pride towards their work	8%

Summary of 7.6:

The majority of skilled tradesmen (70%) claim to have construction experience of between 10 to 20 years, and 15% each claim to have between 5 to 9 and more than 20 years of construction experience respectively. These results are commensurate with site managers and trade foremen results.

The majority of skilled tradesmen (90%) claim that they are always informed of acceptable standard of quality work verbally by their superiors. Only 41% of tradesmen claim that they always receive written instructions from their superiors.

Training and skills are considered by the majority of skilled tradesmen to have a very high influnce on the quality of their work, and attitude towards employer or job are considered by 76% of the skilled tradesmen to have a fairly high influence on the quality of their work.

Poor artisan training and site supervision, low morale due to low wages, poor contractors' attitude to artisans and general inadequacy of training in the Botswana construction industry are considered by skilled tradesmen to be major causes of unacceptable quality of work.

7.7 Architect, Quantity Surveyor and Engineer respondents (n=10, 8 and 9 respectively)

An identical questionnaire was posted to architects, quantity surveyors and engineers as discussed in Chapter 6 (sections 6.2 and 6.3). The questionnaire synopsis for these respondents is given in Table 6.1.

Insofar as the age group of respondents is concerned, Table 7.42 reflect the age groups of architects, quantity surveyors and engineers (see question AQE:2).

Table 7.42 Age group of architects, quantity surveyors and engineers

Age group	Architects (n=10)	Quantity surveyors (n=8)	Engineers (n=9)
Under 30 years	0%	0%	0%
30 - 39 years	10%	22%	36%
40 - 49 years	70%	62%	43%
Above 50 years	20%	16%	21%

The majority of architects (70%), quantity surveyors (62%) and engineers (43%) are in the 40 - 49 years age group. In contrast, the majority of site managers (59%) and trade foremen (59%) are within 30 - 39 years age group. Like the construction firm executives, contracts managers and site managers results, there are no architect, quantity surveyor and engineer respondents within less than 30 years age group.

The majority of respondents, architects (60%), quantity surveyors (62%) and engineers (65%) reported that they had construction experience of between 10 - 20 years. These results are commensurate with those reported by construction firm executives, contracts managers and site managers (see question AQE:3 and Table 7.43). These results suggest that most respondents are experienced within their areas of expertise.

Table 7.43 Architects, quantity surveyors and engineers construction experience

Construction Experience in Years	Architects (n=10)	Quantity surveyors (n=8)	Engineers (n=9)
Less than 2 years	0%	0%	0%
2 - 4 years	0%	0%	0%
5 - 9 years	0%	15%	0%
10 - 20 years	60%	62%	65%
Above 20 years	40%	23%	35%

In order to ascertain the education background of architects, quantity surveyors and engineers, they were asked to state their medium of training as indicated in question AQE:4. The relevant results are presented in Figure 7.5.

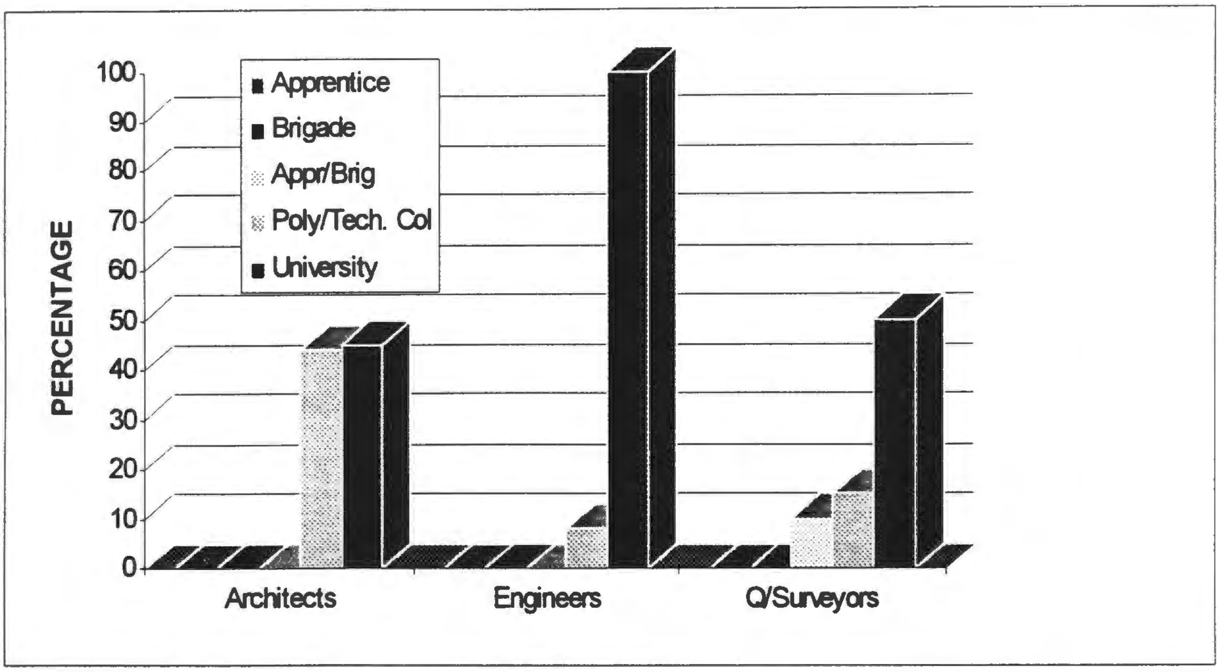


Fig. 7.5 Training of architects, quantity surveyors and engineers

The majority of architects (50%), quantity surveyors (62%) and engineers (88%) claimed that they were trained through universities, 50%, 25% and 12% of architects, quantity surveyors and engineers were trained through polytechnics or technical colleges. Until 1994, there were no architectural, quantity surveying and engineering training programmes in Botswana, hence most of these respondents were trained outside Botswana.

To establish relative incidences of problems concerning quality associated with trades, the opinion of architects, quantity surveyors and engineers was sought (see question AQE:5). The results are presented in Table 7.44.

Table 7.44 Opinions of architects, quantity surveyors and engineers on the relative incidence of problems concerning quality associated with trades (n=10, 8, and 9 respectively)

	Very High			Fairly High			Fairly Low			Very Low		
	Arc	Q/S	Eng	Arch	Q/S	Eng	Arch	Q/S	Eng	Arch	Q/S	Eng
Excavation	0%	0	0.12	0.4	0	0.32	0.4	0	0.2	0.12	0.8	32%
Concrete	20%	78%	21%	40%	12%	42%	40%	10%	21%	0%	0%	0%
Formwork	10%	77%	20%	40%	0%	58%	40%	23%	21%	0%	0%	0%
R.forcement	10%	50%	10%	40%	22%	41%	50%	12%	41%	0%	12%	0%
Brickwork/ Blockwork	15%	0%	10%	55%	0%	58%	15%	82%	21%	15%	12%	10%
Asphalt	30%	0%	11%	20%	0%	21%	30%	15%	58%	20%	85%	10%
Roofing	40%	0%	10%	0%	0%	21%	60%	12%	30%	0%	60%	30%
Carpentry	40%	0%	0%	40%	0%	42%	20%	15%	21%	0%	85%	32%
Joinery	60%	0%	0%	40%	14%	32%	0%	0%	41%	0%	85%	21%
Plastering	40%	10%	0%	40%	50%	30%	20%	22%	41%	0%	10%	10%
Floor Finishing	40%	0%	0%	20%	50%	58%	40%	39%	30%	0%	12%	10%
Plumbing	40%	0%	0%	10%	0%	62%	50%	39%	0%	0%	60%	30%
Heating and Ventilating	20%	0%	10%	10%	12%	42%	70%	22%	10%	0%	61%	30%
Electrical	0%	0%	0%	40%	12%	20%	40%	10%	41%	20%	83%	21%
Glazing	0%	0%	0%	0%	0%	30%	80%	12%	41%	20%	83%	21%
Painting and Decorating	20%	0%	0%	40%	51%	21%	30%	39%	41%	10%	12%	30%
Other (specify)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Architects and engineers are in agreement in the majority of instances on the incidence of problems concerning quality associated with various trades. When mean percentages are taken by combining **very high** and **fairly high** results, the following trades are considered by architects and engineers to have high incidences of problems concerning quality: *excavation, concrete, formwork, reinforcement, brickwork or blockwork, carpentry, joinery, plastering, floor finishing and plumbing*, by 20% and 22%, 30% and 31%, 25% and 39%, 25% and 26%, 30% and 34%, 40% and 21%, 50% and 16%, 40% and 15%, 30% and 29% and 25% and 31% of architects and engineers respectively. Thus, the statistics derived from the architects and engineers responses relate to their perception of quality problems associated with buiding trades.

Adopting this interpretation of the architects' and engineers' responses means that there is agreement between architects and engineers that there are quality problems across most building trades.

The analysis of the quantity surveyors responses proved more difficult. While quantity surveyors were in agreement with architects and engineers on incidences of problems concerning quality on *excavation, formwork, reinforcement, plastering and floor finishings* with 45%, 38%, 36%, 30% and 25% of respondents reporting high incidences of quality problems from these trades respectively, their results on other trades were quite different. Quantity surveyors reported that incidences of quality problems associated with *brickwork or blockwork, carpentry, joinery and plumbing* were fairly low (82%), very low (85%), (85%) and 60% respectively. Quantity surveyors are part of a project team under the traditional procurement system, hence their interpretations on basic project issues are expected to be closely related with the architects and engineers responses. Thus, the statistics derived from the quantity surveyors responses on question AQE:5 (see Table 7.44), should be treated with circumspection.

Table 7.45 depicts the relative incidence of problems concerning quality, associated withvarious types of operatives (see question AQE:6).

Table 7.45 Architects, quantity surveyors and engineers' opinions on the relative incidence of quality problems (by type of operative) (n=10, 8 and 9 respectively)

	Very High			Fairly High			Fairly Low			Very Low		
	Arc	Q/S	Eng	Arc	Q/S	Eng	Arc	Q/S	Eng	Arc	Q/S	Eng
Direct Employees Craftsman	0%	12%	10%	50%	0%	30%	50%	77%	58 %	0%	10%	0%
Direct Employees Labourers	0%	22%	21%	60%	38%	58%	40%	38%	21 %	0%	0%	0%
Subcontractor s - Labours & Material	0%	0%	10%	70%	12%	68%	30%	60%	21 %	0%	12%	0%
Subcontractor s - Labour only	21%	0%	21%	40%	0%	58%	40%	70%	0%	0%	22%	21%
Other (specify)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Fifty per cent of architects, 77% of quantity surveyors and 58% of engineers reported that there were *fairly low incidences* of problems concerning quality associated with *direct employees-craftsmen*. These results are not in agreement with those reported by construction firm executives (see Table 7.2). The three remaining types of operatives are generally considered to have fairly high incidences of problems concerning quality by architects, quantity surveyors and engineers. Architects (60%), quantity surveyors (38%) and engineers (58%) reported that *direct employees-labourers* are considered to have *a fairly high incidence* of problems concerning quality. While *subcontractors-labours and material* and *subcontractors-labour only* were considered by architects (70% and 40%) and engineers (68% and 58%) to have a *fairly high* incidence of problems concerning quality respectively, the majority of quantity surveyors (60% and 70% respectively) considered the same to have fairly low incidences of problems concerning quality.

Table 7.46 depicts the architects, quantity surveyors and engineers' opinions on the relative incidence of problems concerning quality associated with various building locations (see question AQE:7).

Table 7.46 Architects, quantity surveyors and engineers' opinions on relative incidence of problems concerning quality by location (n=10, 8 and 9 respectively)

	Very High			Fairly High			Fairly Low			Very Low		
	Arc	Q/S	Eng	Arc	Q/S	Eng	Arc	Q/S	Eng	Arc	Q/S	Eng
Structural - below ground level	10%	77%	21%	30%	0%	41%	60%	10%	21%	0%	10%	10%
Structural - ground level & above	0%	0%	10%	40%	12%	20%	60%	84%	63%	0%	0%	0%
External cladding	0%	0%	0%	70%	0%	58%	30%	50%	41%	0%	50%	0%
External finishing	0%	0%	0%	70%	0%	58%	30%	50%	41%	0%	50%	0%
Roof coverings	40%	0%	0%	40%	10%	41%	20%	21%	57%	0%	60%	0%
Internal finishings	40%	0%	10%	50%	38%	41%	10%	50%	32%	0%	13%	0%
Services	40%	0%	0%	40%	10%	79%	20%	21%	11%	0%	61%	10%
External works	0%	0%	0%	0%	0%	41%	0%	0%	41%	0%	0%	10%
Other (specify)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

The majority of quantity surveyors (77%) reported, that they consider *structural work below ground level* to have a *very high incidence* of problems concerning quality, while the majority of architects (60%) consider *structural work below ground level* to have a *fairly low* incidence of problems concerning quality. In respect of *structural-ground floor and above*, architects (60%), quantity surveyors (84%) and engineers (63%) reported that this building location has a *fairly low incidence* of problems concerning quality. Architect respondents (50%), quantity surveyors (61%) and engineers (58%), consider *external finishings* to have a *fairly high incidence* of problems concerning quality. Other locations which are considered by architects and engineers to have *fairly high incidences* of problems concerning quality include, *external cladding and internal finishings* (70%, 50% and 58%, 41% respectively).

The architect, quantity surveyor and engineer respondents responses on incidences of problems concerning quality associated with types of work are reflected in Table 7.47 (see question AQE:8). Conventional buildings are considered by the majority of quantity surveyors (61%) to have very low incidence of quality problems. Architects (30%) and engineers (58%) are not in agreement, they consider *conventional building* to have a high incidence of problems concerning quality. Clearly, architects (60%), quantity surveyors (61%) and engineers (58%) are almost in complete agreement that, *industrialised and system buildings* have fairly high incidences of problems concerning quality.

Table 7.47 Opinions of architects, quantity surveyors and engineers on incidence of problems concerning quality, associated with types of work (n=10, 8 and 9 respectively)

	Very High			Fairly High			Fairly Low			Very Low		
	Arc	Q/S	Eng	Arc	Q/S	Eng	Arc	Q/S	Eng	Arc	Q/S	Eng
Conventiional Building	30%	0%	0%	30%	10%	58%	20%	21%	30%	20%	61%	10%
Industrialised and System Building	0%	11%	10%	60%	61%	58%	40%	22%	30%	0%	0%	0%
Alterations	30%	10%	10%	30%	61%	42%	40%	22%	40%	0%	0%	0%
Other (specify)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Architect, quantity surveyor and engineer respondents were asked to state what they consider to be three major causes of unacceptable quality work in the Botswana public building sector (see question AQE:9). The results of this are shown in Table 7.48.

Table 7.48 Major causes of unacceptable quality work as suggested by architects, quantity surveyors and engineers (cont. on page 197)

	Frequency of response		
Major causes of unacceptable quality work	Architects (n=10)	Quantity surveyors (n=8)	Engineers (n=9)
	%	%	%
Lack of skilled labour	80%	75%	44%
Poor site supervision	80%	50%	44%
Poor understanding of specifications and drawings	30%	13%	22%
"Lack of pride in achievement and lacadaisical approach"	10%	0%	0%
"Lack of interest for work (just money syndrome)"	40%	0%	22%
"Poor knowledge of the trading business language"	10%	0%	0%
"Very few contractors understand quality work"	10%	0%	0%
"Poor contractual supervision and lack of conforming to specifications"	10%	13%	0%
"Poor support of consultants who wish to maintain standards by client bodies"	10%	0%	0%
"Coordination between architect and other parties (poor)"	0%	13%	11%
"Architects are poor managers"	0%	26%	0%
"Incomplete drawings"	0%	13%	0%
"Inadequate direction given by documentational or other instructions"	0%	13%	0%
"Poor workmanship of contractors' workforce"	0%	13%	0%
"Relaxed project consultants"	0%	13%	0%
"Custom and practice has not been aimed at quality in the past"	0%	0%	11%
"Quality suffers from productivity pressure"	0%	0%	11%
"On the job skills training required"	0%	0%	11%
"Lack of preparation"	0%	0%	11%
"General lack of trained personnel"	0%	0%	55%
"Arrogance"	0%	0%	11%
"Poor contract documentation"	0%	0%	11%

Three major causes of unacceptable quality work were listed by most of the architect, quantity surveyor, engineer respondents (see Table 7.48). These are: *lack of skilled labour, poor site supevision, and poor understanding of specifications and drawings*. These factors were supported by architects (80%, 80%, and 30%), quantity surveyors (75%, 50% and 13%) and engineers (44%, 44% and 22%) respectively. Clearly, architects, quantity surveyors, engineers and skilled tradesmen are almost in complete agreement about the first two factors: *lack of skilled labour and poor site supervision*. Credence is given to this point by the fact that there is agreement between top project consultants and skilled operatives.

It is clear from Table 7.48 that, there are other factors beside the above mantioned factors which need to be considered. More specifically, those which were supported by a significant number of respondents. 40% of architects and 22% of engineers listed, *"lack on interest for work (just money syndrome)"* as one of the major causes of unacceptable quality of work.

It is worthy of note, however, that there are other causes of unacceptable quality work which were listed by significant numbers of a single group of respondents: 55% of engineers listed, *"general lack of trained personnel"* in the Botswana construction industry, and 26% felt that *"architects are poor managers"*.

Linked to the issue of identifying major problems concerning quality, is the size of project your involved with. Architect, quantity surveyor and engineer respondents were asked to indicate on a given range of approximate values of projects they were involved with at the time of completing the questionnaire (see question AQE:10). These results are shown in Table 7.49.

Table 7.49 The number and approximate value of each project in which architects, quantity surveyors and engineers are concerned with (n=10, 8 and 9 respectively)

	Number of projects														
	1			2			3			4			>4		
Project Valve (P,000s)	Arc %	QS %	Eng %	Arc %	QS %	Eng %	Arc %	QS %	Eng %	Arc %	QS %	Eng %	Arc %	QS %	Eng %
<150	10	13	11	20	0	22	10	0	0	10	0	11	30	0	11
150-450	0	52	33	30	0	11	0	0	11	0	0	0	0	0	11
450 - 900	40	39	11	10	0	33	10	0	11	0	0	0	0	0	22
900 - 2000	10	13	22	0	13	0	0	13	22	0	0	11	0	0	0
2000 - 4000	10	0	32	40	78	22	0	0	0	0	0	0	0	0	11
>4000	50	52	44	10	0	22	10	0	11	10	0	11	0	13	0

Architects, quantity surveyors and engineers were asked to state the approximate proportion of time, in an average week, that they spend on activities which are primarily and directly concerned with achieving a specified level of quality (see question AQE:11). The survey indicates that the architects, quantity surveyors and engineers spend an average of *44%, 18%* and *40%* respectively of their working time on activities which are primarily and directly concerned with quality.

Linked to the approximate proportion of time in an average working week spent on activities which are primarily and directly concerned with achieving a specified level of quality (see question AQE:11), is the proportion of this time spent on various activities (see question AQE:12). Architects, quantity surveyors and engineers were asked to indicate the proportion of the time stated in question AQE:11, that they spend on various activities. These results are shown in Table 7.50.

Table 7.50 The approximate proportion of the time stated in question AQE:11 that architects, quantity surveyors and engineers spend on various activities (n=10, 8 and 9 respectively)

	80-100%			60-79%			40-59%			20-39%			1-29%			0%		
	%			%			%			%			%			%		
	A	Q	E	A	Q	E	A	Q	E	A	Q	E	A	Q	E	A	Q	E
Inspection	0	0	11	0	0	0	10	0	11	70	0	0	10	39	66	0	0	0
Supervision	0	0	0	0	0	0	0	0	0	60	0	44	50	13	44	0	13	0
Verbal instruction	0	0	0	0	0	0	0	0	11	0	0	0	90	26	55	0	0	0
Written instruction	0	0	0	0	0	11	0	0	11	30	0	22	60	52	44	0	0	0
Discussion	0	0	0	0	0	22	20	0	0	40	0	33	30	78	22	0	0	0
Assistance	0	0	11	0	0	11	0	0	0	30	0	11	50	13	55	0	13	0
Corspndnce	0	0	0	0	0	22	0	13	0	40	0	0	50	39	33	0	0	0
Report writing	0	0	0	0	0	22	0	0	0	20	13	22	70	26	44	0	0	0
Travelling	0	0	0	0	0	0	0	0	11	0	0	11	90	39	22	0	0	0
Other:	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0

A = Architect Q = Quantity Surveyor E = Engineer

The majority of architects (70% and 60%) spend **39-20%** of the time spent on activities which are primarily and directly concerned with achieving a specified level of quality on *inspection* and *supervision* respectively. Mostly, architect, quantity surveyor and engineer respondents spend **19-1%** of the time spent on activities which are primarily and directly concerned with achieving a specified level of quality on *inspection, supervision, verbal instruction, written instruction, discussion, assistance, report writing and travelling.*

Architect, quantity surveyor and engineer respondents were asked to state the average number of persons who normally report to them (see question AQE:13). The average number of persons who normally report to architects, quantity surveyors and engineers range from *4 to 10, 1 to 7 and 3 to 12* persons respectively (with mean averages of *6, 3 and 9* persons respectively).

All quantity surveyor and engineer respondents reported that they *do not maintain a separate specification writing department or section* within their firms. Eighty per cent of architects reported that they *were not maintaining a separate specification writing department or section*, but 20% *were maintaining a separate specification writing department or section* in their firms (see question AQE:14).

All quantity surveyors and engineers reported that they *were not employing any full time specification writers*, but 10% of the *architect respondents claimed that they were employing full time specification writers* (see question AQE:15).

The architect, quantity surveyor and engineer respondents who indicated that they were not maintaining a separate specification writing department or section within their firms and were not employing any full-time specification writers, were asked to state the specialist responsible for writing their specifications (see question AQE:16).

Architect respondents who gave a negative answer (`no') to questions AQE:14 and AQE:15, reported that a *quantity surveyor, project engineer, project architect and principal of a firm* were responsible for writing their specifications but this depends on the nature of the project.

Quantity surveyors reported that the *project quantity surveyor and principal of the firm* were responsible for writing their specifications. Engineers, like quantity surveyors indicated that *project engineers, quantity surveyors and firm principals* were responsible for writing their specifications.

Architects, quantity surveyors and engineers agree over one of the minimum qualifications which a specification writer should possess (see question AQE:17 and Table 7.51). Eighty per cent of architects, 88% of quantity surveyors and 55% of engineers consider *design and construction (field) experience* as a minimum qualification which a specification writer should possess. Quantity surveyors (75%) , engineers (88%) and architects (40%) feel that an *engineering degree* should be a minimum qualification for a specification writer. Furthermore, 60% of the architects are of the opinion that an *architectural degree* should be a minimum qualification for a specification writer. Interestingly, no single respondent feel that a *masters degree* should be a minimum qualification for a specification writer.

Table 7.51 Architects', quantity surveyors' and engineers' opinions regarding the minimum qualifications which the specification writer should possess

Minimum Qualifications which the Specification Writer Should Possess	Architect (n=10)	Quantity surveyor (n=8)	Engineer (n=9)
Architectural degree	60%	25%	0%
Engineering degree	40%	75%	88%
Design experience	40%	13%	44%
Design and construction (field) experience	80%	88%	55%
Prior knowledge of understanding a project	20%	26%	22%
Masters degree	0%	0%	0%
Other (specify): Specification experience	0%	13%	0%

In order to determine the extent of architects', quantity surveyors' and engineers' involvement in specification writing and the importance attached to specification preparations, their opinions were surveyed by asking them to indicate the percentage of the design budget which is normally allocated for specification writing in establishing their in-house budget for a project (see question AQE:18). The results are shown in Table 7.52.

The majority of architect (40%), quantity surveyor (75%) and engineer (22%) respondents report that less than 2% of the design budget is allocated for specification writing when establishing the in-house budget for a project.

Table 7.52 Percentage of the design budget allocated for specification writing when establishing in-house budget for a project (architects', quantity surveyors' and engineers' opinions)

Percentage of design budget	Architect (n=10)	Quantity surveyor (n=8)	Engineer (n=9)
Less than 2%	40%	75%	22%
2 - 4%	10%	0%	11%
5 - 9%	10%	0%	22%
10 - 14%	20%	0%	22%
15 - 20%	0%	13%	11%
Over 20%	10%	13%	0%

Specifications have been criticised by various contractors and various construction specialists, that they do not mostly reflect the required information necessary to meet client requirements (Fisk (1978), Nugent (1978) and Committee on Specifications (1979)). Architects' quantity surveyors' and engineers' opinions were sought (see question AQE:19) regarding their **greatest in-house problem in getting out a good set of specifications**. This information is portrayed in Table 7.53.

