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DISSERTATION

An Investigation into Quality Concerns in House Construction in Government-subsidised Low-income Housing Projects in the Pietermaritzburg Area

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EXECUTIVE SUMMARY

Ongoing quality concerns in low income housing have allegedly not been addressed adequately, as has been expressed in numerous speeches and at the Provincial Housing Summit of 2005.

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. It is informed by total quality management literature.

It is motivated by aspects including: (1) government's accountability for public funds; (2) serving as base research for improved resource allocation; (3) and for quality improvement and sustainability strategies; (4) creating an opportunity for introspection by other members in the supply chain; and (5) a responsibility of all stakeholders to realise the ultimate goal of customer satisfaction.

Research Design

The following research objectives were set:

(1) To identify house construction quality concerns in government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) To identify the causes of house construction quality problems in the low income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal. In the context of this research, "developer" is defined as the entity used by the Department or the municipality as an agent for implementing projects.

(3) To identify how house construction quality issues are currently being addressed.

The research was approached in two phases. Phase 1 was designed to identify whether quality concerns existed in the low income housing projects in the Pietermaritzburg area; and to identify the nature and the extent thereof. Phase 2 was designed to explore the perceived causes of quality concerns, and to identify the systems used by the municipality, its developing agent and the Department of Housing, to ensure sustained quality management.

Findings

Defects : The findings recorded in Chapter 5 illustrate that there are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship, especially the topping of slabs (i.e., the process in which a final layer of cement is applied to smoothen the floor surface, also referred to as "screeding"). The Pareto analysis indicates that there is a mixture of defect types and causes that need to be addressed, and in order of priority. These are : (1) screeding; (2) water connection; (3) fitting frames; (4) site clearance; (5) constructions of walls; (6) plumbing, specifically toilet fittings; (7) glazing; (8) corking/filling of gaps; (9) plaster material; (10) door quality; (11) plaster work; and (12) the quality of frames.

Existing systems, norms and standards : Role players are at different stages of advancement with regard to quality and supply chain management. The institutions appear to have an internal focus to quality management that is not customer focussed and lacks information and involvement of all stakeholders. There is no formalised policy on quality management. Such a policy is needed to guide quality improvement and monitoring systems (Gryna, 2001:185). The institutions do not appear to have a quality management strategy, or to have a fully integrated quality perspective. Quality assurance and audit process are also lacking. Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes.

It appears that the proper infrastructure is not in place to implement a quality management system. Information systems are poor and this is a barrier to effective quality improvement implementation programmes, and to effective project management. There is no common understanding of roles, responsibilities and inspection criteria and processes and internal and external role players are excluded from quality management processes.

The management environment and organisational culture within the municipality and the department do not appear to be conducive to encourage a learning organisation approach.

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects.

Recommendations : These have been summarised as follows:

1. The adoption of a quality management policy that incorporates all stakeholders;
2. The inclusion of quality management in strategic plans with a phased implementation programme;
3. Partnership development and joint planning with all role players;
4. Use of larger contracts, over a longer period of time through a programmatic systems approach;
5. Identification of benchmarking partners;
6. The adoption of an audit and assurance mechanism, based on ISO 9000;
7. Development of a learning organisation and change management culture, led from the top;
8. The inclusion of quality performance targets in managers' performance reviews;
9. Clearly defined inspections procedures and documents (including roles and responsibilities), and availability of these on site;
10. Information management systems upgrading;
11. Revision to National Building Regulations in the context of low-income housing;
12. Improved municipal strategies on water connection;
13. On site training regarding topping of slabs, fitting windows and door frames and block work; and
14. Training of all managers and staff on all aspects of quality management theory, tools and techniques, and specifically in relation to low-income housing.

DECLARATION

I, Martha Maria Milne, hereby declare that the contents of this dissertation are my own work, and that all sources utilised, have been accurately reported and acknowledged. This dissertation has not been, nor is submitted for any degree or examination at any other university.

Signed: Date: 22/9/06

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CHAPTER 1 : INTRODUCTION

1.1 INTRODUCTION

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. It is informed by total quality management literature (discussed more fully in Chapter 2). Chapter 1 aims to explain the background of, and motivation for the study, and to identify the research questions and objectives of the study. Chapter 2 looks at the theoretical framework of quality management, focussing mainly on total quality management philosophy. Chapter 3 places total quality management in the context of low-income housing. Chapter 4 provides an explanation of the research methodology. Findings are then presented in Chapter 5, whilst conclusions are formulated in Chapter 6. Chapter 7 makes recommendations based on findings and conclusions, and also presents areas for future research.