The majority of architect (70%), quantity surveyor (88%) and engineer (56%) respondents reported that their greatest in-house problem in getting out a good set of specifications was the *insufficient time allowed for preparation of specifications*. Interestingly, while the insufficiency of time allowed to prepare specifications was supported by more than 50% of each respondents category, quantity surveyors (75%) and engineers (67%) reported that *insufficient information to prepare specification* was another in-house problem they were facing. Architects didn't consider this to be one of the problems. *Coordination between various disciplines involved in the project* was reported by architects (20%), quantity surveyors (25%) and engineers (22%) as a greatest in-house problem in getting out a good set of specifications. It appears unusual for 20% of the architects to claim that there is no great in-house problem when preparing specifications.

Table 7.53 Architects', quantity surveyors' and engineers' opinions regarding their greatest in-house problem in getting out a good set of specifications

In-house problem	Architect (n=10)	Quantity surveyor (n=8)	Engineer (n=9)
Insufficient time for preparation	70%	88%	56%
Coordination between plans and specifications	0%	0%	0%
Coordination of all phases of work in project schedule	0%	0%	11%
Coordination between various disciplines involved	20%	25%	22%
Insufficient information to prepare specification	0%	75%	67%
Other: No problem	20%	0%	0%

Various project stake holders face a variety of problems with project specifications when administrating contracts. In an attempt to establish particular problems which architects, quantity surveyors and engineers face with project specifications when administrating contracts, they were requested to select from a list of possible problems (see question AQE:20). The results are shown in Table 7.54.

Two most pressing problems appear to be *the contractors' failure to read or understand the specifications* and *contractors neglecting to follow the specifications*. These are reported by architects (70% and 90%), quantity surveyors (13% and 52%) and engineers (89% and 56%) respectively. Furthermore, quantity surveyors (78%) reported that *inadequate inspection and quality control in the field* is another problem with project specifications when administrating contracts.

Table 7.54 Architects', quantity surveyors' and engineers' opinions regarding problems with project specifications when administrating contracts

Problems with project specifications when administrating contracts	Architect (n=10)	Quantity surveyor (n=8)	Engineer (n=9)
Contractors' failure to read or understand the specifications	70%	13%	89%
Contractors neglecting to follow the specifications	90%	52%	56%
Unauthorised substitutions of materials by the contractor	20%	0%	22%
Lack of enforcement of the specifications involved	10%	0%	11%
Inadequate inspection and quality control in the field	40%	78%	22%
Field personnel do not read and understand the specifications	10%	39%	33%
Conflict between the plans and specifications and lack of coordination	0%	13%	11%
Specification writer - unfamiliar with the tests and standards he/she specifies	0%	0%	0%
Incomplete or incorrect specifications	0%	26%	0%
Ambiguous language in specifications	0%	13%	0%
Other	0%	0%	0%

Architects, quantity surveyors and engineers were in agreement that points 1, 3, 4, 5, 6, 7, and 9 represented the true characteristics of most of their public building projects (see question AQE: 21 and Table 7.55). The majority of architects (90%), quantity surveyors (95%) and engineers (96%) reported that point 2 (see Table 7.55) was not true with regard to the characteristics of most of their projects. Architects, quantity surveyors and engineers were in agreement over point 8 (see Table 7.55). They reported that it was false to say that an acceptable negotiated project contract form is normally used to ensure a fair and familiar distribution of risk.

From the above, it is clear that architect, quantity surveyor and engineer respondents are in agreement with construction firm executives, contracts managers, site managers and trade foremen that the dominant procurement system in the Botswana public building sector is not what is generally purported to be. The respondents reported that a hybrid version of the traditional procurement system is primarily used in the Botswana public building sector of the construction industry.

Table 7.55 Architects', quantity surveyors' and engineers' opinions regarding the characteristics of their projects (n=10, 8 and 9 respectively)

Project characteristics	True			More true than false			Difficult to say			More false than true			False		
	A	QS	E	A	QS	E	A	QS	E	A	QS	E	A	QS	E
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
1. The client commissions, and takes responsibility for the design of the works	90	95	95	0	0	0	10	5	5	0	0	0	0	0	0
2. The design is complete at the time of selecting the contractor	5	0	0	0	0	0	5	5	4	0	0	0	90	95	96
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum	90	95	90	0	0	0	10	5	10	0	0	0	0	0	0
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication	95	80	85	0	0	0	5	20	15	0	0	0	0	0	0
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect	90	95	95	0	0	0	10	0	5	0	5	0	0	0	0
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices	96	95	95	0	0	0	4	5	5	0	0	0	0	0	0
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)	90	95	96	0	0	0	10	0	5	5	0	0	0	0	0
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk	5	5	0	0	0	0	0	0	4	0	0	0	95	95	96
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue	90	85	80	0	0	0	5	15	20	0	0	0	5	0	0

A = Architect, QS = Quantity surveyor, E = Engineer

Summary of 7.7:

It appears that the majority of architects, quantity surveyors and engineers are experienced individuals within their areas of expertise. The majority of these respondents were trained through universities, and others were trained through polytechnics and technical colleges.

Excavation, formwork, reinforcement, plastering and floor finishings are considered by the majority of architects, quantity surveyors and engineers to have high incidences of problems concerning quality. Three major causes of unacceptable quality work as reported by the majority architect, quantity surveyor and engineer respondents are: lack of skilled labour, poor site supervision and poor understanding of specifications and drawings.

The majority of architects, quantity surveyors and engineers are in favour of a project specification writer to have design and construction (site) experience as a minimum qualification. Furthermore, their greatest in-house problem in getting out a good set of specifications is the insufficient time allowed for preparation of specifications.

Architects, quantity surveyors and engineers are concerned that contractors fail to read or understand the specifications and they neglect to follow the specifications. They consider these to be the most pressing problems with project specifications when administrating contracts.

Contrary to common knowledge that `pure' traditional procurement system is the dominant system in the Botswana public building sector, architect, quantity surveyor and engineer respondents are in agreement that the dominant procurement system in the Botswana public building sector is the hybrid version of the traditional procurement system.

7.8 Conclusion

The purpose of this chapter has been to document the results of a questionnaire survey into the current practice of quality management during the construction process in the Botswana public building sector, using Gaborone as a case study. Within the constraints inherent in a survey of this nature, the writer considers that meaningful insight into the practice of quality management during the construction process, has been gained. It is clear that current practice differs from perceived situation and general theory presented in current texts.

CHAPTER 8
THE CURRENT PRACTICE OF QUALITY MANAGEMENT: CASE STUDIES AND CLIENT INTERVIEWS

8.1 Introduction

This chapter reports the results of case studies and interviews undertaken in order to supplement the findings of the questionnaire survey reported in chapter 7. The reasons behind the supplementation approach are discussed in chapter 6.

Case studies:

As indicated in Chapter 6, two types of case studies were carried out:

(i) *Site visits*: Two randomly selected site visits, where the author observed various site work processes and the overall management of sites. Site agents and client representatives were interviewed by the author on issues related to site quality management.

(ii) *Project specifications*: Project specifications of ten randomly selected projects were analyzed on the basis of their suitability as quality management documents during the construction process.

The above case studies are described and analyzed according to the observation guidelines outlined in Appendix X and XI, covering the main issues affecting quality management which were established in Chapter 3 and incorporated in the hypotheses.

Client representatives interviews:

One senior representative from each of the two organizations representing 90% of the public building sector clients were interviewed. These are the Department of Architecture and Building Services (DABS) and Botswana Housing Corporation (BHC). In order to maintain confidentiality, these organizations will not be referred to by name in the analysis. The interviews are analyzed according to the pre-prepared guidelines outlined in Appendix XI, covering the main issues affecting quality management which were established in Chapter 3 and incorporated in the hypothesis.

8.2 Site visit case studies

8.2.1 Case study A

Project description:

Outline: The project was an office block/warehouses/workshops for the Botswana Government. The site was a piece of land in the western side of the city of Gaborone.
The traditional procurement system was used, using Bills of Quantities as one of the main contract documents. A five weeks tendering period was allowed.

The tender sum was 32, 000, 000 Pula (approximately 46 Million Rands) at 1992 prices. The duration of the contract was 12 months. The management of the project was partly performed in-house, and partly external professional consultants for quantity surveying, structural engineering and services engineering work. Each consultant had a counterpart within the Department of Architecture and Building Services (DABS). The architectural work was done in-house and fully managed in-house.

The nominated sub-contractors included: Electrical installation, Mechanical and Air Conditioning, Glazing, Partitioning, Flooring, Waterproofing, Landscaping and Earthwork. Much of the structure consisted of traditional construction on strip foundation and ground beams. At the time of visit the main contractor had completed more than 80% of the contracted work.

When the client representative (project architect) was asked to give a brief background on the project stages of work, the following were noted:

Stage of Work	General Comments
1. Inception	There was close control and good co-ordination between designers and the client.
2. Feasibility	Good co-ordination between project stakeholders.
3. Sketch scheme	Good integration of ideas from project stakeholders
4. Detail design	Above average feedback between project stakeholders; average integration; close client involvement.
5. Contract	Good feedback; above average co-ordination of project activities; close client involvement.
6. Construction	Excellent feedback; minimum duplication of responsibilities between the site agent and subordinates, and the clerk of works; excellent client involvement due to site agent initiative; other aspects are described below.

When asked to explain the reason(s) behind choosing the traditional organizational structure among other options, the client representative had the following points:
(i) Although the range of project organizational options to clients is increasing, the Botswana public building sector doesn't have any formal approach of choosing between procurement methods. The traditional procurement system is "a given" in almost all projects.
(ii) The Department of Architecture and Building Services (DABS) has categorized and classified procurement systems to such an extent that it has developed the traditional procurement system and decided to stick to it irrespective of project needs.

Drawings and specifications on site:
At the time of moving to the construction site 80% of the project drawings were completed. After that the remaining 20% were arriving in dribs and drabs as work progressed. The site

manager (site agent) put forward the view that the architect was designing the remaining parts as they were constructed. The remaining drawings were not very explicit and the architect visited the site several times during the author's three days site case study period. The agent was always communicating with the architect through the clerk of works in order to avoid unnecessary delays.

The *DABS Standard Specification of Materials and Workmanship for Building Contractors (April 1989 Edition)* was used for this project. The *`Shotgun approach'* which is referred to by Fisk (1978) as an approach where inapplicable material is included in the specifications was used in writing the specifications. The DABS general standard specification handbook (DABS, 1978) was used without any substantial adjustments on various parts of the document which were not applicable to the project. The standard specification handbook refers to the South African Bureau of Standards (SABS), Central African Standards (CAS) and the British Standards (BS). The main contractor did not posses these documents, the site agent indicated that he was depending on DABS for supplementary information from these documents.

Site management team:
The contractor provided a senior and three junior site agents and two construction engineers. The client provided a full-time building clerk of works and a part-time quantity surveyor and Mechanical and Electrical (M&E) clerk of works.

Site Management:
The site agent and his own staff comprised a lively and dynamic team and overall enjoyed the increased responsibilities the unusual traditional procurement system contractual procedures gave to them. For example: the site agent conscientiously and effectively took responsibilities which were outside the established functions of a site manager, guiding the architect, and checking his drawings very thoroughly. Generally, the system was working quite well, the agent and his staff putting great effort and skill into organising the site and managing the various sub-contractors so that quality problems were not arising from clashes between sub-

contractors. In fact, the main contractor's staff prided themselves on their effective management.

The site agent took positive measures to ensure good communication. He kept very comprehensive charts on his office wall which he filled in to show exactly which subcontractors were on site and when, what plant was on site and even a report of weather conditions. He benefitted from three junior site agents, and two construction engineers who worked as his deputies on various aspects of the project.

The site agent had close liaison with the clerk of works and the project architect and was prepared to carry out small items of work that were no longer his responsibility, partly through his own professional pride and also to keep the client satisfied.

The clerk of works took a keen interest in quality and progress. He checked through all paperwork produced, inspected the state of the site - cleanliness, tidiness, the attitude of all labourers to their work and checked on safety - he insisted on safety helmets being worn by everyone. He also checked on conformance with drawings and specifications as far as possible.

Quality Problems:

All the quality "problems" observed never really came into the category of problems as they were effectively dealt with (usually by the site agent). A notable quality management procedure was observed by the author during one of his site visits. The key medium for motivating the employees and gaining their commitment to quality management, **`face-to-face communication'** and **`visible management commitment'** was in practice.

The specification on this project was consulted a number of times with respect to the cement and sand screed that was being laid at the time of the author's visit. Trunking junction boxes were being buried in the screed deeper than the project architect anticipated, so it was decided to increase the screed depth to accommodate them. The site agent pointed out that larger aggregates were suitable in deeper screeds. After much discussion and perusal of documents the project architect decided not to change the specification and continued the use of smaller sizes of the aggregate.

Appraisal:

Although project documentation was poor in relation with the requirements of the procurement system, the overall management of the contractor was very good. An authoritative and competent site agent and his immediate subordinates. The site agent was instrumental in developing a communicative site team and he was well supported by the clerk of works and the architect. The site agent's understanding that the project organizational structure was inadequate in addressing project quality requirements made him more visible on site and he made the architect to have direct input on site, especially in solving design interpretation problems. Mainly, deficiencies were prevented because the site agent was keen in making sure that: (i) Every task was always carried out and always in the logically defined sequence; (ii) The element inputs were always appropriate to specific tasks in question in terms of a project management application; and (iii) The element detail inputs were always appropriate to and in place for specific elements in question in terms of project management support. This ensured the comparative success of this project.

8.2.2 Case study B

Project description:

Outline: This project consisted mainly of trade exhibition stores at trade show grounds. The single storey exhibition stores were of steel structure, cladding with face bricks in-fill, cement concrete granolithic flooring and IBR roof covering. The show grounds external wall enclosure and other external services to the stores were completed before the construction work of trade exhibition stores started.

The design and build procurement system was used, where the traditional procurement system standard forms of contract (without quantities) were used with minimal amendments.

According to the project architect, the project brief was incomplete at the start of the project, the decision was to develop the brief as project work advanced.

The tendering procedure: the project scheme was developed by the in-house team of the Department of Architecture and Building Services, and sent out to tenderers. Tenderers were asked initially to submit basic drawings towards contract award. Detail drawings were developed by the contractor during post-contract stage.

The tender sum was 4, 400, 000 Pula (approximately 3.3 Million Rands) at 1994 prices. The duration of the contract was originally set at 4 months. The management of the project was mainly performed by the project main contractor, using external professional consultants for architectural work, structural engineering and quantity surveying work. In order to verify the credentials of the consultants, it was specified during pre-qualification stage that every tenderer was required to submit names and *curricula vitae* of these consultants among other information during the tendering stage.

The client representative (DABS Architect) was asked to give a brief background on the project stages of work, and the following information was given:

Stage of Work	General Comments
1. Inception	Mediocre consultants involvement, and very little information gathered in order to aid the feasibility stage. Incomplete brief.
2. Feasibility	No formal feasibility study was carried out.
3. Sketch scheme	Basic sketch scheme; good co-ordination; no duplication of activities.
4. Detail design	Slight lack of co-ordination between the client representative and the main contractor responsible for design.
5. Contract	Poor co-ordination; mediocre control of project consultants by the main contractor.
6. Construction	Poor integration, duplication of co-ordination between the main contractor and the client representative; good client involvement as a mediator between the main contractor and the consultants.

Drawings on site:

The client representative advised the author that the drawings were not all that they might be, due to the rush to get the job started and the main contractor's co-ordination problems which were mainly due to inexperience with the project procurement system. The client representative (DABS architect) found himself co-ordinating design work from the project architect because the main contractor was failing to enforce a proper drawing submission schedule. Unfortunately the client representative was claiming to have other projects commitments, and it meant that he was only able to be on site when he was not visiting other projects outside Gaborone.

Site management team:

Because it was a design and build procurement arrangement, the main contractor was responsible for the integration of design and construction. The main contractor's site manager appeared to be having difficulties in controlling the consultants and the site. The client representative (DABS Architect) was almost managing the site on behalf of the main contractor. Originally the client representative was visiting the site once a week, but later changed to three visits a week. Having realized that the main contractor's site manager was failing to co-ordinate the site team, most consultants were not visiting the site as was expected.

Site management:

The main contractor's site manager was very much on the periphery of the administration for the site - he was almost out of touch with all aspects of site life. At first sight he seemed to have a firm attitude to running the job: his appearance and his office were neat, but in fact he had very little understanding about the way the job was run. His management style employed to deal with his subordinates to control quality and throughput was crude. Quite often it amounted to shouting commands such as "Watch your bricklayers, they are wasting too much mortar" or What are you doing guys, the formwork is kicking". The shouted orders and reprimand were completely ignored by the trade foremen.

Communication was very poor on site, for example bar charts on his office wall were not `filled in'. It was not easy to establish from the site manager exactly which subcontractors were on site and when and what plant was on site. The author found out later that the client representative was forced to intervene, and asked the main contractor's managing director to ask his site manager to take positive measures to ensure good communication on site. The communication vacuum was contributing to various delays which, according to the client representative, could have been avoided through good site administration.

Quality problems:

Most of the common problems with brickwork were occuring - incorrectly fixed damp proof courses around windows, poorly fixed flashings and wide cracks. The site manager's on-site effectiveness in dealing with these problems was limited - because of his inability to assume his contractual managerial role, he had only limited authority.

According to the client representative, the brickwork subcontractor foreman had been observed on other sites previously where extremely good brickwork was produced.

Another serious quality problem was painting defects on woodwork - paint blistering, paint peeling, poor adhesion and flaking and irregular cracks. According to the client representative the main causes of these painting defects on wood were discussed between him and the site manager, and the following causes were established:
(i) Poor application of paint was the main cause of blisters and poorly seasoned wood was used and in some instances knots were not properly treated. Excessive heat exposure precipitated the problem;
(ii) Peeling, poor adhesion and flaking were due to poor application of paint particularly priming coat and poorly seasoned wood was used and surfaces were not properly cleaned;
(iii) The appearance of irregular cracks on painted surfaces was primarily due to the application of paint over soft new paint, and the excessive heat exposure contributed as a catalyst to the problem.

The biggest single problem on site was plastering defects - fine hair cracks on the finished plaster, plaster surface soft and powdery with very fine cracks and softness or chalkiness of plaster.

The laxity of the site manager was reflected in the way various trade foremen were managing their trades. Although an excellent programme in terms of detailed bar charts were in the site manager's office, no target schedule existed to all trades, so the foremen did not know what they should produce or the schedule requirements in completing trade work. Furthermore, the foremen had no formal benchmark against which they could monitor the performance of their operatives. Information used was simply past experience and `gut feeling'. Beside occasional shouts from the site manager, operatives were never formally informed about how well or badly their gangs were doing. The above quality problems were a result of a trade supervisory vacuum which was obvious when you visited the site.

Appraisal:

The overall management by the main contractor as indicated above was generally very poor and this include the day to day control over individual sub-contractors, consultants and in house trade foremen. A major problem was the poor organised design and rushed commencement of work on site. The client, main contractor and all consultants were new to the contractual procedure being used. It was not clearly indicated to the author as to how the design and build contractor qualified for the project with such a poor management ability.

8.3 Project specifications case studies

This section reports on project defects which were listed in respective snag lists and site meeting reports. *Error or defect detection and removal are parts of an effective quality management system, in this project some listed defects were remedied, hence only those defects which were not remedied, either nothing was done or partial work was done but the defects were still visible are considered.* The way or ways in which the defects were manifested themselves are described. The nature and scope of appropriate construction in order to avoid the defect is given for each defect, and working drawings and specifications are scrutinized to identify the details and information provided to the contractor prior to construction.

8.3.1 Case study C

Project description:

This project consisted of thirty five town houses and six blocks of two bed room flats. The six blocks of flats were partly of cement stock bricks on in-situ traditional strip foundation and partly reinforced concrete columns on bases. All structures had pitched concrete tiled roof on prefabricated timber trusses. All structures had glazed metal windows.

The traditional procurement system was used, using Bills of Quantities as one of the main contract documents. The tender sum was 10, 282, 425 Pula (approximately 14, 700, 000 Rands) at 1990 prices. The initial estimated duration of the contract was 27 months but it was finally completed after 35 months.

Defects identified:

(i) Dampness internally around the window openings

Water was penetrating between the wall jamb and the window frame, due to loss of adhesion of the sealant pointing. This was caused by the use of an incorrect sealant material.

Remedy: Use a correct sealant material: oleo-resinous and acrylic (emulsion) types of sealant are suitable.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The details of the horizontal cross section cutting through the wall and window frame was annotated and the position of the mastic were well indicated.

(b) Specifications: The sealant specifications were provided under a sub-section on painting in the standard Specification handbook. The sealant materials requirements were referred to the SABS without specific reference to a particular section of the SABS as follows (BHC, 1991):

> *"All sealers,....are to be of approved manufacture and quality and shall comply with the requirements of the SABS."*

On paper the basic requirements of sealing are provided by the working drawing and specification handbook, but in order to find the details of avoiding this manifestation, it was necessary that the SABS must be consulted, and the particular section dealing with sealants was supposed to be identified.

(ii) Cracking and detachment of wall tiling

This was found to have been caused by differential movement, chiefly from moisture movement, between the finish and the background. Movement joints were not provided.

Remedy: Provision of movement joint in order to take care of shrinkage. Shrinkage can be estimated by measuring the background's moisture content and comparing this with known values of the material in its *`dry state'*.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: Beside an indication that the walls were supposed to be tiled and the required height of tiling, no details were given in the drawing to help the site operative to provide the required movement joint.

(b) Specifications: The information given in the contract specification document covered tiles bedding, jointing and various sizes of tiles requirements, but nothing was provided on movement joints. The contract bills of quantities (BOQs) relevant item, which was measured according to ASAQS (1977), was silent about movement joints.

(iii) Blistering of paintwork

Blistering was found to have been caused by the application of an inappropriate primer and the likeliness of an inappropriate preparation of the surface of the timber, both were incompatible with the paint system.

Remedy: Preparation of the timber and applying the correct paint system.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The information provided in the contract drawing was adequate. The painting schedule was provided, and the details on application were referred to the contract specifications handbook.

(b) Specifications: The contract specifications on painting was clear. Although referred to BS Code of Practice 231 for **preparing surfaces** and **providing and applying the paint**, the general instructions on the following main items of painting were clearly covered: *materials;*

workmanship; surface preparation. This item was adequately covered even in the absence of BS Code of Practice 231.

(iv) Cracking of window glass pane

Although there are various sources of this manifestation, this failure was found to have been caused by the provision of an inadequate clearance around the panel.

Remedy: Provision of the panel with sufficient clearance to suit the material and the degree of exposure to sunlight (usually a minimum clearance of 5mm at each edge for panels with a dimension exceeding 750mm).

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The details of the horizontal cross-section through the window frame was annotated and the position of the glass pane was clearly shown. The required clearance was clearly indicated. The details provided in the working drawing were sufficient for the provision of the panel with the required clearance.

(b) Specifications: The information provided under Clause 105 (BHC 1991:79-81) was sufficient for the provision of required clearance. Although BS 952 and BS 544 are referred to under Clause 105, the basic glazing requirements on workmanship, different types of glass and terms are sufficient for the avoidance of the respective defect.

(v) Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space (roof pitch 15^0). The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be `Weather stripped'.

Reference for correct detailing in the contract specifications:

(a) **Drawings:** The eaves detail working drawing was showing the principal parts of the roof, and there was no indication on the provision of ventilation. In general the eaves details were not sufficient to direct operative to provide the required roof space ventilation. The project BOQs relevant item was silent about ventilation provision.

(b) **Specifications:** The project specification handbook was silent about this particular detail.

8.3.2 Case study D

Project description:

This Municipal services and residential housing project consisted of 861 low cost houses, 477 medium cost, 137 high cost, 173 town houses and 234 flats. The Federation Internationale Des Ingenieurs-Conseils (FIDIC) was used for the whole project, following closely the traditional procurement system management structure. The contractual set-up for houses and flats was based on a standard FIDIC form of contract with firm bills of quantities. Provisional bills of quantities were used for the civil works which included road works, external water supply works, waste water disposal and drainage.

The tender sum for the whole project (building and civil works) was 227 Million Pula (approximately 325 Million Rands) at 1990 prices. The project was estimated to take 36 months, but was extended to 44 months. External consultants which included architects, quantity surveyors, civil engineers and water engineers were used.

Defects identified:

(i) Dampness at or near wall/ceiling junction internally

Detachment and dislodgement of the pointing and asphalt had occurred because the horizontal chase was inadequately formed and sized for proper asphalt tucking and mortar pointing above. Rainwater found its way behind the asphalt.

Remedy: Cut a chase correctly and shaped and then relay the asphalt with a weathered top and space for pointing. Point with cement:sand (1:3) between the top of the asphalt and the underside of the chase.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The working drawing showing the ceiling/roof details did not detail the asphalt tucking and mortar pointing.

(b) Specifications: No direct information was given in the project specification handbook towards avoiding this defect.

(ii) Slumping of skirting

This was found to had been caused by the following:

(a) The vertical substrate did not provide an adequate key for the asphalt, by being damp at the time asphalt was applied.

(b) The angle fillet was too small (ie. less than the minimum of 50mm).

(c) The asphalt became too soft owing to the lack of solar reflective treatment.

Remedy: Provide an adequate key to the vertical substrate. The concrete surface should be roughened. In addition, cement: sand gauged with PVAC; or bitumen rubber emulsion can be applied to the vertical surface. The asphalt should be relayed on isolating felt where it is horizontal so that it is level with the existing asphalt; 13mm minimum thickness of asphalt should be laid vertically with a 50mm minimum angle fillet.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The working drawings were silent about slumping of skirting. The details provided for the flat roof were very basic to help the operatives to avoid this defect. No information was found in the project file about this very important omission.

(b) Specifications: No direct information was provided towards avoiding this defect.

(iii) Reinforced concrete flat roof: Extensive cracking in the region of the angle fillet

This was found to have been caused by differential movement between the roof deck and the upstand, this was aggravated by the fillet being too small.

Remedy: Form a pre-screeded woodwool or timber kerb with a 13mm minimum movement gap between the back of the kerb and face of the upstand. Tack expanded metal lath on the face of the kerb and for 100mm along the horizontal surface over new isolating membrane. Apply asphalt. Install a non-ferrous metal apron flashing with cleats and dress over the top of the asphalt to the kerb.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The reinforced concrete flat details were very basic showing the main construction details. The roof deck and upstand construction details were not clearly indicated in the drawing. The author's follow-up on various project correspondences were not referring to the requirements of avoiding this defects. This defect was discussed during one of the project site meeting, where the contractor was asked to rectify the defect. This was raised by the project Structural Engineer, and no indication was found referring to the drawings silence in providing appropriate details towards the avoidance of this defect .

(b) Specifications: No direct information was provided towards avoiding this defect.

(iv) Reinforced concrete flat roof: Dampness near the wall/ceiling junction internally

This was found to have been caused by the dpc which was not taken over the top of the splayed asphalt and not extended beyond the face of the vertical asphalt thus allowing water to penetrate behind the asphalt.

Remedy: The tingle must be dressed over the top of the asphalt. The insertion needs to be carried out with extreme care. Remove short lengths of the brick course above - no more than 3 bricks at a time. Remove the asphalt in the chase for about 50mm below it. The chase itself need to be enlarged, taking care not to damage the dpc while so doing. After the tingle is inserted, the asphalt should be relayed into the chase, and after it has cooled, the tingle dressed over it.

Reference for correct detailing in the contract drawings and specifications:
(a) Drawings: While the reinforced concrete flat roof details were provided in the working drawings, they mainly covered the general construction details of slab dimensions and reinforcement arrangements. Water proofing details were not provided by working drawings.
(b) Specifications: Like the working drawings, the project specifications handbook was silent on the roof waterproofing requirements. The information provided in the handbook on damp proof courses was too general to relate to this particular project.

(v) Reinforced Concrete Frame/ Concrete Panel Junctions:Dampness internally, near panel joints

This was caused by a defective *flashing*, hence rain penetration, especially because the walls were subject to driving rain. *The defective flashing:* the flashing edge was recessed behind the outer face of the concrete panel, rainwater penetrated underneath the flashing and there was no protection or alternative line of defence behind to prevent further water penetration.

Remedy: The flashing edge should be recessed infront of the outer face of the concrete panel (as a protection against rainwater), in this way rainwater will not penetrate underneath the flashing.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: Like (iv) above the working drawing which was supposed to provide details of protecting the roof against rainwater, provided the general roof slab details: slab dimensions and reinforcement arrangements. Flashing construction details were not given.

(b) Specifications: The project specifications handbook was silent on the requirements of roof flashing provision.

(vi) Pitched tiled roof: Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space (roof pitch 15^0). The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be provided with weather strips.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The basic parts of the eaves detail were clearly shown by the working drawings, but no indication on the provision of roof space ventilation. Without additional eaves detail working drawings it was not possible to use the available drawings to meet the basic roof space ventilation provisions.

(b) Specifications: The specification handbook was silent about this particular detail.

8.3.3 Case study E

Project description:

This high cost experimental house consisted of a main house, a guard house and associated external works and services. It was constructed of cement stock brick walls on traditional strip foundations. All had pitched concrete tiled roof. The structural part of the roof was prefabricated timber trusses.

The traditional procurement system was used, using Bills of Quantities and Botswana Housing Corporation Standard Conditions of Contract and Preambles (1991 Edition). The tender sum for the project was 1, 750, 000 Pula (approximately 2, 500,000 Rands) at 1991 prices. External project consultants were used in the administration of the project. These included architects and quantity surveyors.

Defects identified:

(i) Cracking and detachment of tiling

This was found to have been caused by differential movement, chiefly from moisture movement, between the finish and the background. Movement joints were not provided.

Remedy: Provision of movement joint in order to take care of shrinkage. Shrinkage can be estimated by measuring the background's moisture content and comparing this with known values of the material in its *`dry state'*.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: General information specifying the walls which were supposed to be tiled and the required height of tiling were given, but no details on movement joints.

(b) Specifications: Extensive information was provided in the contract specifications document covering bedding and jointing of tiles and various sizes of tiles. Nothing was provided on movement joints. The contract BOQs relevant item, which was measured according to ASAQS (1991), was silent about this detail.

(ii) Blistering of paintwork

Blistering was found to have been caused by the application of an inappropriate primer and the likeliness of an inappropriate preparation of the surface of the timber, both were incompatible with the paint system.

Remedy: Preparation of the timber and applying the correct paint system.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The painting schedule was provided and the details on paint application were referred to the project specifications document. Generally the information provided in the contract drawings was adequate.

(b) Specifications: Although the contract specifications on painting referred to BS Code of Practice 231 for **preparing surfaces, providing and applying the paint**, the general instructions given in the specifications document on **materials, workmanship and surface preparation** were adequate to avoid this defect.

(iii) Lifting of PVC (vinyl) tiles

An incorrect adhesive was used.

Remedy: Laying tiles with a correct adhesive following the advice of the adhesive manufacturer.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The details provided in the working drawings were sufficient enough in terms of identifying the surface to be tiled and the extent of tiling.

(b) Specifications: Nothing was provided in the project specification document relating to fixing of PVC tiles, specifically dealing with types of adhesives.

8.3.4 Case study F

Project description:

These 118 low cost residential houses consisted of cement stock brick walls on in-situ traditional strip foundations. All had concrete tiled roof covering on prefabricated timber trusses.

The total value of these houses was 3, 521, 067 Pula (approximately 5 Million Rands) at 1993 prices. The estimated duration of the contract was 19 months. In house project consultants were used. These included architects, quantity surveyors, structural engineers and electrical engineers.

The traditional procurement system was used, using Bills of Quantities. The Botswana Housing Corporation Standard Conditions of Contract and Preambles was used as the main specification document.

Defects identified:

(i) Window openings: Dampness internally around the opening

This was caused by the use of an incorrect sealant material.

Remedy: Use a correct sealant material.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The details showing the horizontal cross-section through the wall and window frame were clearly provided.

(b) Specifications: Like in the case of case study C, defect (i), the basic requirements of sealing were provided by the working drawings and the project specification documents on paper, but the details of achieving the required detail the SABS was required to be consulted. No specific SABS section reference was indicated.

(ii) Timber windows: Timber decay, externally

This was found to have been caused by the growth of wet rot fungi on timber (soft wood). The timber was not preserved properly.

Remedy: Use preserved timber, and allow timber to dry before painting.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The working drawings details were adequate.

(b) Specifications: The general information given under BHC (1991:58-60), covering the basic requirements of carpentry timber (clause 85) and carpentry and joinery (clause 87) was sufficient to avoid the defect.

(iii) Blistering of paintwork

Blistering was found to have been caused by the application of an inappropriate primer and the likeliness of an inappropriate preparation of the surface of the timber, both were incompatible with the paint system.

Remedy: Preparation of the timber and applying the correct paint system.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The information provided was adequate. The painting schedule was provided and details on preparing surfaces, providing and applying paint were referred to the project specifications document.

(b) Specifications: The general information provided was adequate in order to avoid the defect. Although the BS Code of Practice 231 was referred to for further details, the author feels that it was not necessary to use the BS Code of Practice in order to achieve the required quality of painted work.

(iv) Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space (roof pitch 15^0). The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be 'Weather stripped'.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The drawing showing the eaves details were not sufficient to direct the operative(s) towards the provision of roof space ventilation.

(b) Specifications: This particular detail was not covered by the project specifications document.

8.3.5 Case study G

Project description:

This project consisted 84 high cost residential houses. These houses were of load bearing cement brick walls on traditional strip foundations. The roof consisted of concrete tiles on prefabricated timber trusses.

The traditional procurement system was used. External consultants were used. These included architects, quantity surveyors and civil engineers (structures).

Defects identified:

(i) Cracking and detachment of wall tiling

This was found to have been caused by differential movement, chiefly from moisture movement, between the finish and the background. Movement joints were not provided.

Remedy: Provision of movement joint in order to take care of shrinkage. Shrinkage can be estimated by measuring the background's moisture content and comparing this with known values of the material in its *`dry state'*.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: No details were given in the working drawings to help the operative to be able to provide the required movement joint. The general information provided in the drawing was sufficient for setting out the work and the movement joint requirements were left out.

(b) Specifications: Nothing was provided in the project specifications document on movement joints. The project BOQs relevant item, which was measured according to ASAQS (1991), was silent about this detail.

(ii) Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space (roof pitch 15^0). The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be `Weather stripped'.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: There were no sufficient details to direct the operative(s) to provide roof space ventilation.

(b) Specifications: The project specification document was silent about this detail.

(iii) Lifting of PVC (vinyl) tiles

An incorrect adhesive was used.

Remedy: Laying tiles with a correct adhesive following the advice of the adhesive manufacturer.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: Sufficient details were provided.

(b) Specifications: The information provided in the specifications document was not sufficient to guide the selection and use of suitable adhesives for fixing the vinyl tiles. The information provided was too general to relate to this particular detail.

8.3.6 Case study H

Project description:

This phase two double storey primary school classroom block was constructed of conventional reinforced concrete structural frame with infill brick walls, finished externally with face brickwork. Standard steel door frames and windows. The roof was prefabricated timber roof trusses covered with coloured steel sheeting.

External consultants were used. These included architects, quantity surveyors and structural engineers.

The traditional procurement system was used, using Bills of Quantities, the Ministry of Works, Transport and Communications Standard Specification of Materials and Workmanship for Building Contracts (DABS Specification) (April, 1989 Edition). The total value for this project was 490, 953 Pula (approximately 702, 000 Rands) at 1993 prices.

Defects identified:

(i) Cracking and detachment of wall tiling

This was found to have been caused by differential movement, chiefly from moisture movement, between the finish and the background. Movement joints were not provided.

Remedy: Provision of movement joint in order to take care of shrinkage. Shrinkage can be estimated by measuring the background's moisture content and comparing this with known values of the material in its *`dry state'*.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The drawing details were adequate in terms of fixing the tiles, but silent on the movement joint details.

(b) Specifications: The information provided in the project specifications document (DABS, 1989) provided detailed general information on tiling but nothing was provided on movement joints. The provisions of Code of Practice SABS 0107 were referred to for the requirement of fixing glazed tiles.

(ii) Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space. The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be `Weather stripped'.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: No roof space ventilation details were provided.

(b) Specifications: There was no particular information on roof space ventilation. Most of the general aspects of roofing were provided in detail with the exception of ventilation details.

8.3.7 Case study I

Project description:

The extension of a training and testing centre consisted of an administration block, kitchen/dining block, external works: site clearance, screen walling and gates, covered walkway, paths and pavings, roads and car parks, water connections and soil drainage.

The traditional procurement system was used, using bills of quantities, and DABS Specification.

Defects identified:

(i) Cracking and detachment of wall tiling

This was found to have been caused by differential movement, chiefly from moisture movement, between the finish and the background. Movement joints were not provided.

Remedy: Provision of movement joint in order to take care of shrinkage. Shrinkage can be estimated by measuring the background's moisture content and comparing this with known values of the material in its `*dry state*'.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The working drawing was adequate for the provision of the required movement joint. The positions of movement joints were clearly indicated and their respective centre to centre distances given.

(b) Specifications: The project specification document was silent about movement joints.

(ii) Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space (roof pitch 15^0). The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be `Weather stripped'.

Reference for correct detailing in the contract drawings specifications:

(a) Drawings: Basic details were provided, but no ventilation details were shown.

(b) Specifications: The project specification document was silent about this requirement.

(iii) Lifting of PVC (vinyl) floor tiles

An incorrect adhesive was used.

Remedy: Laying tiles with a correct adhesive following the advice of the adhesive manufacturer.

Reference for correct detailing in the contract drawings and specifications:

(a) Drawings: The working drawings provided sufficient details.

(b) Specifications: The requirements provided in the project specifications document (DABS, 1989:117) were sufficient in terms of providing a correct adhesive for fixing vinyl tiles.

8.3.8 Case study J

Project description:

This completely new senior secondary school project was consisted of conventional reinforced concrete structural frame, with infill brick walls finished externally with face bricks. Standard steel door linings and windows were used. The pitched roof of prefabricated timber roof trusses covered with coloured steel sheeting.

Three main external consultants were involved in the management of the project. These included civil engineers (structural), electrical engineers and mechanical engineers. In-house architects and quantity surveyors were used. The traditional procurement system was used, using bills of quantities and DABS Specification. The tender sum was 32, 954, 725 Pula (approximately 47, 100, 000 Rands) at 1994 prices.

Defects identified:

(i) Cladding: Buckling and dislodgement of brickslips; with spalling of the bricks immediately above the slips

This was essentially found to have been caused by moisture movement. The cladding was literally squeezed by the vertical shrinkage and creep of the concrete frame and probably accentuated by the expansion of the bricks.

Remedy: Cutting out the mortar joint below the reinforced concrete beam and fill the joint with a sealant backed with a foamed plastic (both the sealant and the plastic foam must be capable of accepting the compressive forces induced by any further movement).

Reference for correct detailing in the contract specifications:

(a) Drawings: The drawings were silent about this detail.

(b) Specifications: The information on cladding was superficial in terms of providing specific requirements which could have helped the construction, and hence the provision of a defect free cladding.

(ii) Cracking and detachment of wall tiling

This was found to have been caused by differential movement, chiefly from moisture movement, between the finish and the background. Movement joints were not provided.

Remedy: Provision of movement joint in order to take care of shrinkage. Shrinkage can be estimated by measuring the background's moisture content and comparing this with known values of the material in its *`dry state'*.

Reference for correct detailing in the contract specifications:

(a) Drawings: No movement joint details were provided in the working drawings.

(b) Specifications: The specifications document was silent about movement joints.

(iii) Blistering of paintwork

Blistering was found to have been caused by the application of an inappropriate primer and the likeliness of an inappropriate preparation of the surface of the timber, both were incompatible with the paint system.

Remedy: Preparation of the timber and applying the correct paint system.

Reference for correct detailing in the contract specifications:

(a) Drawings: The details provided in the working drawings were adequate. A detailed painting schedule was provided.

(b) Specifications: The project specifications were detailed enough (DABS, 1989:151-158). Although the instructions given were of general nature, they were providing all the necessary information to avoid the defect.

(iv) Window: Cracking of glass pane

Although there are various sources of this manifestation, this failure was found to have been caused by the provision of an inadequate clearance around the panel.

Remedy: Provision of the panel with sufficient clearance suit the material and the degree of exposure to sunlight (usually a minimum clearance of 5mm at each edge for panels with a dimension exceeding 750mm).

Reference for correct detailing in the contract specifications:

(a) Drawings: The working drawings details were adequate enough to allow the fixing of glass with the required clearance.

(b) Specifications: Although the information provided in the project specification document was word by word taken from DABS (1989:147-150), it was providing adequate instructions necessary to avoid the respective defect.

(v) Pitched Roofs: Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space (roof pitch 15^0). The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be provided with weather strips.

Reference for correct detailing in the contract specifications:

(a) Drawings: Although the working drawings were showing the principal details of the roof (at the eaves), there was no indication on the provision of ventilation.

(b) Specifications: The project specification document was silent about this particular detail.

8.3.9 Case study K

Project description:

This double storey parastatal bank building consisted of a reinforced concrete framed structure with in-fill brick walls and external face brick, Gamma Zenith applied finish and glazed aluminium shop fronts. The pitched roof was sheet metal roof covering on timber roof trusses .

The total value for this project was 1, 284, 231 Pula (approximately 1.8 Million Rands) at 1990 prices.

The traditional procurement system was used, where bills of quantities and DABS Specification were among the contract documents. Private consultants were used for this project. These included architects, quantity surveyors, electrical and mechanical engineers and civil engineers (structural).

Defects identified:

(i) Dampness at ceiling level - concentrated at the junction with the external wall

This was basically caused by condensation in the roof space (roof pitch 15^0). The underlay was acting as a vapour barrier and being cold, condensation formed underneath it and dropped on to the ceiling.

Remedy: Provision of ventilation at the eaves by means of openings along two opposite sides equivalent to a continuous opening (usually 10mm wide). In order to deal permanently with the problem of condensation (when ventilation provision does not work), a vapour check should be incorporated in the ceiling. Depending on the moisture conditions within the room below the ceiling, it may be sufficient to apply chlorinated rubber paint. Or alternatively PVC/foil backed paper can be used. In all cases it is essential that all the gaps are properly sealed, particularly those gaps around light fittings and other projections through the ceiling- the gaps should be filled with a sealant. In addition trap doors into the roof space should be 'Weather stripped'.

Reference for correct detailing in the contract specifications:

(a) Drawings: The working drawings were clearly detailed. The roof ventilation details were well presented for easy use during construction.

(b) Specifications: Although the project specifications document was too general on this particular item, the working drawings provided supplementary information necessary to help the contractor to meet the required quality of work, hence the avoidance of the defect.

(ii) Window Openings: Dampness internally around the opening

This was caused by the use of an incorrect sealant material.

Remedy: Use a correct sealant material.

Reference for correct detailing in the contract specifications:

(a) Drawings: The working drawings were adequate for the construction details necessary.

(b) Specifications: The project specifications document was silent about the requirements of suitable sealant materials.

8.3.10 Case study L

Project description:

This completely new parastatal bank staff housing project consisted of 21 pairs of low cost semi-detached houses, 32 medium cost houses and 6 high cost houses. The traditional procurement system was used to manage the project.

Defects identified:

(i) Flat roof skirting: Dampness at or near wall/ceiling junction internally

Detachment and dislodgement of the pointing and asphalt had occurred because the horizontal chase was inadequately formed and sized for proper asphalt tucking and mortar pointing above. Rainwater found its way behind the asphalt.

Remedy: Cut a chase correctly and shaped and then relay the asphalt with a weathered top and space for pointing. Point with cement:sand (1:3) between the top of the asphalt and the underside of the chase.

Reference for correct detailing in the contract specifications:

(a) Drawings: The working drawings provided adequate details for the provision of all necessary measures in avoiding dampness.

(b) Specifications: The specifications instructions were vague in providing the necessary requirements of avoiding the defect.

(ii) Slumping of skirting

This was found to had been caused by the following:

(a) The vertical substrate did not provide an adequate key for the asphalt, by being damp at the time asphalt was applied.

(b) The angle fillet was too small (ie. less than the minimum of 50mm).

(c) The asphalt became too soft owing to the lack of solar reflective treatment.

Remedy: Provide an adequate key to the vertical substrate. The concrete surface should be roughened. In addition, cement: sand gauged with PVAC; or bitumen rubber emulsion can be applied to the vertical surface. The asphalt should be relayed on isolating felt where it is horizontal so that it is level with the existing asphalt; 13mm minimum thickness of asphalt should be laid vertically with a 50mm minimum angle fillet.

Reference for correct detailing in the contract specifications:

(a) Drawings: The working drawings left a lot to be desired. Beside providing the general basic details of a flat roof, the necessary details for protecting the flat roof finishes were not indicated.

(b) Specifications: Like the project drawings, the specifications document dealt with general instructions of constructing reinforced concrete work, but nothing was covered in order to avoid the defect.

(iii) Extensive cracking in the region of the angle fillet

This was found to have been caused by differential movement between the roof deck and the upstand, this was aggravated by the fillet being too small.

Remedy: Form a pre-screeded woodwool or timber kerb with a 13mm minimum movement gap between the back of the kerb and face of the upstand. Tack expanded metal lath on the face of the kerb and for 100mm along the horizontal surface over new isolating membrane. Apply asphalt. Install a non-ferrous metal apron flashing with cleats and dress over the top of the asphalt to the kerb.

Reference for correct detailing in the contract specifications:
(a) Drawings: The working drawings were silent about this detail.
(b) Specifications: No specific instructions were provided in the project specifications document dealing with the necessary requirements of avoiding the defect.

(iv) Blistering of paintwork
Blistering was found to have been caused by the application of an inappropriate primer and the likeliness of an inappropriate preparation of the surface of the timber, both were incompatible with the paint system.

Remedy: Preparation of the timber and applying the correct paint system.

Reference for correct detailing in the contract specifications:
(a) Drawings: The working drawings details were adequate. The painting schedule was provided, and some of the necessary details on application were clearly indicated.
(b) Specifications: The painting system information was adequately covered.

The remedied defects
(i) Stains on external walls
(ii) Random cracking of rendering on brickwork (external walls)

8.4 Interviews

Two senior representatives from two major public building clients in Botswana: *The Botswana Housing Corporation (BHC) and the Directorate of Architecture and Building Services (DABS)* were interviewed. In order to maintain confidentiality as indicated above, individual representatives and establishments will not be referred to by name, they will be referred to as interviewee "A" and "B".

Interviewees were questioned on both their perceptions of the state of quality in the Botswana public building sector of the construction industry in general, and in their establishments in particular. This was followed by a series of questions designed to test the research hypothesis presented in this thesis. Although the interview was structured, questions were open-ended. The structure of the interview is presented in Appendix XI..

Comments on the hypotheses

There was complete consensus regarding the practice of using the traditional procurement system in almost all their projects. 99% of their building projects were procured through the traditional procurement system. The boundaries of the quality management system were defined by the standard form of contract which defines the roles and responsibilities of various parties to the contract, hence the project organizational structure. All acknowledged that there was an implied assumption that the traditional procurement system was the principal viable solution to most project management problems in the Botswana public building sector.

It was generally agreed that the reality of the situation in the Botswana public building sector was the existence of quality problems which were too common and too often remaining unresolved. On the basis of this situation, the two interviewees were not able to accept or reject the hypotheses statements. But they expressed a strong desire to finding a solution to quality problems, which they felt were costing them a lots of money in terms of building maintenance costs and delays in completing projects.

Project documentation relative to standards is poor

Both interviewees were particularly critical of the general performance of the consulting design teams. They quoted poor detailing, late information and inadequate co-ordination of project documents. Specification information received particular criticisms, and were described by interviewee **"A"** as *"documents which create confusion instead of determining and communicating the nature and quality of work."* He was of the opinion that this situation makes adherence to any standard difficult.

Interviewee **"B"** expressed concern at the inadequacy of drawings, which contributes to disruption in production on site and make it harder for staff to devote time to maintaining standards of workmanship. He was concerned that the majority of the projects he has found site managers ineffective because they were not aware of the quality standards to which they are expected to work. He argued that the building project quality standards are supposed to be defined partly by project drawings and specifications, in terms of the particular building's purpose, technical performance and appearance. The prevailing situation, he argued that most projects were managed with incomplete drawings and poorly written specifications. He was concerned to note that the attention given to project drawings and specifications was inadequate and this resulted to *"poor standards for building sites and consequently for the quality of work."* He further commented that: *" Site agents were assimilating poor documentation, and thus passing poor and inadequate information on to the operatives."*

Both interviewees were concerned that the predominant failure in documentation is relatively hard to remedy under the current procurement system. Through their experiences, if drawings were incorrect or inadequate, work would be normally wrongly built or delay caused. *"Both these situations have caused frustration and affected performance on so many projects under our supervision"*, interviewee **"A"** commented.

Identification of problematic building trades

Both interviewees were in agreement on the general causes of defects, but could not identify specific problematic building trades. In the majority of their projects, low quality workmanship, poor design and construction without adhering to designs were considered as general causes of defects.

Although not pointing a finger at particular building trades as "problematic", interviewee "A" was very concerned with two building trades: *brickwork* - specifically poor construction of face bricks and *carpentry and joinery* - where he was concerned about the skills and the use of inadequate tools, which has resulted in poor carpentry and joinery work. When pressed to be specific on his concern, interviewee "A" had this to say: *"We have completed buildings where brick facings are cracking and heights and widths of various fittings and fixtures are not in conformance with the working drawings."*

Three major problems adversely influencing quality of building work in order of importance

Interviewee "A" was reluctant to list three major problems adversely influencing quality of building, but after a long discussion with the author on the importance of focusing on major problems, he listed the following problems (but not in order of importance):

(i) *Inadequate designs and information:* he was concerned about the poor designs on various projects, incompleteness of drawings when they are required on site, and poor accessibility of project information by various parties to the contract.

(ii) *Poor quality of supervision on site:* in most projects, he insisted that the lines of authority are not often clearly understood and site staff have no opportunity to contribute to and take responsibility for quality achievement. He further argued that another aspect which was affecting the quality of supervision in most of the projects was the time spent by site managers dealing with technical queries to the detriment of other aspects of quality management.