1.2 BACKGROUND AND MOTIVATION

1.2.1 Statement of the problem

Ongoing quality concerns in low-income housing have allegedly not been addressed adequately.

1.2.2 Background

Quality concerns in housing have been ongoing. This matter has been raised in numerous political speeches at National and Provincial level (Makhaye, 2000: 4, and Mabandla, 2003: 4). These concerns were also raised at the KwaZulu-Natal Housing Summit held on 23 and 24 March 2005. The report on the summit highlights the Department of Housing's role in ensuring quality that is acceptable to the beneficiaries (Department of Housing, 2005a:9). Commissions at the summit recorded the need for the quality of housing to be reviewed, the need for improved value of this type of asset, review of the house design, and quantity *vis-à-vis* quality aspects (Department of Housing, 2005a:32). A resolution was taken to "beef up the inspectorate component" of the Department of Housing (herein referred to as the Department), to assist in addressing the quality concerns (Department of Housing, 2005b:4 and 2005a:38). Resolutions were also made that required the Department to develop performance indicators, standardise reporting and monitoring templates, and quality specifications for various housing options (Department of Housing, 2005a:37).

The South African Government's policy on housing for the poor (1994) was originally based on maximising the volume of delivery. Many stakeholders have raised concerns on the resultant quality of units that were delivered. (Department of Housing, undated*(a)*:1, and Sisulu, 2005b:5). In 1999 the National Department of Housing introduced norms and standards aimed at ensuring a minimum top structure size ($30m^2$) and service levels (Department of Housing, 2000:181). In 2002 the National Minister of Housing responsible for housing (herein referred to as "National Minister") announced that the involvement of the National Home Builder's Registration Council (NHBRC) would be extended to low-income housing green field projects from 1 April 2002 (Department of Housing, 2002:4). A further agreement had been reached that extended the NHBRC involvement to in-situ developments and units built by people themselves (Department of Housing, 2005c:6).

In 2005, the National Minister reiterated the need to focus on quality. She announced that houses built between 1994 and 2002 would be audited and action would be taken regarding poorly built houses (Sisulu, 2005a:2). She quoted unpublished research which indicates that shoddy construction has been found in the form of poor roofing, cracks, weak doors, damp, poor foundations, and no floors (Sisulu, 2005c:4). A media article quoted her stating the need not to push for quantity only, but to look at quality and correct past errors. This would result in spending funds on corrective work, thus reducing the budget available for new houses (Anonymous, 2005: paragraph 6).

In addition to this, the construction industry has been reported to have experienced several capacity problems in delivery resulting in poor quality construction throughout the sector (CIDB, 2002a: paragraph 2). Demand for delivery is increasing due to additional needs such as infrastructure requirements for the 2010 Soccer World Cup and which will increase the strain on resources and skills within the construction- and public(CIDB, 2006:2).

1.2.3 Motivation for research

Quality problems in housing construction have been an ongoing concern in all spheres of government. In spite of this, little has been done to quantify the extent of the problem. No research has been done by the Department of Housing in KwaZulu-Natal in this area. The following five reasons also motivate the research:

Reason One : Accountability for public funds

The Department is answerable to the public for its expenditure on housing initiatives. South African legislation compels all spheres of government to ensure proper spending of public funds, in a cost effective, transparent and equitable manner (Republic of South Africa, 1999: sections 2 and 38, and Republic of South Africa, 2004a: section 2).

The Provincial Budget allocation details for low-income housing projects are summarised in Table 1.1 below:

Table 1.1 : Summary of Budget : 2005/2006 Financial Year

		Medium-term estimates (R million)		
2004/2005 Allocated	2004/2005 Estimated Actual	2005/2006	2006/2007	2007/2008
538,616	609,287	563,601	664,164	644,144

(Mabuyakhulu, 2005:7 and 16)

The Msunduzi Municipality (Pietermaritzburg) has the second highest allocation for the Medium Term Expenditure Framework (after Durban Metropolitan Council) (Provincial Treasury, 2005:300). In terms of municipal categorisation, it has the highest allocation of all the municipalities in its category (Category B) (Provincial Treasury, 2005:300). The three "Category B" Municipalities with the highest allocations are summarised in Table 1.2 below.

Table 1.2 : Summary of "Category B" Municipalities with the highest subsidy allocations

Municipality	Medium-term estimates(R million)		
	2005/2006	2006/2007	2007/2008
Msunduzi (Pietermaritzburg)	29,581	34,861	33,854
Usinga	17,415	20,513	19,920
Ntambanana	14,864	17,495	16,989

(Provincial Treasury, 2005:300)

Reason 2 : Base research for improved resource allocation

The housing backlog is still very large and resources are extremely limited. Proper planning and efficient use of resources is, thus, critical if housing goals are to be achieved (Department of Housing, 2005d:2). Rework on poor quality construction depletes scarce resources even further. This research could facilitate more efficient resource utilisation.

Reason 3 : Base research for quality improvement and sustainability strategies

Quality concerns in housing still persist (Department of Housing, undated*(a)* :1). At the Provincial Housing Summit, the Minister indicated that the Department would be engaging in a rigorous process that will ensure a decent quality of housing (Department of Housing, 2005a:8). The Department has limited resources at the moment, and research in regard to quality has not progressed. No internal research has been done to identify and/or quantify housing construction quality defaults. The scope of the problem is unknown at this stage.

This research will assist in identifying quality default and management trends that could assist the Department in developing suitable strategies.

Reason 4 : Introspection by other members in the supply chain

Developers and municipalities could benefit by looking into their supply chain and quality management issues to enhance delivery.

Reason 5 : Customer satisfaction, the ultimate goal

Beneficiaries of the subsidy will also benefit as the identification of quality problems could inform strategies and policies to improve house construction in this sector of the market.

1.2.4 Theoretical framework

The research is based on quality management theory as a framework to analyse issues regarding quality in low-income housing projects, with a view to suggesting recommendations that may enhance house construction in the market. The relationship between world class supply chain management, total quality management (TQM) and the role of norms, standards and specifications is also explored in Chapter 2, and contextualised to low-income housing projects in Chapter 3.

1.2.5 Context

The study was done in the context of low-income housing projects, subsidised by government's conditional grant. It focussed on the activities relating to the actual construction of houses in the Pietermaritzburg area.

The context chapter (Chapter 3) includes findings of international research on quality issues in housing. It highlights prominent standards and specifications applicable to low-income housing, supply chain management, and quality control, in South Africa.

1.3 RESEARCH QUESTIONS AND OBJECTIVES

1.3.1 The purpose of this study

The purpose of this study was to identify issues that affect quality in the construction of houses through the South African Government's low-income housing subsidy scheme in the Pietermaritzburg area, and to determine how quality management can assist in improving house construction in an environment limited by budget constraints.

1.3.2 <u>Research questions</u>

The following questions were investigated:

(1) Are there quality problems in projects in the Pietermaritzburg area?

(2) What is the nature and extent thereof and how does it measure against acceptable industry norms?

(3) What are the perceived causes of quality concerns?

(4) What systems, norms and standards are in place to ensure sustained quality management?

1.3.3 <u>Research objectives</u>

The following research objectives were set:

(1) To identify house construction quality concerns in government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal. In the context of this research, "developer" is defined as the entity used by the Department or the municipality as an agent for implementing projects.

(3) To identify how house construction quality issues are currently being addressed.

1.4 CHAPTER PLAN

Table 1.3, below provides a summary of the structure of the document.

Table 1.3 : Structure of the research report

Chapter	Content	Purpose
1	Introduction	Overview of the chapter, what is covered and motivation for research.
		Brief overview of low-income housing policy and quality improvement initiatives in government low-income housing.
		Research questions and objectives.
		Outline of this document.
2	Quality management theory	Defines and describes quality management.
		Role of quality management.
		Summary of quality management theories (history and current trends).
		Total quality management (TQM), its nature, benefits and challenges.
		Supply chain management (in the context of quality management).
		Norms, standards and specifications.
		Relationship between TQM, supply chain management, norms, standards and specifications.
3	Quality Management in the context of low-income housing	International findings on quality in low-income housing as a description of quality concerns in low-income housing at international level, and how these are addressed.
		Quality concerns in South African low-income housing.
		National and Provincial initiatives and institutions involved in quality management and assurance in the context of low-income housing.
		Overview of norms, standards and specifications in low-income housing, as defined in terms of legislation and government policies.
4	Research methodology	Describes phasing of the research, population, sample, and data types, -tools, and –analysis.
5	Findings	
6	Conclusions	
7	Recommendations	

1.5 SUMMARY

This chapter provides a brief overview of the content of the report. It presents the problem statement, background and motivation for the research. It also identifies the research questions and objectives and provides a summary of the structure of the report.