(iii) *Inadequate project specifications:* most specifications are often unrelated to the quality requirements of a particular contract and are therefore quite often rarely referred to.

Interviewee **"B"** was not happy with the requirement to list three problems because in his experience the problems were **`very fluid'**, they were dependent on the scope and nature of the respective project. Nevertheless he was willing to comment on three problems which he considered very important among others:

(i) *Ineffective clerk of works:* he was concerned that the clerk of works has been finding it difficult to act as an effective quality controller within a site quality management system because of lack of contractual authority. He has seen experienced clerk of works, who know what is needed to make a job go well, are even less likely to step outside their brief and help, because they know the contractual dangers if they do not have authority conferred on them by the architect. He was concerned that the procurement system does not allow *"good practice and codified procedures to coincide by making provision for the architect to delegate more of his powers to the clerk of works."*

(ii) *Late drawings and project information:* in most projects site management spend too much time chasing late drawings and other project information, which inevitably reduces the time available for quality management.

(iii) *Irrelevant and poorly written specifications:* in practice specifications do not communicate the project standards required. Too few are project specific. In most projects specifications contain large and irrelevant sections reprinted from the general specification handbook and a proliferation of standard references to codes of practice, Agreement, South African Bureau of Standards (SABS), Central African Standards (CAS), British Standards (BS), Building Regulations and manufacturers' instructions, which are often not meaningful to operatives on site who do not have access to the reference material. He stressed the need for specifications to be made relevant to the particular job and easy to use.

Who writes your building project specifications?

Both interviewees were in agreement on the writers of their projects specifications. The architect is usually responsible for the bulky of the project drawings and the necessary annotated specifications, and if there are extensive specialist engineering details, i.e. structural work, services engineering drawings and annotated specifications are provided by the respective specialist engineers. In most projects the Quantity Surveyor was responsible for the production of a bills of quantities (BOQs) and the general project specification handbook.

Comment on the suitability of the specifications writer

Both interviewees were concerned with the single handed approach of using the Quantity Surveyor to produce the general project specifications handbook. In order to write an appropriate specifications handbook with clarity and directness they insisted that a knowledge of field practices was very important. Since a general specifications handbook embrace all building trades in a project, the direct involvement of trade specialists, architect and engineers with on-site experience was essential to the concept of "*specifying by objectives.*" They were both in agreement to use the Quantity Surveyor as a compiler of the specification handbook.

Table 8.1 Interviewees opinions on characteristics of their building projects for the last ten years

	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works	A&B				
2. The design is complete at the time of selecting the contractor					A&B
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum	A&B				
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication	A&B		A&B		
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjunction with the architect	A&B				
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices	A&B				
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)	A&B				
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk	A&B				
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue					A&B

As indicated in the table above, both client interviewees were in agreement that project characteristics 1, 3, 4, 5, 6, 7 and 8 represented the characteristics of most of their projects within the last ten years. Both interviewees expressed mixed opinions on characteristic 4. On one side they were concerned with abilities of their architects to cope with co-ordination of design teams, leading design efforts and co-ordination of interface between design and fabrication and on the other side they felt that project architects were adequately experienced to discharge these duties. When pressed to explain on this opinion, each interviewee expressed satisfaction with the work of architects on some projects, and felt that it was unfair to describe the performance of all architects as good or bad. In interviewee **"A"**'s own words:

> *"... for example architect X did a very good work on project 1,2 and 3 and it was a disaster when he worked on project 4. I think it is very difficult to comment on the ability of this architect in terms of `good' and `bad'. For this architect, I think it is `difficult to say'."*

When asked to give their opinions regarding the principal characteristic of the `pure' traditional procurement system (characteristic 2), interviewees were again in agreement that building project designs are normally incomplete at the time of tender.

Interviewees response to project characteristic 9 was interesting, the words "client does not know what else to do" were wrongly interpreted by each interviewee. They responded in defence of their competencies, and felt that the statement was false. As a follow-up to clear the misunderstanding, each interviewee was asked to explain the common procedure of selecting a building project procurement method within his establishment. One interviewee responded by saying:

> *"...the agreed procurement method which is very well known by all contractors in Botswana follows the standard forms. ....we stock enough copies ready for any project. Actually the standard form is one of our old documents....."*

The other interviewee said:

> *"Our standard form of contract, with or without quantities represents all what we want in order to manage our projects. We have been using this document for years and it has served us very well."*

The above answers to the follow-up question confirmed the true answer to characteristic 9 in Table 8.1. By accepting that they were using a specific standard procurement structure in procuring most of their building projects suggest that project characteristic 9 was supposed to be accepted as a true statement representing most of their building projects.

From the above, it is clear that public building clients are in agreement with architect, quantity surveyor, engineer, construction firm executive, contract manager and trade foreman respondents **(in chapter 7)** that the dominant procurement system in the Botswana public building sector is not what is generally purported to be. Respondents reported that a hybrid version of the traditional procurement system was primarily used in the Botswana public building sector.

CHAPTER 9

ANALYSIS AND SYNTHESIS OF FINDINGS

9.1 Introduction

A comprehensive description of the essential features of the current practice of quality management was provided in Chapter 7. In Chapter 8, the results of interview surveys and case studies concerning quality management in the Botswana public building sector were described.

In this chapter a discussion of the significant results reported in Chapter 7 is made. Some findings are expounded by reference to the case studies and interviews as a means of explanation and provision of further supporting evidence; for others an attempt is made to interpret the outcomes and so generate new propositions for testing the hypothesis. Thus the aims of the research are fulfilled in that the hypotheses will be proven or rejected *and* new propositions generated to assist in formulating a conceptual model in Chapter 10.

9.2 Personal information

9.2.1 Respondents age groups

The majority of *architects, quantity surveyors, engineers, contracts managers and skilled tradesmen* are **within 40-49 years age group**. Furthermore, the majority of *site managers and trade foremen* are **within 30-39 years age group**. It can be deduced from these results that the majority of qualified construction firm personnel and project consultants are aged between 30 to 50 years age group.

9.2.2 Education background

Architect, quantity surveyor, engineer and site manager respondents were **trained through universities, polytechnics** and **technical colleges**. The majority of these respondents were trained through **universities**.

The majority of *contracts manager* and *skilled tradesperson* respondents were trained through **polytechnic** and **technical colleges**. While other *contracts managers* were trained through **universities**, *skilled tradesperson* respondents qualified through **apprenticeship**.

The majority of *trade foremen* were trained through **polytechnics** and **universities**, and the remainder qualified through **apprenticeship, brigades** and **on site experience programmes**. It must be commented from these results that brigades train Botswana citizens only, hence those respondents who reported that they were trained through brigades are Batswana.

The majority of *construction firm executives* were trained through **polytechnics or universities**, and *other respondents* qualified through **apprenticeship and brigades**. The fact that some construction firm executives qualified through apprenticeship and brigades needs a comment. These construction firm executives could have developed from the Botswana emerging construction firm sector. This sector represents Botswana citizen contractors who have benefitted from the national affirmative action emerging contractors support programme. The support programme's main objective is to raise the standard of Batswana contractors in terms of their technical and managerial skills, hence being able to produce quality work and consequently raise their abilities to compete with foreign based contractors who constitute the majority of large construction firms in Botswana.

9.2.3 Construction experience

The construction experience survey of *construction firm executives, architects, quantity surveyors, engineers, contracts managers, site managers, tradesforemen and skilled tradesmen* produced very similar results. Each group of respondents showed a fairly high level of experience. The majority of respondent groups had **construction experience of ten years or more**.

Conclusion to 9.2:

From the above summary of results, it can be deduced that the majority of respondents have appropriate education within their respective fields of expertise, and all respondent groups are highly experienced in various aspects of construction business and project management.

Although possession of formal qualifications are not the only indication of a persons' ability to manage or supervise work, they must have some bearing on the quality of and competence of management and supervision.

9.3 Factors influencing quality

9.3.1 Relative incidence of quality problems in trades

Concrete, formwork, plastering, floor finishings, painting and decorating have **high incidences of problems** concerning quality. This is supported by the majority of construction firm executives, contracts managers, site managers, architects, quantity surveyors and engineers. These results are commensurate with those established from case studies reported in Chapter 8.

9.3.2 Relative incidence of quality problems associated with types of operatives

Construction firm executives, contracts managers, site managers, architects, quantity surveyors and engineers are in agreement that *direct employees-craftsmen* have **fairly low incidences of problems concerning quality**. *Labour-only subcontractors* are considered to have **a fairly high incidence of problems concerning quality**.

9.3.3 Relative incidence of quality problems associated with locations of building

Internal finishings are considered by construction firm executives, contracts managers, site managers, architects, quantity surveyors and engineers to have **a high incidence of problems concerning quality**. A significant number of respondents consider *external finishings* to have fairly high incidences of problems concerning quality.

9.3.4 Relative incidence of quality problems associated with types of building work

There is a fairly high degree of agreement between architects, quantity surveyors, engineers, that *industrialised systems* have **fairly high incidences of problems concerning quality**. From various research projects (for example Abbot 1976), this is understandable because system building is inflexible and depends on a high level of accuracy which often delays work on site, not only by requiring more care in construction but also by making remedial work more difficult and costly, particularly where units are supplied from a distant factory. Interestingly, the contractor's personnel on the other hand, are not so much concerned with costly delays and see fewer problems. It must be considered here that there are very few public building projects in Botswana which have used industrialised or systems buildings, hence it could be argued that architect, quantity surveyor and engineer respondents, could be answering question AQE:8 based on their experiences outside Botswana. The contractor's personnel respondents have divided opinions, some consider *conventional buildings* or *alterations* to have **high incidences of quality problems.**

9.3.5 Major problems influencing quality

There is a high level of agreement between architects, quantity surveyors, engineers and skilled tradesmen that, *lack of skilled labour* and *poor site supervision* are **two major problems influencing quality**. It appears that senior construction firm personnel respondents believe that the problem is not so much poor site supervision but rather that the *existing project organization structure* is **very poor**.

Conclusion to 9.3.1 to 9.3.5:

The use of subcontractors, particularly `labour-only', generally is perceived to result in work of poorer quality than that where `directly employed' craftsmen are involved. According to client interviews, this is not because they necessarily possess fewer skill, but mainly because they are not properly coordinated and are too concerned with speed of work and consequent earnings.

Two major problems influencing quality are: lack of skilled labour, poor site and poor project organization structure.

Lack of skilled labour:

Although, qualification and experience of contractor personnel respondents were found to be of acceptable levels, there is a general lack of skilled labour in the Botswana construction industry. Reflecting on the history of training opportunities in Botswana, the situation in 1965 was that only one in four children were in school and of these only 50% passed beyond standard 2, while less than 50 obtained a school certificate (Air Botswana, 1992). This situation has been affecting various industries in Botswana when looking for a pool of school leavers for skill training. Training of professionals, technicians and crafts in various disciplines, could be described as a recent undertaking by most training institutions in Botswana. The Botswana government and the private sectors' intensive programmes for training both within Botswana and outside gained momentum from 1972, when Botswana started to experience a `building boom'. From the foregoing, it is argued that lack of skilled labour is one of the `forces' exerting strain upon the quality management systems in the Botswana construction industry. Any effective building project procurement system must address this reality in order to meet client objectives.

There is another side of skilled labour availability in Botswana. In order to supplement local skilled labour demands, the Botswana construction industry depends on imported skilled labour from Southern African countries, like Zimbabwe, Zambia, South Africa, Tanzania Malawi and Lesotho. Although the supply of these foreign skilled labourers is very high, the recruitment procedure is very complicated and cumbersome. From the foregoing, it is important to substantiate that another way of looking at `lack of skilled labour' as indicated by survey respondents is more to do with `lack of skilled Batswana labourers' rather than a general lack of skilled labourers.

Poor site organization:

This refers primarily to supervision and inspection. The current practice of supervision and inspection as will be demonstrated in the following sections (section 9.3.6 - 9.3.9), is to a large extent ineffective due to: First, the inadequate total time spent on various building activities. Contractors, though understandably seeking to economise on overheads by reducing the numbers of site supervisory staff should bear in mind that their costs arising from unacceptable work could lead them to excessive negative earnings which could finally result into insolvencies. Secondly, there is little planning and organisation of time particularly that spent on supervision and inspection. It is not used as effectively as it should be. The survey has shown which trades, building locations and types of building work have a tendency to produce more faulty work than others. Based on this information, it is possible to adapt a pragmatic but flexible approach to the allocation of supervision time, based on this knowledge, so that those types of buildings, trades and building locations receive more attention.

9.3.6 Proportion of time spent on activities primarily and directly concerned with quality, and the proportion of this time spent on various activities

Table 9.1 Proportion of working time spent on activities primarily and directly concerned with quality

	Arc	Qs	Eng	Ce	Cm	Sm	Tf
	%	%	%	%	%	%	%
Average	44	18	40	25	30	60	60

Arc= Architect, Qs= Quantity surveyor, Eng= Engineer, Ce= Construction firm executive, Cm= Contracts manager, Sm= Site manager, Tf= Trade foreman

The critical activities in quality achievement are clearly *inspection* and *supervision* and an estimate of the approximate average time spent on these activities can be obtained by using Table 9.1 and the midpoints of the ranges shown in Tables 7.7, 7.19, 7.29b, 7.33 and 7.50 as follows:

Architects	44% x 29.5% = 13 per cent
Quantity surveyors	18% x 10% = 2 per cent
Engineers	40% x 10% = 4 per cent
Construction firm executives	25% x 9% = 2 per cent
Contracts managers	30% x 29.5% = 9 per cent
Site managers	60% x 29.5% = 18 per cent
Trade foremen	60% x 29.5% = 18 per cent

These estimates of the percentage of working time spent on these activities may appear rather low but in fact they are independently supported by results of other surveys in the United Kingdom (R.I.B.A, 1962, Abbot, 1976). This is understandable because the majority of the Botswana construction industry professionals were trained in the United Kingdom, and building projects contractual arrangements are identical to United Kingdom arrangements.

Focusing on the contractor's supervisor (for example site managers), the time spent on activities, primarily and directly concerned with quality, amounted to an average of 60% of the working time and supervision and inspection were each in the range of 20%-39% of the 60%. Using the midpoint of the range as indicated above, the time spent on supervision and inspection would be 18%. It is interesting to note that this percentage is larger than those found by Majid (1968), Swedish State Council for Building Industry (1962) and Abbot (1976) which showed 11%, 10% and 13% respectively.

At peak periods of activity on a large complex site there could be 10 or more different trade operations in progress at the same time. Using the above figure of 18% there would be only 1.8% of working time available for the supervision and inspection of quality for each trade operation, i.e., 8.64 minutes per day.

It is clear that even the most able and well qualified supervisor could have little effect on quality by this amount of supervision and inspection and he or she must rely heavily on the *motivation and skill of the operatives, and above all the appropriateness of the project organizational structure. The organizational structure needs to motivate every project stake - holder to understand and believe in the project quality management system.*

9.3.7 Building procurement system(s) used in the Botswana public building sector

The survey of opinion of construction firm executives, contracts managers, site managers, trade foremen, architects, quantity surveyors and engineers plus the public building client interviews on the characteristics of their public building projects, produced similar and confirmatory patterns of information from each of the respondent groups. Each respondent group showed a fairly high general level of agreement with the others on the characteristics which are general to most public building projects. These are *characteristics 1, 3, 5, 6, 7 and 9 : client commissions design, prime cost sums do not dominate, there is a traditional architect/Qs axis, contractor selection is based upon tendering (bidding), nomination is important for the client and there is absence of any other suggestion for alternative building procurement systems respectively as provided in Tables 7.8, 7.20, 7.30, 7.34 and 7.55.*

The views expressed of course represent the opinion of those responsible for the management, supervision, design and inspection of construction work, and it was considered that a more complete picture would evolve if the views of those physically producing the work were obtained and compared with those received from the public clients interviews and the general perception as described in Chapter 1 (sub-section 1.1.1).

The majority of respondents, were in agreement that, for most of their projects *it was false to conclude* that *"the design is normally complete at the time of selecting the contractor."* This indicates that most public project designs *are incomplete at the time of selecting the contractor. Furthermore, this means that the selection of a contractor is based upon a provisional price, though referred to in the contract as `a firm price'. Under this situation, it means that the client (employer) can not describe, with certainty what it is that the contractor is being invited to carry out.*

On the aspect of the architect being adequately experienced to cope with the co-ordination of the design team, to lead the design effort and co-ordinate the interface between design and fabrication, the majority of respondents were in agreement that *this is not the case or it is difficult to say*. As could be expected, most architect respondents felt that the statement was true.

A conclusion could be made from these results that, although the architect is contractually in-charge (client representative) of most of the Botswana public building projects, the majority of contractors and consultants are not confident with the architect's role and his or her ability as a project manager. Why are they not confident? The architect is required to supervise and coordinate the project team. In order for this to work, the client must be assured that the architect has the relevant integrative skills, but the public building sector clients are in doubt about these skills. This is a very serious situation which need to be addressed. If quality buildings are going to be constructed, clients must have confidence with architects as project managers under the traditional building procurement system.

9.3.8 How are quality standards achieved on site?

Contracts manager

The *majority of contracts managers were responsible for a surprisingly high number of projects*. More than 50% of respondents were *responsible for 4 or more contracts. The effectiveness of any manager with this wide range of responsibilities is questionable. How much are they able to contribute when they are unable to spend even one day a week on each project? Appropriate quality plans should be managed through positive approaches in managing the quality parameter on site, and in most instances proper instructions must be given in writing.*

Although the *majority of contracts managers* were normally *involved in new projects at the pre-tender stage*, some are **not involved** *until commencement date*. This means that *there is a situation where in some projects nobody who is to be closely involved in managing the project becomes familiar with the project until it has actually started. This is obviously not the*

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Although the *majority of contracts managers* were normally *involved in new projects at the pre-tender stage*, some are **not involved** *until commencement date*. This means that *there is a situation where in some projects nobody who is to be closely involved in managing the project becomes familiar with the project until it has actually started. This is obviously not the* *ideal way to commence a new venture*. This situation although affects the minority of respondents, presumably *occurs because contracts managers are too busy* and are unable to devote time to new projects until the last possible moment, that is when a solution to the first problem cannot be further postponed.

According to *contract managers, site managers or agents are allowed less than two weeks to prepare for new projects*. This is a very serious pre-contract situation, because the stages involved during this stage need more time in order produce effective project strategies. During pre-contract planning stage, budgets, plans of action and programmes are usually prepared. Time period of up to six weeks are, common practice (Cooke, 1981). Contract managers appear to be unaware or unwilling to admit to what does actually happen: that *nobody in a management function has any detailed knowledge of new projects before commencement date nor has any pre-planning been carried out*.

Project *communication procedures* are *determined by project architect/engineer or project supervisor*.

The *majority of contracts managers* generally *instruct in writing*. Bearing in mind the level of responsibility highlighted in the answer to question CM:5 it is surprising to find the *second largest number of contracts managers instruct their supervisors* **`verbally'**. *It would appear that some contracts managers because of their level of responsibilities are unable to properly instruct in writing. They resort to random crisis solving telephone calls. This crisis management is not appropriate to modern business*.

The contracts managers are unanimous on the *importance of communication between project stakeholders on the finished quality* of the building.

It was not unexpected that the *majority of contracts managers* thought *inaccurate, incomplete and late quality information* are significant *contributory factors to causes of unacceptable* *quality work. This is another proof, that the `pure' traditional building procurement system purported to be in use, is not used in the Botswana public building sector. Incomplete and late quality information directly relate to a building procurement system and its respective project organization structure, where project documents are not complete at time of tender.*

Site manager and trade foreman

The survey identified contractors' site staff as generally being stable and experienced. The majority of *site managers* and *trade foremen* had held their existing role for *over five years*.

Stability is the feature at the level of the project, *site managers* and *trade foremen* are involved in the project *since its commencement.*

A *high level of movement* seemed to occur between trade *foremen* and *site managers*, an average of 30% of each group *had not worked for their immediate superiors prior to their current projects*.

Site manager

Most sites would appear to have the necessary quality documentation readily available for them.

A *significant number of sites did not possess current British or South African standards and Codes of Practice. This is surprising as these documents are invariably essential back up documents to specifications, which make numerous references to Standards and Codes.*

Most *construction firms* appear to *possess Botswana Building Regulations and DABS Standard Specifications*. Bearing in mind that most site managers had less than five Codes of Practice, *it could be argued that it is not possible to use specifications effectively because they normally make numerous references to Codes of Practice. This situation would again emphasise the inadequacy of quality management documents.*

The evidence suggest that **most site managers are left to get on with their work as best as they can.** *Supervisors* **(general foremen or trade foremen)** *either receive instructions in writing, verbally or help themselves from documents available. They are not generally adequately instructed by their site managers, as all the supervisors sometimes receive written instructions, verbal or help themselves from the project documents available.*

A high proportion of *sites receive information directly from the architect/engineer or supervising officer. This practice would seem to confuse the communication channels, and many contracts managers are not, therefore kept fully updated on correspondence.*

Most *construction firms* appear to *possess a library of current British and South African Standards, Codes of Practice and manufacturers' literature, although the extent of these libraries is unknown. Furthermore, it is surprising to note that a high proportion of site managers are not sure if their construction firms are in possession of these documents.*

Trade foreman

Some *trade foremen* are *unaware* of any *unusual requirements regarding specification and tolerances. This situation must reflect the fact that they are unaware because they do not have the information which would tell them.*

Although the *majority of trade foremen* have **access to specification/drawings,** *few have access to back up documents on site. 43% of trade foremen are unaware of any time target imposed upon their work.*

The category which received the highest ranking in determining the quality of the trade foremans' supervision of the work was *`personal experience'. Standards of quality are therefore, highly subjective.* They rest upon the *judgement of the foreman rather than on any authoritative documentation. This situation is against the primary requirements of quality management. Quality as defined in Chapter 5 (section 5.2.1), refers to meeting client* *requirements, hence documents defining these requirements are of paramount importance otherwise subjective decisions could be made towards producing work, and this could lead to poor building work. Only 7% of trade foremen considered written instruction from superiors as of importance.*

When inspecting, the *majority of trade foremen* favour *personal visits when checking that building trade information has been received and is being used.*

Although the *majority of trade foremen* reported that *incomplete information* has *a high frequency in contributing to causes of unacceptable quality work, inaccurate information* and *late information* are other significant causes of unacceptable quality work.

There is *an arbitrary nature of determining quality on site*. While the *majority of trade foremen* believe that *their managers (general foremen or site managers) determine standards*, some believe that *they determine standards themselves*. This is to some extent borne out by the answer to question TF:12 which shows that *quality on site is checked by a person in addition to the supervisor.*

Trade foremen are unanimous on the *importance of communication on the finished quality* of the building on site.

The *majority of trade foremen are in agreement with contracts managers* that, *inaccurate information, late information and incomplete information are contributing factors to causes of unacceptable quality work.*

9.3.9 Project specifications

The majority of *architect, quantity surveyor and engineer respondents do not maintain* separate *specification writing departments or sections*. Furthermore, they do not employ full time specification writers.

Respective project designers are normally responsible for the preparation of project specifications. It is very strange to note that the quantity surveyor is not mentioned as a specifications writer, because under the traditional building procurement system, the Quantity Surveyor prepares the bills of quantities and most of the required specifications. It may be, that the Quantity Surveyor is not mentioned because contractually he/she does this on behalf of the Architect.

There are mixed opinions regarding the **minimum qualifications which specification writers should possess**, these range from *design and construction (field) experience, engineering degree or architectural degree*. These are very interesting results, because under the `pure' traditional building procurement system, the quantity surveyor prepares the bulk of project specifications on behalf of the architect. The above minimum qualifications, beside the field experience requirement, do not relate to what most quantity surveyors qualifications are supposed to be in practice. This raises the question of appropriateness of the quantity surveyor as a one of the specification writers.