The next chapter provides insight to relevant aspects relating to quality management.

CHAPTER 2 : QUALITY MANAGEMENT THEORY

2.1 INTRODUCTION

Quality has emerged as a dominant theme in management since 1940 (Beckford, 1998: 3). It affects all levels of the organization, i.e. operational, administrative and strategic (Beckford, 1998:11). The need for quality is equally applicable to the public sector as it is required to deliver services at the same or lower cost to meet public expectations (Beckford, 1998:10).

In investigating issues affecting quality in low-income housing, this chapter explores literature to identify how quality is defined, and to obtain a brief overview of the historic evolution of quality philosophies in total quality management (TQM). The importance of quality management is explored from both an internal and external perspective. The quality control process and the tools and techniques commonly referred to in literature is briefly outlined. This includes an overview of process analysis, statistical methods, "six-sigma" and benchmarking. The qualitative methods of quality circles, job design, organisational structure and supply chain management will be discussed briefly. An overview is also given of standards, specifications, and supply chain management, as quality is often defined as "conformance to requirements" (Crosby in Evans and Lindsay, 2002:106), and an integrative approach (Gitlow, et al, 1999:3, and Feigenbaum in Evans and Lindsay, 2002:108).

2.2 DEFINITION OF QUALITY

Quality has been defined as the degree of conformance to standards or fitness of use (McLaughlin, 1995:32). Deming defined it as "a predictable degree of uniformity and dependability, at low cost and suited to the market" (Deming in Gitlow, et al, 1999:1).

Juran and Gryna (1988:2.2) defined it as "fitness of use"... and "those product features which meet the needs of customers and thereby provide product satisfaction, (and also) freedom of deficiencies". Fitness of use is achieved through a collection of activities that make up the quality function, and these are critical in achieving some degree of predictability (Gitlow, et al, 1999:168). A product or service is less fit for use when:

(1) Product features (quality of design) do not match customer needs; (2) there is a lack of consistency and reliability due to high process variability which reduces customer confidence; and (3) there are high degrees of variation (Gitlow, et al, 1999:9). Quality of conformance is lost with variations to the specification (quality of design), where these variations are above or below the specification limits (Gitlow, et al, 1999:6). Variation may occur in processes related to things such as poor lighting, training, poor design. This is known as common process variation (Gitlow, et al, 1999:9). Special variation may also occur when elements such as material, employees or equipment are introduced (Gitlow, et al., 1999:9).

Crosby defines it as "conformance to requirements, not elegance" (Evans and Lindsay, 2002:106).

Gitlow, et al (1999:3) explores the definition: "Quality is customer satisfaction". They define customers as external (purchasers, intermediaries and all those who come into contact with the product, including governments and regulators), and internal customers which cover the entire organization (Gitlow, et al, 1999:3). They explore customer satisfaction in terms of "product features" (i.e. quality of design) and "freedom from deficiencies" (i.e. quality of conformance), (Gitlow, et al, 1999:5).

Quality of design defines the quality characteristics of a product or service required to meet the needs of the market (Gitlow, et al, 1999:5). This requires a strong customer focus, consumer research and involvement of all stakeholders in the design (Gitlow, et al, 1999:5).

Quality of conformance is the extent to which the specification (quality of design) can be achieved within cost (Gitlow, et al, 1999:6). Quality of performance relates to how quality of design and conformance perform in the market (Gitlow, et al, 1999:8). This includes after sales, maintenance, logistical support, reliability and purchase rates (Gitlow, et al, 1999:8).

The description that quality comprises customer satisfaction and fitness of use correlates with Juran and Feigenbaum's description of "total quality". *Total Quality* has been defined by Juran (1988:2.5) as a function comprising "an entire collection of activities through which we achieve fitness for use, no matter where these activities are performed". It covers every process, job and person (McLaughlin, 1995:31) and can be applied to any organization (Pike and Barnes 1996:24). It is "a system of behaviour which embraces everyone within an organization and determines their relationship with the outside world – customers, suppliers, competitors, society and the environment" (Develin and Hand, 1995:3). Feigenbaum, who in literature is best known for coining the phrase "total quality control", defined it as "an effective system for integrating the quality development, quality maintenance and quality improvement efforts of various groups in an organization to enable production and service at the most economical levels which allow full customer satisfaction" (Evans and Lindsay, 2002:108).