Two greatest in-house problems in getting out a good set of specifications are: *insufficient time allowed for preparation of specifications and insufficient information to prepare specification.* These problems are closely related to point 2 in Tables 7.8, 7.20, 7.30, 7.34 and 7.55, where the majority of *construction firm executives, contracts managers, site managers, trade foremen, quantity surveyors and engineers* were unanimous that in most public building projects, *normally designs are not complete at the time of selecting the contractor*. If designs are not complete before tendering, it is not possible to have all the necessary project information included in the specifications. Furthermore, this confirms trade foreman, contracts manager and site manager respondents opinions that two of the contributing factors to causes of unacceptable quality work are *incomplete and late information.*

Three most pressing problems with project specifications when administering projects, as indicated by architect, quantity surveyor and engineer respondents are that: *the contractors can* *not read or understand the specifications, contractors neglect specifications (they do not follow them) and the inadequacy of inspection and quality control on site.*

Clients were concerned that *specifications were not fully playing their primary role, that of communicating the standard required.* They were concerned that **in practice** *specifications are rarely used for this purpose. Too few specifications are project specific.*

Focusing on public building projects specifications case studies as reported in Chapter 8 (section 8.3), the following could be deduced:

- Most project specification documents could be described as conformers to *"everything is incidental"* syndrome as described by Nugent (1978). Specifications have got a common theme of inducing the project architect to require the contractor to assume the obligation for all unforeseen and unanticipated eventualities with the presumption that if they are incorporated as incidental the architect as a client representative will not be liable for most problems.
- Project specification documents are primarily complicated, in terms of language used and the number of references to Codes of Practice. They have minimum uniformity and they are ambiguous. *There is a need to produce specifications where wording used should be concise, simple, clear and easily understandable.*
- There is an extensive use of what Fisk (1978) refers to as the *`shotgun approach'* in preparing specification documents, this is an approach where *inapplicable material is included in the specifications.* Standard specification documents are incorporated as project specifications without any substantial adjustments on various parts of the documents which are not applicable to the project. Hence, too many specifications contain large and irrelevant sections reprinted from previous projects and a proliferation of standard references to codes of practice. The appropriate question to be asked is: Is there any mechanism of checking that specification documents are relevant to the project? The evidence available suggests that the mechanism does not exist.

Conclusion to 9.3.6 - 9.3.9:

In conclusion it can be argued that a gap exists between, on the one hand, how standards of quality within established building procurement system of the public building sector are defined (i.e. by project consultants in the form of specifications with heavy reliance upon Codes of Practice) and on the other, how standards of quality are established in the site situation. It would appear from this survey that site supervisors partly establish standards of quality and that their decisions are highly arbitrary. Supervisors' own experience and supervisory ability, therefore partly determines the level of quality that occurs.

Site management, it would appear, is generally unaware of the required `imposed' standards of quality as developed ***from the clients'*** *brief: site managers usually have copies of specifications, but not copies of Codes of Practice to which the majority of specification item refer. Based on this finding, it could be argued that project documentation relative to standards of workmanship is poor in the Botswana public building sector, and site managers and trade foremen play key roles in determining quality achieved.*

There is a gap between definition of standards and actual establishment of standards is accompanied by a series of breakdowns in communication throughout the whole construction process. What appear to be wrong is the partial use of written communication, with a subsequent reliance upon verbal communication.

At the level of the firm, contracts managers are the focus point of all criteria relating to standards of quality (specification, drawings, Codes of Practice, South African Standards, British Standards, DABS and NHC Standards, building regulations, technical publications and company policy and requirements). Based on their construction experience and education background as reported in section 7.3, it is likely that they are the people within construction firms to have the greatest knowledge about what quality is required. From the survey it would also appear that they are potentially the busiest. Over 50% of contracts managers had 4 or more projects for which they were responsible. With this level of responsibility, it is not *surprising that contract managers do not ensure site management is correctly briefed (very short time is allowed) about standards to be produced on individual projects.*

General conclusion to 9.2 and 9.3:

It is apparent that there is a need for a project organisation structure which provides appropriate functions to different managers within the project organization. For example, the contracts manager's need to describe to site management and supervision, in a practical manner, precisely what is required as regards standards of workmanship on each project. Looking at the results of this study, this function does not seem to exist.

The survey reveals that the `pure' traditional building procurement system in the Botswana public building sector is basically used as a `default system'. In other words, there are indications to suggest that it is used merely because the consultants have failed to consider the issue of appropriateness. This building procurement system seems to be adopted because no-one plans the means of procurement. The Botswana public building clients appear to have categorized and classified the `pure' traditional building procurement system to such an extent that it has become their own particular favourite method of organization which they have stuck to. Based on the results of this survey, there are indications to suggest that this approach of procuring public buildings in Botswana has partly led to the situation described by Carpenter (1981), who states that:

> *"...projects go wrong because the actual tasks peculiar to the project are not identified. This failure prevents appropriate procedures being developed for the project."*

The various professionals surveyed are well qualified and competent people, but they seem to fit into Neal's (1984) comments that they have:

> *"...become powerless prisoners of ill-conceived management structures and control procedures."*

Project documentation itself is a contributing factor to breakdown in communication. Specifications and Codes of Practice are not generally in a form which is easily understood, *and the poorness of many specifications means that standards are often not adequately defined. Inadequacy of specifications lead to the need to interpret. Contractors have priced work in competition, and will, therefore, interpret the standards to be achieved differently from the architect/engineer, who will view standards in the light of maximisation of his or her client's interests or his or her own reputation.*

9.4 Synthesis of results and their implications for the hypotheses

The survey results as reported in Chapters 7 and 8 have been discussed in sections 9.2, and 9.3. The purpose of this section is to draw together the salient findings on site quality management in order to establish critical areas which should form the nucleus of a conceptual framework for an appropriate quality management system which will be established in Chapter 10.

9.4.1 Synthesis of results

The foregoing may be synthesised into the following salient points, which are referenced in parentheses to facilitate cross-referencing later in the text:

(a) The current practice of procuring public buildings in Botswana, demonstrates that the contractor's obligation is confined to fabricating only what is described in the documents. But these documents are quite often late to arrive on site, they are incomplete and contain large sections of irrelevant material (Q1).

(b) The practice of supervision and inspection by the contractor is to a large extent ineffective because the time spent on these activities is inadequate (Q2).

(c) There is very little planning and organisation of time spent on supervision and inspection (Q3).

(d) A considerable amount of unacceptable quality work arises due to lack of organisation and coordination between trades, which affects location, accuracy, finish, sequence, damage, etc. (Q4).

(e) Within the contractor's own organisation there appears to be a great deal of reliance on verbal communication particularly between the contracts manager and site manager, foremen and the operatives. Apart from the variability of interpretation which can arise, it is very difficult for the operatives to retain verbal information all the time (Q5).

(f) The building procurement system allows the architect to provide minimal supervision of the work and probably this is why they spend very little time on project supervision and organisation, but at the same time expect him/her to enforce standards by reference to the contract. The evidence shows that the architect is risking failure and loss of goodwill from the client, project consultants and the contractor. This has led to a situation where the majority of building project stake holders do not have confidence in the architect. They feel that the architect who is normally appointed by the client is not adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication (Q6).

(g) Considering controllability of individual trade operations, at their commencement the contractor has more power to control quality than the operative and slightly less than the architect who has ordered the specification. During the progress of the operation, the contractor's power to control diminishes and that of the operatives increases, so that in the later stages the operative has greater power than the contractor, and the architect has less. Clearly, the characteristics of the `pure' traditional building procurement system differ considerably from those inherent in most Botswana public building projects (Q7).

(h) The dominant project organization structure in the Botswana public building sector is to a large extent a replica of the `pure' traditional organizational structure. The evidence from the survey suggest that it is a hybrid of the traditional building procurement system that is used in the Botswana public building sector, while the project organization structure remains that of the `pure' traditional structure, and not one adjusted to suit a hybrid of the traditional project organizational structure. This arrangement does not follow an appropriate project management approach (Q8).

9.4.2 Implications of results for the hypotheses

Focusing on the above points (9.4.1:a-h), it is clear that Botswana public building clients have categorized and classified the `pure' traditional building procurement system to such an extent that they have developed it as their particular favourite system of organization which they have decided to stick to. This is demonstrated by the decision to use identical Standard Form of Building Contract (SFBC) irrespective of varying project characteristics. *Since the SFBC defines what is to be built, the roles of the various parties concerned and the terms of the bargain between them, in so doing, it provides a framework of a quality system, hence the respective project organizational structure.*

Although the Botswana public building clients have developed the `pure' traditional building procurement system, and its respective organizational structure, and decided to stick to it, the following have resulted from this trend:

(a) Objectives and tasks that are peculiar to projects are not identified, hence, no appropriate procedures have been developed for them.

(b) The majority of practitioners give an impression that the `pure' traditional building procurement system (with its respective organizational structure) is the solution to all project management problems. But contractors are often in the position of contracting to provide building work to a standard which is unknown.

The foregoing results lead to concluding comments that:

(a) *Clearly, the nature of the current building procurement system in the Botswana public building sector differs significantly from that portrayed by the theoretical model in Chapter 5: section 5.3.3.*

(b) *An inappropriate project organizational structure is used extensively in the Botswana public building sector.*

(c) *A building project procurement system defines the project organizational structure, hence it provides the framework of a quality management system. Based on the foregoing comment, this would indicate that the Botswana public building sector uses an inappropriate quality management system.*

(d) *The popular position among Botswana public building clients and consultants, is to get the project done and keep the client happy. It neglects however to consider whether better results might be obtained if more theoretically guided interventions were made.*

Clearly, the foregoing comments lead to partial acceptance of the established hypotheses that:

Hypothesis 1: *"Quality problems related to public building construction processes are primarily due to an inappropriate project organizational structure."*
The findings of the survey have clearly indicated that the Botswana public building sector is predominantly characterized by an inappropriate project organizational structure. The overwhelming impression based on the survey results is that building project organization is one of inflexibility. In more than 95% of the projects, the `pure' traditional procurement building system organizational structure is used as a `given', to such an extent that standard contract documents which define responsibilities of various parties in the organization of a project are used directly without substantial adjustments. The fact that more than 95% of the

projects go to tender without completed designs is a clear indication that a major characteristic of the `pure' traditional building procurement system is not usually met by these projects. This important finding suggest that there are actual tasks peculiar to various building projects which are not usually identified. This failure prevents adjustments of the `pure' traditional building procurement system organizational structure to suit the project characteristics. Based on the findings it is argued that quality problems related to public building construction processes are primarily due to an inappropriate project organizational structure, **hence the hypothesis is true.**

Hypothesis 2: *"The traditional building procurement system provides a poor quality management system."*

The findings of this study as briefly described under hypothesis 1 above, clearly reveal that the `pure' traditional building procurement system is used as a `default system'. In other words, the traditional building procurement system is used merely because project consultants have failed to consider the issue of appropriateness. The findings of this study therefore, **do not provide any facts to support or to refute the statement that the traditional building procurement system provides a poor quality management system.**

Hypothesis 3: *"The traditional building procurement system is incapable of facilitating derived quality levels as defined by contract drawings and specifications."*

The conclusions made under hypothesis 2 are relevant to this hypothesis. Since the traditional building procurement system is used as a `default system', **the findings of this study do not support or refute this hypothesis.**

9.4.3 Implications of results for the hypotheses and their relationship to organizational theory

The purpose of this section is to draw together the principles of general organization theory as discussed in Chapter 4, using *Systems Approach (Systems Thinking-TSI)* as the theoretical approach to the research established in section 4.6. The principles established will be used towards the proposition of a conceptual framework for an appropriate project quality management system during the construction process.

Using the philosophy of *Systems Thinking* to reflect on the synthesised findings, three positions are used as proposed by Flood and Jackson (1991). These are *"complementarism"*, *"sociological awareness"* and the promotion of *"human well-being and emancipation"*.

Complementarism

There are two arguments under this position: *"pragmatist"* and *"isolationist"*. **Pragmatists** argue that it is important to concentrate on building up a "tool-kit" of techniques which have been shown to work in practice. *This is a popular position among those managers who are normally anxious to get the job done and keep the client happy.* The pragmatist popular position of sticking to techniques which have been shown to work in practice, neglects to consider whether or not better results might be obtained if more theoretically guided interventions were made. It fails to recognise that learning can take place only if practice (successful or otherwise) can be related back to a set of theoretical presuppositions which are being consciously tested through that practice. In elevating "what works in practice" to the position of deciding between "good" and "bad" interventions, the possibility that factors other than "proper" method or choice of methodology choice might be the reason behind success is excluded. Finally, it follows that pragmatism abandons the hope of developing management science as an intellectual discipline, the main tenets of which can be passed on to "apprentices".

Isolationism implies sticking to one method or methodology only, because the analyst knows and wants to know no other approach. Isolationists, adhere stolidly to one well worked out theoretical position and linked methodology , but adapting other methods and methodologies for use under the tutelage of the preferred theoretical position. This has the inevitable effect of distorting the methods or methodologies chosen for incorporation, with a consequent loss of the force they command when properly used in the service of their more appropriate theoretical rationalities. Isolationism divides management science and the systems community unto warring factions, each arguing for the primacy of its favoured approach-whether it be hard (approaches based on means -end), soft (approaches based on interpretations and their interrelations) or cybernetic (approaches based on laws of organisation)-and its ability to tackle all (or the great majority) of "problem types".

Looking at the above complimentarism position and focusing on the findings of this study, it can be argued that the current situation in the Botswana public building sector, where an inappropriate building procurement system is used, there is an indirect reflection that the building procurement process appears to borrow partly from "pragmatism" and "isolationism". *`Pragmatism'*, in the sense that clients and consultants stick to the `pure' traditional building procurement project management structure and its respective contractual arrangements, probably with intentions of getting jobs done, but neglecting the question of building procurement system appropriateness as a pre-requisite of a successful project. The *`isolationist'* tendency is depicted from the way most research respondents failed to relate the characteristics of the `pure' traditional building procurement system and the adoption of its typical project management structure and the quality problems affecting the Botswana public building sector.

According to Flood and Jackson (1991), *complementarism is steadfastly opposed to the "pick and mix" strategy of the pragmatists*. It rests on the premise that different methodologies express different rationalities stemming from alternative theoretical positions which they reflect. These alternative positions must be respected, and methodologies and their appropriate theoretical underpinnings developed in partnership. Furthermore, the claim of any one theoretical rationality (e.g. the Botswana public building sector use of the `pure' traditional management structure, irrespective of its inappropriateness) to be the sole legitimate one (isolationism) or to absorb all others (imperialism) must be resisted. The existence of a range of systems methodologies, each driven by a different theoretical position, should be seen as a strength rather than as a weakness of the systems movement. *It is important therefore that* *the conceptual model which will be developed in Chapter 10 should use the guidance offered by complementarism so that each methodology (**i.e. building procurement system/management structure**) is put to work only on the kinds of issues or "problems" (public building projects) for which it is the most suitable.*

Sociological awareness

The sociological awareness of critical systems thinking, recognises that there are project organisational and environmental/societal pressures (i.e. project characteristics in the case of the Botswana public building sector) which have led to certain systems methodologies being popular for guiding interventions at particular times. Sociological awareness should make users of TSI contemplate the social consequences of using particular methodologies. For example, the choice of using the `pure' traditional organization structure to manage the majority of public building projects in Botswana clearly implies that one goal or objective (i.e. time) is being privileged at the expense of other possibilities (i.e. quality, cost etc.). The sociological awareness focus should help to ask a question: Is this goal or objective (for example, meeting the project schedule) general to all project stakeholders, or is it simply that of the most powerful (i.e. the clients)? *The conceptual model, at every stage of its application should provide room for a question like this to be asked, because this will help to adopt an appropriate building procurement system, which will lead to an appropriate quality management system and consequently an appropriate project organizational structure.*

Human well-being and emancipation

According to Flood and Jackson (1991), this position seeks to achieve for all individuals, working through organisations (i.e. public building projects) and in society (i.e. the Botswana public), the maximum development of their potential. As Habermas (1972) has argued, there are two fundamental conditions underpinning the socio-cultural form of life in the human species. These he calls "work" and "interaction". "Work" (i.e. public building project activities) enables human beings (i.e. public building project stakeholders) to achieve goals (e.g. public building conforming to clients requirements) and to bring about material well-being through social labour. The importance of work leads human beings (i.e. public building project workers) to have a "technical interest" in the prediction and control of natural and social affairs. This is one of two anthropologically based cognitive interests which Habermas (1972) believes the human species possesses. The other is linked to "interaction" and is labelled the "practical interest". Its concern is with securing and expanding the possibilities for mutual understanding among all those involved in social systems (project stakeholders, or what is referred to as internal and external clients in Chapter 5: 5.2). Disagreement between different groups (e.g. between domestic and nominated contractors, project consultants and main contractor personnel etc.) can be just as much a threat to the reproduction of the socio-cultural form of life as a failure to predict and control natural and social processes.

*If there is a **technical**, a **practical** and an **emancipatory interest** in the functioning of the public building project organisation, then a management science which can support all these various interests has an important role to play in project stakeholders and emancipation. The formulation of a conceptual model in Chapter 10, must stand on the fact that this is exactly what complementarism and sociologically aware systems thinking can provide.*

The philosophy of TSI, which comes through in the principles and practice, should be known and respected by all who would use the conceptual model, because it is through the TSI approach that an appropriate building procurement system (leading to an appropriate quality management system) will be established.

9.5 Conclusion

The purpose of this chapter has been to document an analysis of findings reported in chapters 7 and 8 regarding the practice of quality management during the construction process in the Botswana public building sector, thus permitting the development of a set of salient points regarding the causes of poor quality suitable for helping in the formulation of an appropriate quality management conceptual model.

It has been established that, the `pure' traditional building procurement system which the Boswana public building sector purports to use, differs significantly from that portrayed by the theory. This has several implications for the desired appropriate building procurement system. These implications may be considered to represent, at least in part, a set of basic requirements which the conceptual model must address. It is suggested that these requirements constitute a firm base in formulating a conceptual model.

These basic requirements are carried forward to Chapter 10 to be used in the formulation of a building procurement system conceptual model.

CHAPTER TEN

THE CONCEPTUAL MODEL OF QUALITY MANAGEMENT

10.1 Introduction

A comprehensive description of the essential features of the current practice of quality management in the Botswana public building sector was provided in Chapter 7. In Chapter 8, the results of case studies and Botswana public building clients interview surveys, relevant to the quality management system during the construction process, were described. In Chapter 9, a discussion of the significant results reported in Chapter 7 were made. Some findings were expounded by reference to case studies and interviews as described in Chapter 8, an attempt was made to interpret the outcomes and new propositions were generated and used to test the hypothesis. Furthermore, new propositions were generated to assist in formulating a conceptual model.

This chapter deals with the fourth objective of this study, *`a conceptual model of a quality management system'* during the construction process, together with discussion of various variables which are pre-requisites in formulating an effective quality management model. In section 10.2, a crucial *question will be asked and answered, if one of the objectives of this study is still valid: if there is a need for a quality management system model.*

Section 10.3 briefly surveys the development in models formulation in order to understand the position and usefulness of the conceptual model which will be developed.

In section 10.4 a conceptual quality management system model is developed. Finally, in section 10.5 an evaluation of the model and model specification are presented.

10.2 Is there a need for a quality management model?

The survey results as reported in chapters 7 and 8 and summerized in chapter 9 suggest that the quality management system, based on the `pure' traditional procurement system which is purported to be in use in the Botswana public building sector, is basically used as a default system.

This study has established in chapters 7, 8 and 9, that the quality management system as discussed through the `pure' traditional procurement system contractual requirements in Chapter 5 is categorized and classified as the basic system in the Botswana public building sector. While this sector has decided to stick to this quality management system, poor quality public buildings continue to be constructed. Most participants to the empirical survey and the interviewed clients have given implied answers to the reasons behind poor quality buildings, by suggesting that the actual tasks peculiar to building projects are normally not identified.

From the foregoing, it is argued that the failure to identify actual tasks peculiar to building projects has prevented appropriate procedures being developed for the majority of projects. This is clearly demonstrated by the opinions of the empirical survey participants regarding the characteristics of most public building projects in Botswana (Tables 7.8, 7.20, 7.30, 7.34 and 7.55), summarized in section 9.4. The opinion that most of public building projects in the Botswana public building sector go to tender before designs are complete, indicates that the predominant procurement system is not the `pure' traditional procurement system as the government official system suggest in terms of standard documents and project organisation structure. The common practice of adopting the `pure' traditional organization structure, and hence respective contractual arrangements is a direct indication that there is a clear problem in that they lack an appropriate approach to choose between procument systems.

The implications of the above observations are significant. They suggest the following:

(a) As discussed in chapters 1 (section 1.1.1) and 5 (section 5.3.3), the building project procurement system, through its respective contract, define what is to be built, the roles of the various parties concerned and the terms of the contract between them, hence, in so doing, it provides a framework of a quality system. *Based on the foregoing, it is apparent that in order to propose an appropriate quality management system, it is necessary to establish a method of selecting an appropriate procurement system first (as discussed in Chapter 5 section 5.3.5).* An appropriate procurement system is a pre-requisite for the establishment of an appropriate quality management system.

(b) *After establishing a method of selecting an appropriate procurement system, which will lead to the selection of the most appropriate procurement system, hence a framework of the most appropriate quality management system will have been established.*

The foregoing implications suggest that the fourth objective of this study is still valid. There is a need for a quality management model in the Botswana public building sector.

10.3 Introducing models

10.3.1 Definitions and descriptions

Definitions and descriptions of general systems theory were covered in Chapter 4 (section 4.5), and these will be used in this section to address systems models.

Schoderbek *et al.* (1990) described models as human ways of dealing with the real world. He argues that the real world is considerably more complex than the mind can comprehend. Therefore, a person first constructs a picture that contains a number of the real-world characteristics great enough to provide an understanding of what is involved. *This picture, which is an abstraction of reality and which contains the most important elements of reality, is called a model.* The purpose of constructing a model is to *understand reality* by organizing it and simplifying it. The model *represents* reality but it is *not* reality.

Using the philosophy of system dynamics (SD) as described in Chapter 4 (section 4.5.2) , Flood and Jackson (1991) describe the need for model structure. They argue that SD emphasises model structure, which supports an interest in prediction and control. Structure is seen as having four significant characteristics, which amount to the focal concerns of any SD analysis. These, they suggest are *order*, *direction of feedback*, *non-linearity* and *loop multiplicity*.

: **Order** A key issue here is the number of "levels" that are used to represent the structure (i.e. those variables which represent amounts of something, such as stock levels or surplus levels). The number of levels determines the order of the system. Levels will be discussed in section 10.3.2.

: **Direction of feedback** This is where the behaviour of one element may feed back, either directly from another element by way of their relationship, or indirectly via a series of connected elements, to influence the element that initiated the behaviour. This feedback, through loops, may be either negative or positive. Negative is an inhibiting or controlling influence. Positive is augmenting, creating either growth or decline. Positive and negative are the directions of feedback and are a central concern in the analysis of structure.

: **Non-linearity** Unlike linear systems, systems influenced by positive feedback produce exponential growth or decline from a set point. Such feedback is not necessarily detrimental in non-linear systems, since non-linear coupling of positive and negative loops can lead to dominance shifts between them, thus allowing for controlled growth.

: **Loop multiplicity** Very few managerial, economic, or social situations can be adequately represented by a single-loop structure. Several loops, both positive and negative, are invariably involved. The number and degree of interactions between these loops lead to difficulties in identifying key variables, predicting outcomes and hence are difficult to comprehend without computer simulation. Without the help of simulation and subsequent analyses, behaviour appears to be counter-intuitive.

Flood and Jackson (1991) argue that given sound reasoning and understanding of structure in the development of a SD model, it is assumed that high quality prediction and control can be achieved.

It must be stressed that the model as described above cannot be adequately considered outside the methodology through which it is formulated and it is, therefore, important that the model and methodology should be discussed.

10.3.2 Model and methodology

Schoderbek *et al.* (1990) and Flood and Jackson (1991) provide an overview of modelling methodology. Initially they suggest that, normally there is some organisational problem situation that focuses the attention of those involved in decision making, and this leads to their purposeful activity. It is essential therefore, at the outset to carry out task formulation, which helps to consider what might be an appropriate way forward.

Identifying modelling purposes: These determine in unitary fashion the essential characteristics of the model to be formulated. According to Flood and Jackson (1991), a potentially worthwhile investigation at this stage is to undertake a critical review of extant models. *Using this study as an example*, many difficulties of quality management have already been addressed in Chapters 2, 5, 7 and 8 and the summary of findings is clearly reported in Chapter 9. By using the summary of findings reported in Chapter 9 and suppported by quality management theory reported in Chapter 5, the basis of establishing essential characteristics of the quality management model during the building process has been accomplished.

Although the discussion above has concentrated on using models as ways of working out predictions, this does not exclude the idea that model structure may itself represent proposed organisational design, and so a thorough assessment of "users" (i.e. those affected by the design) may be necessary so that "relevant" design is undertaken. *This study reports on the assessment of "users" (public building clients, contractors and project consultants) in Chapter*

7.

Model construction: This begins by drawing upon a model development submethodology. Flood and Jackson (1991) argue, that there are a number of key concerns that need to be reflected upon, these include *the availability of data*, *significant theories in the area of concern*, and *any laws which may have been derived to explain particular phenomena*. Also, with any modelling effort, a whole range of assumptions need to be made. These need to be declared in order to increase model transparency and hence falsifiability. The number, importance and controversy of these assumptions will be related to the quality and availability of data, theories and laws.

Model validation: After model construction a validation submethodology needs to be introduced (Schoderbek *et al.* 1990). Validation, according to Flood and Jackson (1991), needs to be an explicit part of the whole modelling process, however, there is real value in detailing the main validatory concerns. These are *empirical*, *theoretical* and *pragmatic* validity. Flood and Jackson (1991) suggest that empirical validation proceeds by way of adaptive fitting, comparing model response to available data over a range of dynamic tests, involving structural changes and other model perturbations. Theoretical validation involves the comparison of any theories that are assumed in the model with those available in scientific literature. As will be demonstrated later this study will formulate a conceptual model of a quality management system (not a scientific model), hence no empirical validation will be made.

Model formulation: The main concern here is *conceptualisation*, *formulation* and *simulation*. These principal stages of model formulation are clearly described by Schoderbek *et al.* (1990) through Figure 10.1.

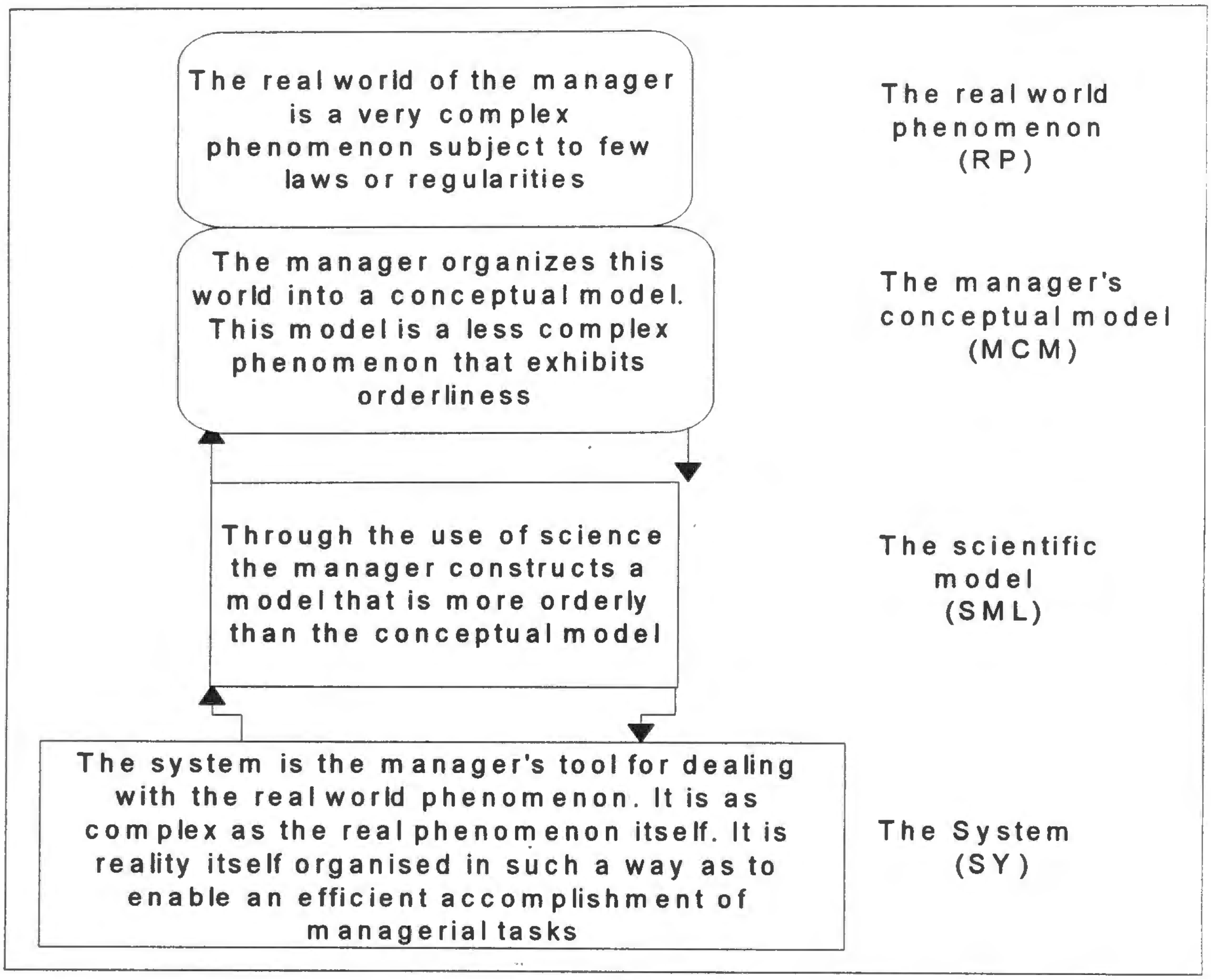


Figure 10.1 The real world, the model, and the system (Schoderbek *et al.* 1990)

Figure 10.1 can be interpreted by reflecting on the intended quality management system model. The box labeled "the Manager's Conceptual Model" (MCM) represents the managers's interpretation of "what is really out there." The objectives of this chapter is to formulate the MCM. This conceptual model will represent the ultimate outcome of the author's sequence of mental activities (study results reported in chapters 7 and 8 and theoretical aspects discussed in Chapters 4 and 5, observation plus conceptualisation) and not the outcome of the sensor system alone.

What is referred to as The Real World Phenomenon (RP) represents (roughly) the conception of what is considered to be the ideal phenomena. *In this study this `ideal phenomena' is interpreted as a situation where an appropriate quality management system is functioning during the building process. In other words, what is constructed `during' this RP is in conformance with the client requirements.*

The scientific model (SML), which is beyond the objective of this study is a representation of the RP but with much less detail than the RP itself. The models, both conceptual and scientific, include only those factors or elements that are absolutely necessary for a rough description of the RP. The modelling process is not a once-and-for-all exercise. Schoderbek *et al.* (1990) suggest that it should be conceived of as consisting of several provisionary models that adequately but roughly describe the manager's (in this study the author's) conception of the RP.

To sum up the four main parts of Figure 10.1, the real world perceived as the real phenomena (RP) is studied as a system (**in this study, this is a quality management system**) by first being converted into a manager's conceptual model (MCM - **the objective of this study**). From MCM, a scientific model (SML) could be constructed and from this base a system (SY) could be arrived at. In Schoderbek's *et al.*(1990) words:

> *"The ultimate system (**in this study, the quality management system during the construction process- author's emphasis**) will be used to deal with the real-world situation must be as complex as the real phenomena (SY=RP)"*

The end result of the previous step is a model. Before converting it into a system, the model could be tested. In testing the model, quite often the task is rather *difficult*, *cumbersome*, and *time consuming*. For these reasons, Flood and Jackson (1991) and Schoderbek *et al.* (1990) suggest that the computer is normally utilized to experiment with the model. Experimentation with the model is called *simulation*. As indicated above, this study will propose a conceptual model (not a scientific model), hence no simulation is necessary, but validation will be carried out.

10.4 A conceptual model of quality management (during the construction process)

The quality management conceptual model, which this study set-out to develop, must address the problems which have led to poor quality of building work in the Botswana public building sector. These problems are summarized in Chapter 9 (**section 9.5.1: Synthesis of results**). Furthermore, the implications of these research results, as discussed in Chapter 9 (**section 9.5.2: Implications of results for the hypothesis**), suggest that most of the quality problems in the Botswana public building sector have nothing to do with the `pure' traditional procurement system. Part of the problem is the inability of public building stakeholders to select appropriate procurement systems, and hence their respective quality management systems. *From the foregoing, logic suggests that the quality management system conceptual model to be developed must be* ***a standard model*** *that can apply to any project procurement system, selected from any category of procurement systems, as illustrated in Chapter 5 (Figure 5.15).*

Within the logic of TSI, this section applies Systems Dynamics (SD) in formulating the conceptual model. The emphasis here is to address the problems facing the Botswana public building sector as reported in Chapters 7 and 8 and summarized in Chapter 9.

The formulation of a quality management system conceptual model is performed in the following sections:

10.4.1 What the conceptual model should represent

10.4.2 Description of the conceptual model

10.4.1 What the conceptual model should represent

A quality management system model for public building projects in Botswana should comprise the following:

(a) The critical tasks needed in the building construction process based on the observation of current practice as reported in the findings of the survey.

(b) A standard construction process model that can apply to any project procurement system, hence it will be important to avoid certain specialist titles which are primarily identified with particular procurement systems.

(c) The model must have features [referred to as Quality management system requirements (**QMSR**)]. These features are referenced to facilitate cross referencing later in the diagramatic representation of the quality management system model. The following must be allowed to take place within the model:

QMSR1: The Quality Management System, which has been established and which should be maintained by the project manegement team.

QMSR2: Quality Assurance (QA) System as a quality management sub-system defining the project organisation structure, responsibilities, processes and resources applicable to ensuring that the project conforms to client requirements.

QMSR3: To review the project contract (the client's requirements), by providing a clear recorded definition of each project party's intentions or requirements at site pre-commencement stage.

QMSR4: To ensure that all project drawings, specifications and other quality related documents, including revisions are properly controlled.

QMSR5: To ensure that bought-in resources (all components, materials and equipments) comply with the client (specified) requirements and that those providing them are competent.

QMSR6: Process control- procedures for planning, subsequent control and documentation.

QMSR7: Inspection and testing and non conformance control.

QMSR8: Handling and storage of materials including protection of completed work.

QMSR9: Maintenance of quality records and accessibility of these records for verification.

QMSR10: Project internal audit to ensure the effectiveness of the quality system.

QMSR11: Training of project personnel.

(d) The application of quality management theory and systems theory as described in previous chapters.

(e) The quality management system model should finally represent a combination of the best and compartible quality practice from both manufacturing and construction industries, in a way that ensures that the vital element of feedback is taken into account.

10.4.2 Description of the conceptual model

The basic framework of the conceptual model reflects a particular set of tasks which together will achieve stated objectives established in the client brief. These tasks could also be considered as a function carried out generally, but not entirely, by one building project participant (in this model, the building contractor).

In order to clearly describe the construction phase quality management system model, it is very important to identify the general critical tasks (CT) mentioned above. The composition of the critical tasks identified for the **constructing phase of the SERC model** (Cornick, 1991), are used for this model. These tasks can be considered as head tasks for any building project under which there could be many sub-tasks. These tasks include:

- People to meet contract and system **(CT)**
- Resources to meet contract and system **(CT1)**
- Specialist commitment to meet contract and system **(CT10)**
- Specialist team to meet contract and system **(CT11)**
- Safe and clear access to site **(CT12)**
- Long delivery materials and services **(CT13)**
- First material and service requirements **(CT14)**
- Training to meet contract and system **(CT15)**
- Cash flow to meet programme **(CT16)**
- Reliable plant, tools and equipment **(CT17)**

- Reliable communication and public utilities **(CT18)**
- Security to meet system **(CT19)**
- Facilities to meet design and specification **(CT20)**
- Site clearance, reduced levels and ground drainage **(CT21)**
- Site roads and main services **(CT22)**
- Excavation for foundations **(CT23)**
- Concrete foundations **(CT24)**
- Concrete ground slab **(CT25)**
- Supporting frames and walls **(CT26)**
- Suspended floors and staircases **(CT27)**
- Suspended roof structure **(CT28)**
- External walls and cladding **(CT29)**
- External roof finish **(CT30)**
- Interior space division **(CT31)**
- First fix of joinery and services plant and distribution **(CT32)**
- Interior wall and ceiling finishes **(CT33)**
- Second fix of joinery and services terminal units **(CT34)**
- Interior floor finish **(CT35)**
- Interior decoration to walls, ceiling and joinery **(CT36)**
- External hard and soft landscape **(CT37)**
- Cleaning of interior and exterior works **(CT38)**
- Commissioning building for use **(CT39)**

Before examining the nature of these tasks and their outputs through the levels of the model, it is necessary to discuss the principles suggested by Quality Systems Standards for this particular phase. The Quality Systems Standards as briefly discussed in Chapter 5, and discussed in detail elsewhere **(i.e., BSI, 1987)**, suggests various principles for the constructing phase. The parts of ISO 9004 require the client (or client representative) within this phase to:

(a) Ensure that construction operations are planned so that they proceed under controlled conditions in the specified manner and sequence. This planned control should be in terms of:

: Appropriate conditions and acceptance criteria in documented construction work instructions for materials, equipment, personnel, etc.

: Verification of construction process and product at appropriate stages with maintainance of documented test and inspection procedures.

: Process and environment capability appropriate to meeting specified requirements in the client brief.

(b) Ensure that construction operations are carried out as planned in terms of:

: Material control and traceability, equipment control and maintenance for key product quality characteristics.

: Special processes for equipment accuracy, operative skills, special environments and certified records.

: Process change control verification and documentation and control of non-conforming materials/elements.

(c) Ensure that end-products are verified during and at the end of the construction process, in terms of:

: Appropriate in-process inspection and test by set-ups, operatives, automatic, fixed and patrolling for specified operations.

: Appropriate final product against specification through lot or continuous sampling.

(d) Ensure that all measuring and test equipment (if any) is controlled in terms of robustness, calibration, adjustment, corrective action and all with documentation.

The construction tasks (CT) listed above are depicted in Figure 10.2. The element inputs to each of the tasks that comprise this constructing phase can be considered in terms of the criticality of deficiencies in inputs and the likely consequences. The feedback loops into this

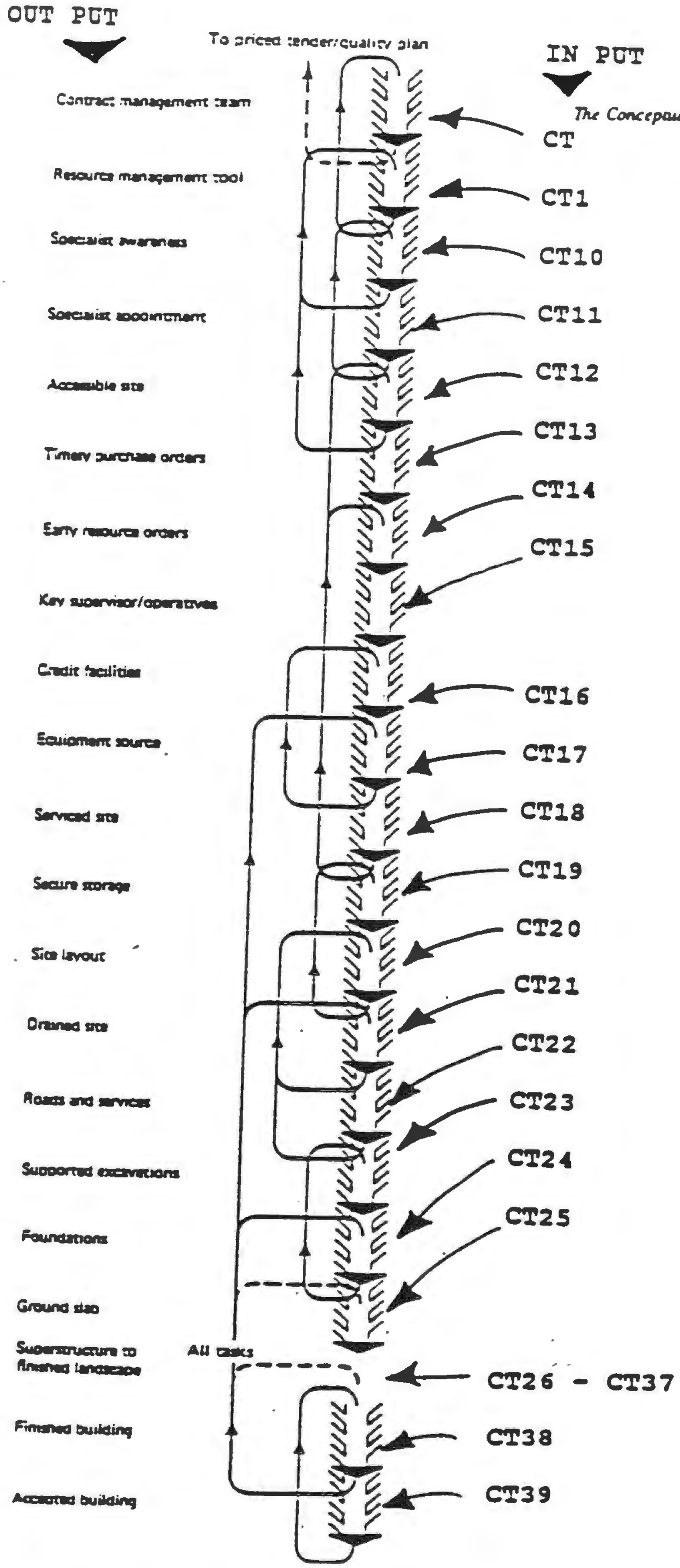


Fig.10.2 The construction tasks (adapted from Cornick 1991)

phase come directly from the various tasks outputs of **briefing, designing, specifying and tendering phases**.

The findings of this study as reported in Chapter 7, suggest that the current situation in the Botswana public building sector suggest that **all** inputs to every task in this phase are the **sole** concern of the building contractor, and that the designer (the architect) can make no direct contribution to any of them. The systems approach which the conceptual model is required to embrace, stands on the fact that it is in the designer's best interest, as well as part of his or her professional duty, to be closely involved with the building contractor(s)'s constructing process. The level of his or her involvement will depend on the project requirements and the project organizational structure.

According to Cornick (1991), deficiencies in tasks carried-out during the constructing phase depicted in Figure 10.2 will be prevented if:

(a) Every task is always carried out and always in the logically defined sequence.

(b) The description is always borne in mind when the task is being carried out, as this is its essential purpose.

(c) The element inputs are always appropriate to the specific task in question in terms of a project management application.

(d) The element detail inputs are always appropriate to and in place for the specific element in question in terms of corporate management support.

(e) The output is not expected to be anything more or anything less than is stated.

10.5 A quality management system conceptual model of the constructing phase

The purpose of this section is to draw together the findings of the quality management system analysis of the Botswana public building sector. These findings were synthesised in Chapter 9 (section 9.5.1).

Clearly, the synthesised findings in section 9.5.1 contradict considerably the expected results from those inherent in the theoretical model discussed in Chapter 5. The quality management environment model depicted in Figure 10.3 reflects these differences, and provides an appropriate description of the quality management system model in the constructing phase of the building project.

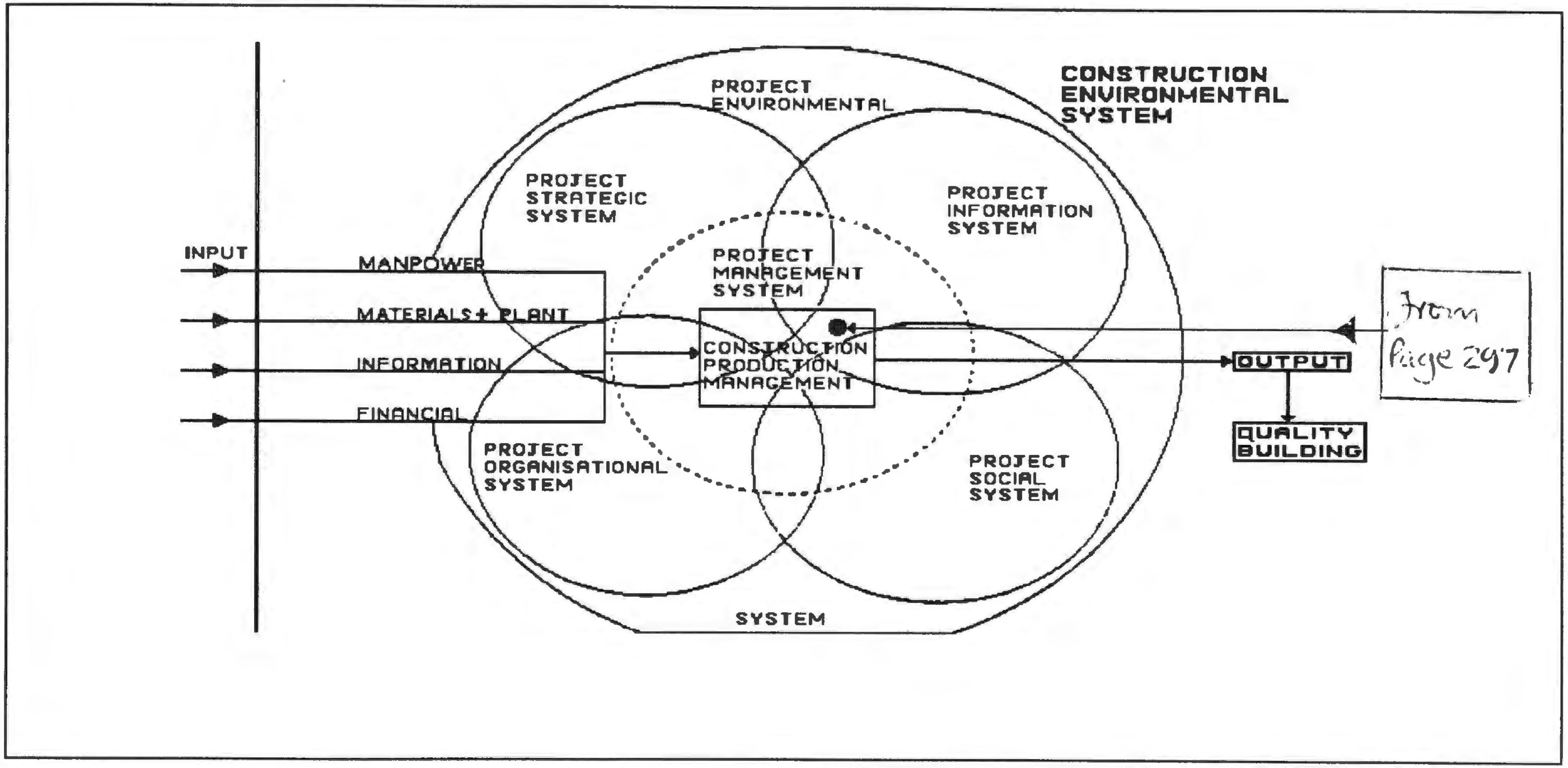
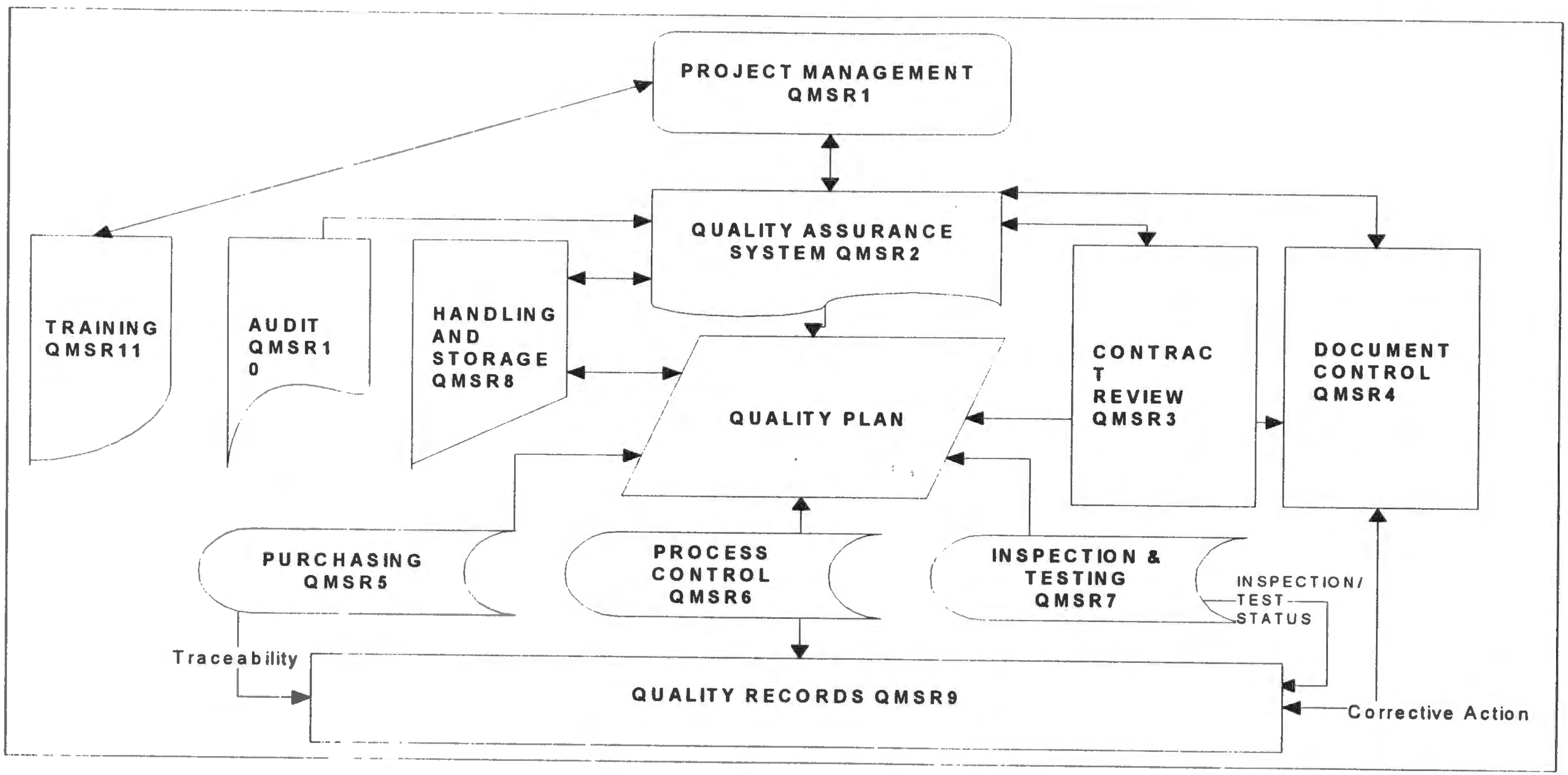


Fig.10.3 The proposed quality management system conceptual model (partly adapted from Newcombe *et al* (1990))



Fiigure10.3(Continued) The proposed quality management system conceptual model

10.5. 1 Synopsis of the quality management system model in the constructing phase (Figure 10.)