It is driven by the principle of continuous improvement (Develin and Hand, 1995:3), in every activity, including decision making and employee behaviour (Develin and Hand, 1995:5). This requires the optimization of systems with all stakeholders, including suppliers, subcontractors, employees, markets, communities, regulators and investors (Gitlow, et al, 1999:3), thus the entire supply chain.

The common thread in most definitions is that quality means to meet customer requirements (Develin and Hand, 1995:3), thus achieving "customer satisfaction... and fitness for use" (Gitlow, et al, 1999:165). The customer, therefore, determines the extent to which quality is achieved in its totality (McLaughlin, 1995:32).

2.3 HISTORIC OVERVIEW AND CONTRIBUTIONS TOWARDS MODERN PHILOSOPHIES AND TECHNIQUES

2.3.1 Early approaches

Quality issues have existed for centuries (Gitlow, et al, 1999:15). Quality management evolved from basic inspection to ensure the well being of others, progressing to corrective action, through to more integrative preventative modern approaches involving the entire system from customers to suppliers (Gitlow, et al, 1999:3).

In 2000BC the Code of Hammurabi referred to quality in the context of poor house construction that causes death of occupants as punishable by death (Gitlow, et al, 1999:15). Phoenician civilizations ensured compliance to government enforced quality standards and specifications by amputating the hand of the maker of defective products (Gitlow, et al, 1999:15).

From the thirteenth century quality became an inherent part of craftsmanship pride and training through apprenticeships to ensure quality skilled craftsmen in the interest of the trade. Government imposed quality standards (weights and measures) also applied (Gitlow, et al, 1999:15).

In the nineteenth century Frederick W. Taylor introduced the scientific management system to find ways of increasing production quantities (Gryna, 2001:228). This was based on assigning planning activities to educated and professional people, and execution to workers and supervisors (Gryna, 2001:228). The assignment of planning activities based on higher education has been diluted due to increased levels of education, cross functional teams and skills development in the workplace (Gryna, 2001:229).

The increased production focus was accelerated by industrialization. Attention to volume compromised quality but resulted in renewed quality efforts, including the creation of specialized chief inspection positions (Gitlow, et al, 1999: 15). This evolved into an explosion of quality philosophies and techniques throughout the twentieth century (Gitlow, et al, 1999:15). The most commonly quoted examples in the literature are briefly discussed in the section below:

2.3.2 Twentieth century trends

Early in the twentieth century **George Edwards** coined the term "quality assurance" as an approach that results from planned and interrelated activities of all the organisational units in the production chain (Gitlow, et al, 1999:16), thus introducing a more holistic and integrative approach to production.

In 1924 **Walter Shewart** introduced statistical quality control to manage variations and these tools are still in use (Gitlow, et al, 1999:16).

After World War II, quality initiatives were used to rebuild business and economies in America, and Japan (Gitlow, et al, 1999:17). From 1950, **Dr Edwards Deming** worked closely with Japanese industrialists to improve perceptions of poor quality products, by practicing continuous improvement processes (Gitlow, et al, 1999:17). His philosophy focuses on improvements by reducing uncertainty and variability in product design and manufacturing processes by applying statistical tools (Evans and Lindsay, 2002:91). Variability is viewed as the main cause of poor quality which could be reduced through a continuous cycle of design, manufacturing, testing, sales, survey and redesign (Evans and Lindsay, 2002:91). This is articulated also in the "Deming wheel", a continuous cycle of plan; do; check; action (Gryna, 2001:127). He advocates quality improvement as a catalyst for sustainability of a business, as follows: Quality improvement results in cost reduction. This increases productivity, thus performance in the market place, which ensures a viable organization, thus enabling increased job creation (Evans and Lindsay, 2002:91).

Joseph Juran also worked extensively with the Japanese and has contributed largely to the *Quality Control Handbook*, published in 1951 (Evans and Lindsay, 2002:104). His philosophy motivates quality management through cost accounting and analysis (Juran and Gryna, 1988:4.4), and focuses on increasing conformance to specifications by eliminating defects through statistical analysis (Juran and Gryna, 1998:23.2). He viewed quality management as a process comprising three generic processes: quality planning, quality control and quality improvement (Juran and Gryna, 1988:2.6).