The project management (QMSR1):

Definition: It must state the project policy and objectives which contain the quality intentions and direction of the building project. The quality management system must be implemented under the guidance of the client representative.

Enable: It must delegate in writing, defining the responsibility and role of all project personnel who manage, perform and verify work affecting quality. It must delegate in writing, authority to stop or reject work and the power to take action to prevent repetition.

Administer: It must ensure that the project personnel noted above have the necessary experience, qualifications or have received appropriate training commensurate with the responsibility and role undertaken.

Control: It must take the responsibility or appoint/nominate a site management representative with defined authority and responsibility for ensuring that the requirements of the quality management system are implemented and maintained. It must regularly review the system at specified intervals to ensure its continuing effectiveness.

Quality Assurance System (QMSR2)

The project Quality Assurance System (PQAS) must be defined in a document. The PQAS document must be available to all project personnel who have defined roles and responsibilities within it. The PQAS document must define organisational structure, responsibilities, processes and resources applicable to ensuring that the building project conforms to the client requirements specified in the drawings and specification.

Contract review (QMSR3)

There must be a procedure at site work pre-commencement stage to review the client's requirements established at the briefing phase. A procedure must ensure that the client's requirements are adequately defined, specified and documented. Furthermore, the procedure must define and resolve any ambiguities or contradictions, and it must ensure that resources are available. The results of the foregoing must be documented.

Document control (QMSR4)

It is important to include procedures which will ensure that all drawings, specifications and other quality related documents, including revisions, are properly controlled. Through this procedure, drawing and other registers must be kept up to date and record to whom copies have been distributed. Procedures must be included to prevent the use of out of date information.

Purchasing (QMSR5)

Procedures must be established to ensure that bought-in project resources are in compliance with the specified client requirements and that those providing them are competent. Compliance may be judged by:

(i) Assessment of their formal Quality System.

(ii) Records of previous achievement.

(iii) Formal assessment procedure for examination of physical or documentary evidence of past performance.

(iv) Provision for higher level of main contractor or contractors supervision and support of their quality standards.

Furthermore, procedures must be established for the continual reassessment of bought-in resources based upon performance and these procedures must ensure that client supplied services or products, including information (if any), also comply with the appropriate quality standard. Also procedures should be included that enable the standards of products incorporated within the building works to be identified and traced.

Building process control (QMSR6)

Procedures must be included for planning, subsequent control and documentation. The procedures may be graded in rigour dependent upon judgement of the item's impact on quality. Written method statements or instructions must be included where product quality would be affected if not used. Intermediate stages must be defined, supervised, controlled and documented where work cannot be properly assessed in its final stage.

Inspection and testing (QMSR7)

Procedures must be established for:

(i) Verification of compliance with specification. It is very important that these must be produced at each of the following stages:

: upon receipt

: during construction

: at completion

(ii) The routine checking and documentation of measuring and test equipment

(iii) The prevention of defective materials or workmanship being finally incorporated into the building works through a system of instructions and records and the control of non-conforming products

(iv) The implementation by project management of corrective action in the event of non-conformance

(v) The use of statistical techniques in establishing conformance.

Handling and Storage (QMSR8)

Procedures must be in place for:

(i) Receipt of materials

(ii) Identification of materials

(iii) Inspection of materials

(iv) Handling and storage of materials in accordance with the manufacturers' recommendations to ensure protection from damage or deterioration

(v) Protection of completed work until handover.

Quality records (QMSR9)

Procedures must be in place to make sure that records are maintained, safely stored and are accessible for verification that work has been carried out in conformance with the quality management system. The degree of documentation and retention times of records shall be that agreed with all project stakeholders or defined within the quality management system.

Audit (QMSR10)

In order to ensure the effectiveness of the quality management system, a planned sequence of project internal audits must be defined. This is a formal procedure by a delegated properly trained individual independent of the project structure and reporting directly to project senior management. The results of audits should be documented and the records should indicate deficiencies, corrective action and its timing and the persons responsible for such action.

Training (QMSR11)

There must be procedures to ensure that:

(i) Project personnel records are kept and are available to confirm that staff or operatives requiring particular skills have been trained, tested or otherwise checked

(ii) Provision is made for additional training where a general or specific need is identified

(iii) Provision is made for quality awareness training.

10.6 Implications for quality management system model - evaluation criteria and a partial mandate for quality management system model specification

In the previous section a quality management system model during the constructing phase was developed to reflect the quality planning and control environment within which acceptable quality levels occurs. In this section the implications of the characteristics of that environment for quality modelling are presented. These implications may be considered, in part, to constitute *evaluation criteria* for quality modelling during the construction phase, and a partial mandate for *model specification.*

From the foregoing, it can be suggested that the utility of any particular quality management methodology in the constructing phase can, in part, be evaluated in terms of how effectively it deals with:

(a) *Appropriate quality issues.* Models should primarily function within procurement systems which have been appropriately selected after establishing client briefs. The adoption of TSI as an approach in selecting procurement systems will pave the way in addressing appropriate quality issues. **(Q6, Q8)**

(b) *Defining, controlling and administering the system.* Models must provide for project management's role in defining, controlling and administering the quality management system. The management must be reactive in terms of developing and improving the system on the basis of the information it receives. This would ensure that authority and responsibility for achieving quality at this phase continues to rest with site management. Hence, it will be first priority for the contractor(s) to spend most of the time supervising and inspecting site works. The senior project management (including the client representative(s)) will monitor the project performance via reports and meetings. **(Q2, Q3)**

(c) *The provision of documentary evidence as an assurance requirement.* Models should facilitate definitions of project organisational structures, responsibilities, processes and resources applicable to ensuring that the project conforms to client requirements. **(Q1, Q2, Q3, Q4, Q6, Q7, Q8)**

(d) *Reviewing client's requirements.* Models should facilitate clear recorded definition of each project party's intentions or requirements at an early stage of the building project. **(Q1, Q6, Q7)**

(e) *Project document control.* Models should allow a system of feeding QA records relevant to maintenance of the system back to the system to be available for inspection and audit. **(Q1)**

(f) *The quality of project bought-in resources.* Models should facilitate the establishment of procedures to ensure that consultants, sub-contractors, materials and equipment and other items are in compliance with client requirements and those providing them are competent. **(Q1, Q4, Q6, Q8)**

(g) *Project specific details of process control.* Models should allow provisions of dealing with the project quality plan, by producing documented project specific details of control of design, standards and codes, special processes and workmanship criteria. **(Q1)**

(h) *Procedures for inspection and testing.* Models should be capable of allowing verification of compliance with specification, routine checking, prevention of defective materials or workmanship to take place. Furthermore, models should allow corrective action to be implemented by project management in the event of non-conformance. **(Q4, Q5)**

(i) *Protection of completed work and prevention of use of poor materials.* Models should allow procedures to prevent the use of materials which have exceeded shelf life, and protection of completed work. **(Q4)**

(j) *Quality records for continuous improvement.* Models should have provisions for maintaining quality records as a feedback necessary for management's role in the continuous improvement and upgrading of the quality management system. **(Q4, Q5)**

(k) *The effectiveness of the quality management system must be ensured.* The models must provide a facility for audit as the means of management control via the quality assurance system. Furthermore, models should provide for another function of audit regarding the checking of the adequacy of project personnel training. **(Q3)**

10.7 Conclusion

The purpose of this chapter has been to document a quality management system analysis in the Botswana public building sector. This has permitted the development of a set of quality management-based criteria suitable for the evaluation of quality management system models in the constructing phase of building projects.

It has been found that, the quality management system model purported to be in use in the Botswana public building sector differs significantly from that portrayed by the theory, and this is primarily due to the use of an inappropriate procurement system. This has several implications for the desired characteristics of the quality management system within the constructing phase of the building project. These implications may be considered to represent, at least in part, a set of quality management system model evaluation criteria. It is suggested that these criteria also constitute a partial mandate for quality management system model specification.

CHAPTER 11

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

11.1 Introduction

In this chapter a summary of findings, conclusions and recommendations are given. These are devises to project the relationships between perceived highlights of the many facts, figures and other findings; the hypotheses and conclusions that emerged from this study.

11.2 Summary of findings

11.2.1 Client aspects

(a) Public building clients seem to emphasize the time and cost aspects whilst neglecting quality.

(b) Inappropriate building procurement systems and, therefore inappropriate project organizational structures are used in most public building projects.

(c) The traditional building procurement system and its project organizational structure is used for most public building projects.

11.2.2 Consultant aspects

(a) Public building clients do not obtain objective and comprehensive advice on the selection of the most appropriate building procurement systems for their particular needs.

(b) The basic requirement of the traditional building procurement system, that design must be completed before a contractor is selected is seldom achieved.

(c) Inappropriate project organizational structures are used in most public building projects.

(d) There is very little building project planning and organisation of time spent on supervision and inspection.

(e) A considerable amount of unacceptable quality work arises due to lack of organisation and coordination between trades, which affects location, accuracy, finish, sequence, damage etc.

(f) There is an attempt to manage the construction process by controlling time and cost in progress whilst quality is managed in retrospect.

(g) Specifications and Codes of Practice are not generally in a form which is easily understood, and the poor quality of many specifications have led to the need to interpret.

11.2.3 Contractor aspects

(a) The current practice of procuring public buildings, demonstrates that the contractor's obligation is confined to fabricating only what is described in contract documents. But these documents are quite often late to arrive on site, they are incomplete and contain large sections of irrelevant material.

(b) The practice of supervision and inspection by the building contractor is to a large extent ineffective because the time spent on these activities is inadequate.

(c) At the level of the firm, contract managers are potentially the busiest. Most of them have four or more building projects for which they are responsible.

11.2.4 General aspects

(a) Within the current project organisation structure, the majority of public building projects stake-holders do not have confidence with the architects. They feel that the architect who is normally appointed by the client is not adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication.

(b) There is partial use of written communication, with a subsequent reliance upon verbal communication.

(c) The quality management system model purported to be in use in the Botswana public sector differs significantly from that recommended in the theory.

11.3 Conclusions

11.3.1 Quality problems and project organizational structure

It seems strange that several writers/researchers have increasingly stressed the need for project organizational structures to be tailored to meet particular needs. This would indicate that the problem has been perceived and its solution is being developed. In the Botswana public building sector, however, it has been found by this study that the sector has fallen into the trap of categorizing and classifying building procurement systems to such an extent that the public sector clients have adopted the traditional building procurement system organization structure, and have not changed to meet changing conditions. This has led to the situation where projects go wrong because the actual tasks peculiar to the project are not identified. This failure has prevented appropriate quality management procedures being developed for public building projects.

Although there is a clear trend towards appropriateness of building procurement systems and their respective organizational structures, in most public building sectors outside Botswana, the situation in the Botswana public building sector is different. Inappropriate building project organizational structures are used in most projects. In this respect the first hypothesis was supported.

11.3.2 The traditional building procurement system and quality management

Questionnaires, case studies and interviews findings give identical results showing that the traditional project organizational structure is used for most public building projects. A standard form of building contract which is used in most public building projects defines what is to be built, the roles of the various parties concerned and the terms of the bargain between them. In so doing the standard building contract provides the framework of a quality system. However, the characteristics of most public building projects in Botswana do not conform with the basic characteristics of the traditional building procurement system. This reveals that the traditional building procurement system is basically used as a `default system'. In other words, the traditional building procurement management structure and its respective standard contract arrangements are used merely because the clients and project consultants do not consider the issue of appropriateness. Because the traditional building procurement system is not used in the manner that it is intended to be used the second hypothesis could not be tested.

11.3.3 The traditional building procurement system as a facilitator of derived quality levels

The traditional building procurement system organizational structure and its respective contractual arrangements are found to be inappropriate to the building projects, because the actual tasks peculiar to the projects are not identified. This failure prevents appropriate quality management procedures being developed for the project. Therefore the traditional building procurement system is not used in most public building projects as it is purported, hence the aspect of this building procurement system facilitating derived quality levels as defined by the contract drawings and specifications does not hold. Thus the third hypothesis could not be validated.

11.3.4 Patterns of quality management in the Botswana public building sector

The tests have revealed certain characteristics of the Botswana public building sector regarding project quality management. These are:

: inflexible sector

: quality problems have been perceived but their solutions are not being developed

: project quality management organizational structures are not tailored to meet particular project needs

: the sector has fallen into the trap of categorizing and classifying the traditional building procurement system to such an extent that it is used in most building projects as a `default system'.

11.3.5 The conceptual model of a quality management system

The proposed conceptual model in Chapter 10 is capable of addressing the problems which have led to poor quality of building work in the Botswana public building sector. However, most of the quality problems discussed in Chapter 9 have nothing to do with the traditional building procurement system. Part of the problem is the inability of the Botswana public building sector stakeholders to select appropriate building procurement systems, and hence their respective quality management systems. The logic therefore suggests that the quality management system conceptual model should be a standard model that can apply to any project procurement system, selected from any category of building procurement systems as illustrated in Chapter 5.

The model comprises the following:

(a) The critical tasks needed in the building construction process based on the observation of current practice as reported in the findings of the survey.

(b) A standard construction process model that can apply to any building project procurement system, hence it avoids certain specialists titles which are primarily identified with particular building procurement systems.

(c) Quality management system requirements (see Chapter 10: section 10.4.1)

(d) Combination of the best and compatible quality practice from both manufacturing project quality management system.

(b) The building project procurement system should be selected at the outset of the project, this should facilitate design of the respective project organizational structure. The selection of the building project procurement system should be done by the adoption of TSI.

(c) Project management should be responsible in defining, controlling and administering the quality management system. This should ensure that authority and responsibility for achieving quality during the construction phase continues to rest with site management. The senior project management (including the client representative(s)) should monitor the project performance.

(d) Within the quality management system, there should be provision of documentary evidence as an assurance requirement.

(e) The quality management system should allow client(s) requirements to be reviewed.

(f) The quality management system should allow project document control to take place. This should be through a system of feeding QA records relevant to maintenance of the quality management system back to the system to be available for inspection and audit.

(g) The quality management system should facilitate the establishment of procedures to ensure that project consultants, contractors, materials, plant and equipments and other items are in compliance with client requirements and those providing them are competent.

(h) The quality management system should allow provisions of dealing with the project quality plan, by producing documented project specific details of control.

(i) The quality management system should provide procedures for inspection and testing. Furthermore, it should allow corrective action to be implemented in the event of non-conformance.

(j) The quality management system should provide procedures of protecting completed work and prevention of use of poor materials.

(k) Provisions for maintaining quality records as a feedback necessary for project management's role in the continuous improvement should be provided by the quality management system.

(l) The quality management system should provide a facility for audit as the means of management control via the quality assurance system.

(m) The quality management system should provide a function of audit regarding the checking of the adequacy of project personnel training.

11.4 Recommendations for future work

(a) In order to establish the basic principles of formulating appropriate quality management systems for various projects, the Botswana public building sector should establish appropriate methods of selecting appropriate building procurement systems. There are a number of ways in which this can be achieved, these are discussed in detail by various authors listed in Chapter 5. As a starting point a literature survey should be carried out as an audit of available methods of selecting appropriate building procurement systems. This should be followed by intensive validation and checking exercises in order to establish selecting methods which are appropriate to the Botswana public building sector projects.

(b) The proposed quality management system conceptual model require further rigorous validation and checking. This should be done by practically applying the model. Public building projects in various regions of Botswana should be selected for this exercise, but this must be preceded by the work proposed in (a) above.

(c) Whilst this study has concentrated on the quality management in the construction phase, it is clear that a similar study should be carried out focusing on the design phase. The current study has demonstrated that quality management during the construction phase is dependant on pre-contract decisions, hence it will be useful to address quality management problems focusing on the entire public building sector building project cycle.

(d) It is also recommended that work be done in establishing a standard flexible contract document which could be used for any selected building procurement system. This means that it will be possible to have a contract document which could go along recommendation (a) above. For any selected building procurement system based on the actual tasks peculiar to the project, the contract document will be adjusted to deal with respective tasks.

(e) Some of the data generated by this study has shown that most contractors, quantity surveyors, architects, engineers and clients are not in tune with current developments in building procurement systems. As a means of exposing them to various development in building procurement systems, continuous professional development (CPD) seminars should be conducted to report on the findings of this study and this will pave the way in reflecting on building procurement systems.

(f) More data need to be generated about quality management problems and their consequences. The application of the conceptual model after implementing recommendation

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Office of ~~the President~~,
Private Bag 001,
G A B O R O N E

22nd January 1992

Ref: OP 46/1 XXXI (103

TO: Mr. P.D. Rwelamila
Botswana Polytechnic
Private Bag 0061
Gaborone.

Dear Sir/Madam,

ANTHRC POLOGICAL RESEARCH ACT:
GRANT OF PERMIT UNDER SECTION 3

I refer to your letter dated 8th November 1991 about application to do research.

In exercise of the powers vested in him by the Anthropological research act the Minister of Presidential Affairs and Public Administration has granted permission to Pantaleo D. Rwelamila to carry out research on the Investigation into factors affecting project Quality Control in Public Buildings in Botswana - The case of Gaborone

The research will be carried out for a period not exceeding Forty-Eight (48) months, with effect from 1st February 1992 and will be carried out at Gaborone

This permit is granted subjective to the condition that any papers written as a result of the research shall be deposited with: Government Archivist, Director - National Library Service.

Yours faithfully,

Signed

K. Lebanna (Mrs)

for/PERMANENT SECRETARY TO THE PRESIDENT

cc: District Commissioner, Gaborone
Director, Library Service
Government Archivist

APPENDIX II

A TYPICAL QUESTIONNAIRE COVERING LETTER

Dear Sir/Madam

RE: QUALITY MANAGEMENT IN PUBLIC BUILDING CONSTRUCTION PROCESSES STUDY

Since 1988 while working in the Department of Civil Engineering at Botswana Polytechnic, and now the Department of Construction Economics and Management at the University of Cape Town, I have been engaged in a number of research projects aimed at improving construction productivity and quality.

As you will recall, there have been great concern from the public through the press and other forums about the quality of public buildings in Botswana. Various newspapers have carried out surveys of tenants and other interested groups about the state of public buildings, and the results of these surveys (though not comprehensive) have been critical on the extensive defects of public residential buildings, government office blocks, and school buildings.

Contractors and consultants have been blamed as the main contributors to the bad state of completed buildings, but no comprehensive study has been carried out to substantiate this.

Having realised the paramount importance of establishing the factors which have been causing quality problems in public buildings, a pilot study was carried out in 1988 and the following were identified as primary indicators on the factors influencing quality management in the Botswana public building sector:

(i) The traditional procurement system which is purported to be dominant in the Botswana public building sector is characterized by an inappropriate project organizational structure, and this have resulted into an inappropriate quality management system, hence poor quality management.

(ii) The traditional procurement system is incapable of facilitating derived quality levels as defined by contract drawings and specifications.

The purpose of this survey is to discover the views of contractors, architects, quantity surveyors and engineers on the quality problem issue.

The enclosed questionnaire is concerned with establishing the problems which affect you as a member of the project team, when dealing with quality issues. Furthermore, it seeks to establish the extent to which different parties to public building projects are engaged in the whole system of managing quality.

Attached, please find relevant research definitions which will help you to understand various terms related to quality management.

This research project is supported by the Botswana President's office, under the Anthropological Research Act: Section 3. A copy of a letter from the President's office +reference OP 46/1 XXXI (103) is enclosed for your perusal.

Please note that all answers will be treated in absolute confidence and published in aggregate form only.

Your co-operation is appreciated.

P D Rwelamila
Senior Lecturer/ PhD Research Student
Encls.

RESEARCH TOPIC: QUALITY MANAGEMENT IN PUBLIC BUILDING CONSTRUCTION PROCESSES

The following definitions are adopted for the purpose of this research:

1. Quality:

Quality is defined as the measure of the fitness of the building and its parts to fulfil the purpose defined in the brief or conformance to established requirements.

2. Quality Management:

Quality management is that aspect of the overall management function of the project which determines and implements the quality policy. The project quality policy hinges on achieving the client's requirements (which are set in the brief, embodied in the project drawings and specifications). Quality management embraces all the actions which the project management takes to achieve its quality policy.

3. Project Quality Policy:

This embraces the overall quality intentions and directions of a building project as regards quality, as formally expressed by the project top management.

4. Quality Management System:

This system is defined as a project organizational structure, responsibilities, procedures, processes and resources for implementing quality management. Such a system must, of necessity, be made up of a number of elements. Some of these elements will provide quality control by eliminating non-conformance, and others will supply verification, or assurance, that standards established from the client brief have been met.

5. Quality Assurance (QA):

QA embraces all those planned and systematic actions necessary to provide adequate confidence that a building will satisfy given requirements for quality.

6. Quality Control (QC):

This includes the operational techniques and activities that are used to fulfil requirements for quality.

APPENDIX III

CONSTRUCTION FIRM EXECUTIVE QUESTIONNAIRE

CFE:1. Please state the full title of your present occupation

____

____

CFE:2. What is your age group in years?

30 years or over	
30 - 40 years	
40 - 50 years	
above 50 years	

CFE:3. What is your construction experience in years?

0 - 2 years	
2 - 5 years	
5 - 10 years	
10 - 20 years	
above 20 years	

CFE:4. How were you trained?

Apprenticeship	
Brigade	
Apprenticeship/Brigade	
Polytechnic/Technical College	
University	

CFE:5. Please indicate the relative incidence of problems concerning quality, associated with the following trades:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Excavation				
Concrete				
Formwork				
Reinforcement				
Brickwork and Blockwork				
Asphalt work				
Roofing				
Carpentry				
Joinery				
Plastering				
Floor Finishing				
Plumbing				
Heating and Ventilating				
Electrical				
Glazing				
Painting and Decorating				
Other (Please specify)				

CFE:6. Please indicate the relative incidence of problems concerning quality, associated with the following types of operatives:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Direct employees-Craftsmen				
Direct employees-Labourers				
Subcontractors-Labours and Material				
Subcontractors-Labour only				
Other (please specify)				

CFE:7. Please indicate the relative incidence of problems concerning quality, associated with the following locations:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Structural-below ground level				
Structural-ground floor and above				
External cladding				
External finishing				
Roof coverings				
Internal finishings				
Services				
External works				
Other (please specify)				

CFE:8. Please indicate the relative incidence of problems concerning quality, associated with the following types of work:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Traditional Building				
Industrialised and System Building				
Alterations				
Other (please specify)				

CFE:9. What do you consider to be <u>three</u> major problems concerning quality in order of importance?

(a) ____

____

(b) ____

____

(c) ____

____

CFE:10. Please indicate the number and approximate value of each project you are normally concerned with at the same time.

	Please tick				
	Number of Projects				
	1	2	3	4	More than 4
(a) Less than P 150,000					
(b) P 150,000-P 450,000					
(c) P 450,000-P 900,000					
(d) P 900,000-P2,000,000					
(e) P2,000,000-P4,000,000					
(f) Over P4,000,000					

CFE:11. State the approximate proportion of time, in an average working week, that you spend on activities which are primarily and directly concerned with achieving a specified level of quality ______________________%

CFE:12. Please indicate the approximate proportion of the time stated in question 11. that you spend on the following activities.

	Please tick					
	Percentage (%)					
	100-80	79-60	59-40	39-20	19-1	0
(a) Inspection						
(b) Supervision						
(c) Verbal instruction						
(d) Written instruction						
(e) Discussion						
(f) Assistance						
(g) Correspondence						
(h) Report Writing						
(i) Travelling						
(j) Other (specify)						

CFE:13. State the average number of persons who normally report to you

____

CFE: 14. Please indicate in your opinion, which characteristics represents the majority of public building projects you have been involved in for the last ten years in Botswana

	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works					
2. The design is complete at the time of selecting the contractor					
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum					
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication					
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect					
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices					
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)					
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk					
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue					

APPENDIX IV

CONTRACTS MANAGER QUESTIONNAIRE

Dear Sir/Madam

This questionnaire is designed in a way that you can make suggestions thereby making invaluable contributions to this work. All answers will be treated in absolute confidence and used only for academic purposes. You are however, free to skip any questions. Complete anonymity is assured. Your co-operation is appreciated.

Thank you.

CM:1. Please indicate your age group in years

30 or under	
30 - 40 years	
40 - 50 years	
above 50 years	

CM:2. What is your construction experience in years?

0 - 2 years	
2 - 5 years	
5 - 10 years	
10 - 20 years	
above 20 years	

CM:3. How were you trained?

Apprenticeship	
Brigade	
Apprenticeship/Brigade	
Polytechnic/Technical College	
University	
On - site experience	
Other (please specify)	

CM:4. For how long have you held your current status or role?

	Please tick
Less than 1 year	
Less than 3 years	
Less than 5 years	
More than 5 years	

CM:5. How many contracts are you responsible for?

	Please tick
1 Project	
2 Projects	
3 Projects	
4 Projects	
5 Projects	
More than 5 Projects	

CM:6. For how many of the current projects in question 5. have your not been involved with from their commencement?

	Please tick
None	
1 Contract	
2 Contracts	
3 Contracts	
4 Contracts	
5 Contracts	
More than 5 Contracts	

CM:7. At what stage are you normally involved with new projects?

	Please tick
Pre-tender	
Pre-planning	
Commencement date	

CM:8. How many times do you allow your site manager/agents to spend on a new project prior to commencement on site?

	Please tick
None	
Less than 1 week	
Less than 2 weeks	
More than 2 weeks	

CM:9. Who decides the communications procedures between the architect/or engineer/client supervising officer and your sites?

	Please tick
You	
The site company policy	
Architect/or Engineer/Supervising officer	

CM:10. How do you instruct your site managers with regard to specified requirements?

	Please tick
In writing	
Verbally	
When requested	
Help themselves from documents available	

CM:11. With regard to quality of workmanship, place in order of importance the following criteria when using **domestic** sub-contractors on site.

	Please tick		
	First	Second	Third
Your company's requirements			
Extract from specifications and drawings			
The sub-contractor's expertise			

CM:12. With regard to quality of workmanship, place in order of importance the following criteria when using **nominated** sub-contractors on site.

	Please tick		
	First	Second	Third
Your company's requirements			
Extract from specifications and drawings			
The sub-contractor's expertise			

CM:13. Please indicate how you check that the information has been received and is being used to give the intended results.

	Please tick		
	First	Second	Third
Personal visit			
Reports from others			
No check			
Other (please specify)			

CM:14. Please indicate how you check that the information has been received and is being used to give the intended results.

	Please tick			
	Always	Often	Sometimes	Never
Personal visit				
Reports from others				
No check				
Other (please specify)				

CM:15. Please indicate the relative frequency <u>in your opinion</u> that the following factors concerning quality information are contributory causes of unacceptable quality work.

	Please tick			
	Very high	Fairly high	Fairly low	Very Low
Late				
Inaccurate				
Incomplete				
Difficult to understand				
Poorly presented				
Other (please specify)				

CM:16. To what extent do you consider that communication contributes to the quality of the finished building?

	Please tick
None	
Little	
A lot	

CM:17. Please indicate the relative incidence of problems concerning quality, associated with the following trades:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Excavation				
Concrete				
Formwork				
Reinforcement				
Brickwork and Blockwork				
Asphalt work				
Roofing				
Carpentry				
Joinery				
Plastering				
Floor Finishing				
Plumbing				
Heating and Ventilating				
Electrical				
Glazing				
Painting and Decorating				
Other (Please specify)				

CM:18. Please indicate the relative incidence of problems concerning quality, associated with the following types of operatives:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Direct employees-Craftsmen				
Direct employees-Labourers				
Subcontractors-Labours and Material				
Subcontractors-Labour only				
Other (please specify)				

CM:19. Please indicate the relative incidence of problems concerning quality, associated with the following locations:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Structural-below ground level				
Structural-ground floor and above				
External cladding				
External finishing				
Roof coverings				
Internal finishings				
Services				
External works				
Other (please specify)				

CM:20. Please indicate the relative incidence of problems concerning quality, associated with the following types of work:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Traditional Building				
Industrialised and System Building				
Alterations				
Other (please specify)				

CM:21. What do you consider to be <u>three</u> major problems concerning quality in order of importance?

(a) ______________________________

____

(b) ______________________________

____

(c) ______________________________

____

CM:22. Please indicate the number and approximate value of each project you are normally concerned with at the same time.

	Please tick				
	Number of Projects				
	1	2	3	4	More than 4
(a) Less than P 150,000					
(b) P 150,000-P 450,000					
(c) P 450,000-P 900,000					
(d) P 900,000-P2,000,000					
(e) P2,000,000-P4,000,000					
(f) Over P4,000,000					

CM:23. State the approximate proportion of time, in an average working week, that you spend on activities which are primarily and directly concerned with achieving a specified level of quality ________________________ %

CM:24. Please indicate the approximate proportion of the time stated in question 11. that you spend on the following activities.

	Please tick					
	Percentage (%)					
	100-80	79-60	59-40	39-20	19-1	0
(a) Inspection						
(b) Supervision						
(c) Verbal instruction						
(d) Written instruction						
(e) Discussion						
(f) Assistance						
(g) Correspondence						
(h) Report Writing						
(i) Travelling						
(j) Other (specify)						

CM:25. Please indicate in your opinion, which characteristics represents the majority of public building projects you have been involved in for the last ten years in Botswana

	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works					
2. The design is complete at the time of selecting the contractor					
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum					
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication					
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect					
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices					
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)					
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk					
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue					

APPENDIX V

SITE MANAGER QUESTIONNAIRE

Dear Sir/Madam

This questionnaire is designed in a way that you can make suggestions thereby making invaluable contributions to this work. All answers will be treated in absolute confidence and used only for academic purposes. You are however, free to skip any questions. Complete anonymity is assured. Your co-operation is appreciated.

Thank you.

SM:1. Please indicate your age group in years.

30 or under	
30 - 40 years	
40 - 50 years	
above 50 years	

SM:2. What is your construction experience in years?

0 - 2 years	
2 - 5 years	
5 - 10 years	
10 - 20 years	
above 20 years	

SM:3. How were you trained?

Apprenticeship	
Brigade	
Apprenticeship/Brigade	
Polytechnic/Technical College	
University	
On - site experience	

SM:4. For how long have you held your current status or role?

	Please tick
Less than 1 year	
Less than 2 years	
Less than 5 years	
More than 5 years	

SM:5. Have you been engaged on your current contract and in your current contract and in your present role since the project started?

	Please tick
Yes	
No	

SM:6. Have you worked for your immediate superior prior to this project?

	Please tick
Yes	
No	

SM:7. Has your current immediate superior been involved with this project prior to your involvement?

	Please tick
Yes	
No	

SM:8. How much time did you spend on your current contract prior to commencing work on site?

	Please tick
(a) None	
(b) Less than 1 week	
(c) Less than 2 weeks	
(d) More than 2 weeks	

SM:9. Do you have for your <u>own use</u> on site the following?

	Please tick
(a) Specification	
(b) Bill of Quantities	
(c) Drawings	
(d) Project programme	

SM:10. Do you have for your <u>own use</u> on site current British/or South African standards and Codes of practice? (in number please)

	Please tick
(a) None	
(b) Less than 5	
(c) Less than 10	
(d) More than 10	

SM:11. Do you have for your <u>own use</u> on site other technical documents applicable to the work in hand? (e.g: Building Department Standard specifications, Building regulations, etc.)

	Please tick
Yes	
No	

SM:12. How do you instruct your supervisors with regard to specified requirements?

	Please tick
(a) In writing	
(b) Verbally	
(c) When requested	
(d) Help themselves from documents available	

SM:13. How does information from the architect/engineer/supervising officer reach you?

	Please tick
(a) Direct	
(b) Via head or other officer	

SM:14. Does your company possess a library or current British/or South African Standards, Codes of Practice, manufacturers' literature?

	Please tick
(a) Yes	
(b) No	
(c) Don't know	

SM:15. Please indicate how you check that project information has been received and is being used to give the intended results.

	Please tick			
	Always	Often	Sometimes	Never
Personal visit				
Reports from others				
No check				
Other (please specify)				

SM:16. Please indicate the relative frequency in <u>your opinion</u> that the following factors concerning quality information are contributory causes of unacceptable quality work.

	Please tick			
	Very high	Fairly high	Fairly low	Very low
(a) Late				
(b) Inaccurate				
(c) Incomplete				
(d) Difficult to understand				
(e) Poorly presented				
(f) Other (please specify)				

SM:17. With regard to quality of workmanship, please place in order of importance the following criteria when using **domestic** sub-contractors on your site.

	Please tick		
	First	Second	Third
(a) Your company's requirements			
(b) Extracts from specifications and drawings			
(c) The sub-contractor's expertise			

SM:18. With regard to quality of workmanship, please place in order of importance the following criteria when using **nominated** sub-contractors on your site.

	Please tick		
	First	Second	Third
(a) Your company's requirements			
(b) Extracts from specifications and drawings			
(c) The sub-contractor's expertise			

SM:19. To what extent do you consider that communication contributes to the quality of the finished building?

	Please tick
(a) None	
(b) Little	
(c) A lot	

SM:20. Please indicate the relative incidence of problems concerning quality, associated with the following trades:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Excavation				
Concrete				
Formwork				
Reinforcement				
Brickwork and Blockwork				
Asphalt work				
Roofing				
Carpentry				
Joinery				
Plastering				
Floor Finishing				
Plumbing				
Heating and Ventilating				
Electrical				
Glazing				
Painting and Decorating				
Other (Please specify)				

SM:21. Please indicate the relative incidence of problems concerning quality, associated with the following types of operatives:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Direct employees-Craftsmen				
Direct employees-Labourers				
Subcontractors-Labours and Material				
Subcontractors-Labour only				
Other (please specify)				

SM:22. Please indicate the relative incidence of problems concerning quality, associated with the following locations:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Structural-below ground level				
Structural-ground floor and above				
External cladding				
External finishing				
Roof coverings				
Internal finishings				
Services				
External works				
Other (please specify)				

SM:23. Please indicate the relative incidence of problems concerning quality, associated with the following types of work:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Traditional Building				
Industrialised and System Building				
Alterations				
Other (please specify)				

SM:24. What do you consider to be <u>three</u> major problems concerning quality in order of importance?

(a) ______________________________
____

(b) ______________________________
____

(c) ______________________________
____

SM:25. Please indicate the number and approximate value of each project you are normally concerned with at the same time.

	Please tick				
	Number of Projects				
	1	2	3	4	More than 4
(a) Less than P 150,000					
(b) P 150,000-P 450,000					
(c) P 450,000-P 900,000					
(d) P 900,000-P2,000,000					
(e) P2,000,000-P4,000,000					
(f) Over P4,000,000					

SM:26. State the approximate proportion of time, in an average working week, that you spend on activities which are primarily and directly concerned with achieving a specified level of quality ________________________%

SM:27. Please indicate the approximate proportion of the time stated in question 11. that you spend on the following activities.

	Please tick					
	Percentage (%)					
	100-80	79-60	59-40	39-20	19-1	0
(a) Inspection						
(b) Supervision						
(c) Verbal instruction						
(d) Written instruction						
(e) Discussion						
(f) Assistance						
(g) Correspondence						
(h) Report Writing						
(i) Travelling						
(j) Other (specify)						

SM:28. Please indicate in your opinion, which characteristics represents the majority of public building projects you have been involved in for the last ten years in Botswana

	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works					
2. The design is complete at the time of selecting the contractor					
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum					
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication					
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect					
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices					
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)					
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk					
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue					

APPENDIX VI

TRADE FOREMAN QUESTIONNAIRE

Dear Sir/Madam

This questionnaire is designed in a way that you can make suggestions thereby making invaluable contributions to this work. All answers will be treated in absolute confidence and used only for academic purposes. You are however, free to skip any questions. Complete anonymity is assured. Your co-operation is appreciated.

Thank you.

TF:1. Please state your trade speciality.

____

TF:2. Please indicate your age group in years.

30 or under	
30 - 40 years	
40 - 50 years	
above 50 years	

TF:3. What is your construction experience in years?

0 - 2 years	
2 - 5 years	
5 - 10 years	
10 - 20 years	
above 20 years	

TF:4. How were you trained?

Apprenticeship	
Brigade	
Apprenticeship/Brigade	
Polytechnic/Technical College	
University	
On - site experience	

TF:5. For how long have you held your current status or role?

	Please tick
Less than 1 year	
Less than 2 years	
Less than 5 years	
More than 5 years	

TF:6. Have you been employed on your current contract and in your current role since the project started?

	Please tick
Yes	
No	

TF:7. Have you worked for your immediate superior prior to this project?

	Please tick
Yes	
No	

TF:8. Has your current immediate superior been involved with this project prior to your involvement?

	Please tick
Yes	
No	

TF:9. Are there any unusual requirements with regard to specifications and/or tolerances on your current project?

	Please tick
Yes	
No	
Don't know	

TF:10. Do you have for your own use or have easy access on site to the following?

	Please tick
Specification	
Bill of Quantities	
Drawings	
Short-term programme	

TF:11. Is the quality of your supervision of the work most dependent upon:

	Please tick
Verbal instructions from your supervisor	
Written instructions from your supervisor	
Specification/drawings	
Your experience	

TF:12. Please indicate how you check that the information has been received and is being used to give the intended results.

	Please tick			
	Always	Often	Some times	Never
Personal visit				
Reports from others				
No check				
Other (please specify)				

TF:13. Please indicate the relative frequency in <u>your opinion</u> that the following factors concerning quality information are contributory causes of unacceptable quality work.

	Please tick			
	Very low	Fairly high	Fairly low	Very low
Late				
Inaccurate				
Incomplete				
Difficult to understand				
Other (please specify)				

TF:14. Who determines the standard of quality or tolerance of workmanship on your current project?

	Please tick
(a) Your manager	
(b) You	
(c) The operatives	
(d) Others	

TF:15. Is the standard of quality referred to in question 12 above, checked by another person?

	Please tick
Yes	
No	

If Yes, by whom

____

TF:16. To what extent do you consider that communication contributes to the quality of the finished building?

	Please tick
(a) None	
(b) Little	
(c) A lot	

TF:17. State the approximate proportion of time, in an average working week, that you spend on activities which are primarily and directly concerned with achieving a specified level of quality ____________________%

TF:18. Please indicate the approximate proportion of the time stated in question 11. that you spend on the following activities.

	Please tick					
	Percentage (%)					
	100-80	79-60	59-40	39-20	19-1	0
(a) Inspection						
(b) Supervision						
(c) Verbal instruction						
(d) Written instruction						
(e) Discussion						
(f) Assistance						
(g) Correspondence						
(h) Report Writing						
(i) Travelling						
(j) Other (specify)						

TF:19. Please indicate in your opinion, which characteristics represents the majority of public building projects you have been involved in for the last ten years in Botswana

	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works					
2. The design is complete at the time of selecting the contractor					
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum					
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication					
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect					
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices					
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)					
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk					
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue					

APPENDIX VII

SKILLED TRADESPERSON QUESTIONNAIRE

Dear Sir/Madam

This questionnaire is designed in a way that you can make suggestions thereby making invaluable contributions to this work. All answers will be treated in absolute confidence and used only for academic purposes. You are however, free to skip any questions. Complete anonymity is assured. Your co-operation is appreciated.

Thank you.

ST:1. Please state your trade speciality.

____

ST:2. Please indicate your age group in years

30 or under	
30 - 40 years	
40 - 50 years	
above 50 years	

ST:3. What is your construction experience in years?

0 - 2 years	
2 - 5 years	
5 - 10 years	
10 - 20 years	
above 20 years	

ST:4. How were you trained?

Apprenticeship	
Brigade	
Apprenticeship/Brigade	
Polytechnic/Technical College	
University	
On - site experience	

ST:5. Indicate how you are usually informed of the acceptable standard of quality of work required for a job:

	Please tick			
	Always	Often	Some-times	Never
Architects/Engineers drawings				
Architects/Engineers specifications				
Written instructions				
Verbal instructions				
Samples of work				
No information received				
Other (please state)				

ST:6. Please indicate the relative value for the purpose of assisting you to produce work of acceptable quality:

	Please tick			
	Great	Considerable	Little	None
Architects/Engineers drawings				
Architects/Engineers specifications				
Written instructions				
Verbal instructions				
Samples of work				
Other (please specify)				

ST:7. Please indicate the approximate proportion of time, during an average working week, that your work is directly supervised or inspected for quality:

	Please tick					
	25%	20%	15%	10%	5%	0%
By an Architect/Engineer						
By a clerk of works						
By your supervisor						
By other (please specify)						

ST:8. On the basis of question 6 state the approximate average number of inspections.

	Please indicate	
	Number per day	Number per week
By an Architects/Engineers		
By a clerk of work		
By your supervisor		
By other (please specify)		

ST:9. Indicate the extent in your opinion, that productivity bonus schemes reduce quality of your work:

Please tick			
Very large	Fairly large	Fairly small	Very small

ST:10. Indicate the extent in your opinion, to which the quality of your finished work is influenced by quality of materials compared with quality of workmanship:

Please tick			
Very large	Fairly large	Fairly small	Very small

ST:11. Please indicate the relative frequency, <u>in your opinion</u>, that the following are reasons for rejection of unacceptable quality work in your trade, after inspection:

	Please tick			
	Very high	Fairly high	Fairly low	Very low
Dimensions				
Performance or function				
Appearance of finished surface				
Other (please specify)				

ST:12. Please indicate the relative frequency, <u>in your opinion</u>, that the following factors, outside your control, which are contributory reasons for rejection of unacceptable quality work in your trade:

	Please tick			
	Very high	Fairly high	Fairly low	Very low
Damage				
Materials				
Information				
Work of other trades				
Other (please specify)				

ST:13. Indicate the relative influence, <u>in your opinion</u>, of the following on the quality of your work:

	Please tick			
	Very high	Fairly high	Fairly low	Very low
Natural ability				
Training and skills				
Attitude towards employer or job				
Other (please specify)				

ST:14. State what you would consider to be three major causes of unacceptable quality work.

(a) ____________________

____

(b) ____________________

____

(c) ____________________

____

ST:15. State the operation which you most dislike or find most difficult to perform when you are producing work of what you consider to be "above average" quality.

____

____

APPENDIX VIII

ARCHITECT, QUANTITY SURVEYOR AND ENGINEER QUESTIONNAIRE

AQE:1. Please state the full title of your present occupation

____

____

AQE:2. What is your age group in years?

30 years or over	
30 - 40 years	
40 - 50 years	
above 50 years	

AQE:3. What is your construction experience in years?

0 - 2 years	
2 - 5 years	
5 - 10 years	
10 - 20 years	
above 20 years	

AQE:4. How were you trained?

Apprenticeship	
Brigade	
Apprenticeship/Brigade	
Polytechnic/Technical College	
University	

AQE:5. Please indicate the relative incidence of problems concerning quality, associated with the following trades:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Excavation				
Concrete				
Formwork				
Reinforcement				
Brickwork and Blockwork				
Asphalt work				
Roofing				
Carpentry				
Joinery				
Plastering				
Floor Finishing				
Plumbing				
Heating and Ventilating				
Electrical				
Glazing				
Painting and Decorating				
Other (Please specify)				

AQE:6. Please indicate the relative incidence of problems concerning quality, associated with the following types of operatives:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Direct employees-Craftsmen				
Direct employees-Labourers				
Subcontractors-Labours and Material				
Subcontractors-Labour only				
Other (please specify)				

AQE:7. Please indicate the relative incidence of problems concerning quality, associated with the following locations:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Structural-below ground level				
Structural-ground floor and above				
External cladding				
External finishing				
Roof coverings				
Internal finishings				
Services				
External works				
Other (please specify)				

AQE:8. Please indicate the relative incidence of problems concerning quality, associated with the following types of work:

	Please tick			
	Very High	Fairly High	Fairly Low	Very Low
Traditional Building				
Industrialised and System Building				
Alterations				
Other (please specify)				

AQE:9. What do you consider to be <u>three</u> major problems concerning quality in order of importance?

(a) ____

____

(b) ____

____

(c) ____

____

AQE:10. Please indicate the number and approximate value of each project you are normally concerned with at the same time.

	Please tick				
	Number of Projects				
	1	2	3	4	More than 4
(a) Less than P 150,000					
(b) P 150,000-P 450,000					
(c) P 450,000-P 900,000					
(d) P 900,000-P2,000,000					
(e) P2,000,000-P4,000,000					
(f) Over P4,000,000					

AQE:11. State the approximate proportion of time, in an average working week, that you spend on activities which are primarily and directly concerned with achieving a specified level of quality ______________________%

AQE:12. Please indicate the approximate proportion of the time stated in question 11. that you spend on the following activities.

	Please tick					
	Percentage (%)					
	100-80	79-60	59-40	39-20	19-1	0
(a) Inspection						
(b) Supervision						
(c) Verbal instruction						
(d) Written instruction						
(e) Discussion						
(f) Assistance						
(g) Correspondence						
(h) Report Writing						
(i) Travelling						
(j) Other (specify)						

AQE:13. State the average number of persons who normally report to you

____

AQE:14. Do you maintain a separate specification department/section?

Yes	
No	

AQE:15. If your answer in question 14 is `no' do you employ any full-time specification writer?

Yes	
No	

AQE:16. If your answers to question No. 14 and No. 15 are negative (`no'), who writes your specifications?

Quantity surveyor	
Project Engineer	
Project Architect	
Principal of firm	
Outside consultant	
Other (please specify)	

AQE:17. What minimum qualifications should a specification writer possess?

Architectural degree	
Engineering degree	
Design experience	
Design and construction (field) experience	
Prior knowledge of understanding a project	
Master's degree	
Other (please specify)	

AQE:18. In establishing the in-house budget for a project, what percentage of the design budget is allocated for specifications?

0 - 2%	
2 - 5%	
5 - 10%	
10 - 15%	
15 - 20%	
Over 20%	

AQE:19. What is your greatest in-house problem in getting out a good set of specification?

Insufficient time for preparation	
Coordination between plans and specifications:	
Coordination of all phases of work in project schedule	
Coordination between various disciplines involved	
Insufficient information to prepare specification	
Other (please specify)	

AQE:20. What are your particular problems with the project specifications when administrating contracts?

Contractor's failure to read or understand the specifications	
Contractors neglecting to follow the specifications	
Unauthorised substitutions of materials by the contractor	
Lack of enforcement of the specifications involved	
Inadequate inspection and quality control in the field	
Field personnel do not read and understand the specifications	
Conflict between the plans and specifications and lack of coordination	
Specification writer - unfamiliar with the tests and standards he/she specifies	
Incomplete or incorrect specifications	
Ambiguous language in specifications	
Other (please specify):	

AQE:21. Please indicate in your opinion, which characteristics represents the majority of public building projects you have been involved in for the last ten years in Botswana

	True	More true than false	Difficult to say	More false than true	False
1. The client commissions, and takes responsibility for the design of the works					
2. The design is complete at the time of selecting the contractor					
3. Prime cost sums, including nominated sub-contracts do not form the major proportion of the contract sum					
4. The architect appointed by the client is adequately experienced to cope with the co-ordination of the design team, to lead the design effort, and to co-ordinate the interface between design and fabrication					
5. The client uses the quantity surveyor to plan and control the finance of the project, in conjuction with the architect					
6. The client requires the contractor selection process to be based upon the contractor's estimate of price and for the contractor to bear the risk of costs exceeding prices					
7. The client reserves the right, via nomination, to select the sub-contractors for certain parts of the work (but see 3 above)					
8. An acceptable negotiated project contract form is used in order to ensure a fair and familiar distribution of risk					
9. The client does not know what else to do, and the consultants do not raise the choice of procurement method as an issue					

APPENDIX IX

PROJECT SPECIFICATIONS CASE STUDY GUIDELINES

1. Pilot Study Finding:

" Specifications are generally considered to be poorly written, ambiguous, obsolete, unclear and irrelevant."

2. What to Consider:

2.1 Project contract sum.

2.2 Description of the building (focus on building elements).

2.3 Contract documents (contract form, contract working drawings, bills of quantities/or schedule of rates).

2.3.1 Compare site meetings reports on issues regarding building quality with specifications requirements.

2.3.2 For completed buildings: check the snag list and compare with the physical building.

2.4 Project consultants

APPENDIX X

SITE CASE STUDIES: OBSERVATION GUIDELINES

1. Pilot Study Indicators:

1.1 Poor communication

1.2 Management of subcontractors

1.3 General management of resources

1.4 Approach to problem solving

1.5 Project documents: drawings and specifications

2. What to observe:

2.1 Description of the project under observation

2.2 General quality levels

2.3 Contracting method

2.4 Drawings and other contract documents on site

2.5 General site management procedures

APPENDIX XI

CLIENT INTERVIEW GUIDELINES

1. Introduction

Before starting the interview, allow 15 minutes for the interviewee to read through the following:

1.1 The research definition of quality and other related terms and

1.2 Research hypotheses

2. Open Ended Questions on the Following Should be Asked:

2.1 Comment on the research hypotheses

2.2 Comment on the statement that: " Project documentation relative to standards is poor in the Botswana public building sector."

2.3 Identification of problematic building trades when managing building projects.

2.4 Three major problems adversely influencing quality of building work in order of importance, and comments on the same.

2.5 Comment on the writer(s) of building project specifications.

2.5.1 Comment on the suitability of the specification writer

2.5 Comment on the characteristics of building projects.