Quality planning involves establishing quality goals, identifying customers and their needs, developing product- and process features, and establishing process controls (Juran and Gryna, 1988:2.6).

Quality control is the regulatory process which measures actual quality performance against quality goals, and acts on the difference (Juran and Gryna, 1988:6.31). This entails choosing control subjects and units of measure, setting goals, creating sensors to assist with monitoring, performance measurements, interpretation of variations, and taking action on causes of variation (Gitlow, et al, 1999:171).

Quality improvement includes confirming the need for quality improvement, identifying quality projects, organizing project teams, problem solving, and change management (Gitlow, et al, 1999:171). These should include detailed improvement programmes for effective implementation (Evans and Lindsay, 2002:105).

Phillip B Crosby offers a behavioural approach to quality management that focuses on managerial thinking (Evans and Lindsay, 2002:107). He emphasizes conformance to clearly defined and understood requirements and getting things right first time to save costs, through a "Zero Defects" performance standard (Evans and Lindsay, 2002:106). He explained that variation was caused by a lack of attention from psychological preconditioning in which defects are perceived to be inevitable, thus mindsets need to be reconditioned to getting it right first time (Evans and Lindsay, 2002:106).

In 1951 **Armand Feigenbaum** expanded on the application of continuous quality improvement from production to all aspects in business, shifting efforts to preventative measures (Gitlow, et al, 1999:17). He emphasizes the role of leadership by management and planning to prevent quality loss (Evans and Lindsay, 2003:108). This requires the integration of quality management into business planning across all disciplines, and involvement of all (Evans and Lindsay, 2002:108). Success of implementation depends on organisational commitment, continuous training and motivation of the entire workforce, and involvement of all role players (Evans and Lindsay, 2002:108).

Kaoru Ishikawa was a pioneer in the Japanese quality revolution. He promoted the bottom up and participative approaches to quality management, through team work and the application of statistical tools in all business analyses (Evans and Lindsay, 2002:109). His philosophy expands on Feigenbaum's integrative approach, as quality should be practiced by all, thus reducing reliance on quality professionals and departments (Evans and Lindsay, 2002:109). He advocates that customer requirements and ongoing education are paramount to quality processes. Quality must be the first priority and should address the root cause, not the symptoms, and the difference between goals and actions to achieve them must be understood (Evans and Lindsay, 2002:109). This can be analysed through fishbone diagrams, named after him as "Ishikawa Diagrams" and flow charts (Develin and Hand, 1995:137).

Genichi Taguchi also contributed and influenced Deming's work (Evans and Lindsay, 2002:109). He grades quality as the extent to which variation occurs about the nominal specification: smaller variation resembles better quality (Evans and Lindsay, 2002:110). He promoted test designs to identify variables, aimed at minimizing the adverse affects of uncontrollable issues on production (Evans and Lindsay, 2002:111 and Gryna, 2001:301).

2.4 IMPORTANCE OF QUALITY MANAGEMENT

Quality is important to the organization itself (i.e. an internal perspective) and to the broader external environment in which it operates (Gitlow, et al, 1999:173).

2.4.1 The internal perspective

Quality improvement can reduce costs by lowering waste (Gitlow, et al, 1999:172). Inappropriate or misguided quality improvement initiatives such as inappropriate design adjustments can, on the other hand, increase cost to an organization (Gitlow, et al, 1999:172). Quality may prolong completion, or reduced time frames may detract from the intended quality, thus quality, costs and schedules must be compatible (Gitlow, et al, 1999:172). Assessments must be undertaken regularly to ensure optimum quality management systems (Gitlow, et al,1999:178).

A hundred percent confidence level in quality rates requires a hundred percent inspection rate, but this is rarely successful, is expensive and impractical in many industries (Beckford, 1998:33). The optimum cost of quality must be determined (Juran and Gryna, 1988:4.20). Where failure costs are high, relative to total costs, and prevention costs are low, quality improvement projects should be undertaken. Where appraisal costs exceed failure costs, the appropriateness of standards may be reviewed, inspections may be reduced and sample audits can be introduced (Gitlow, et al, 1999:188), where quality is inherent to the process and the product (Beckford, 1998:33).

Industry norms on quality costs are seldom available. Quality costs should be assessed against the nature of the industry, client and the company's policy on cost reduction to consumers (Gitlow, et al, 1999: 186, 189 and 190). Some industries (e.g. pharmaceutical) may require quality at all costs. Affluent clients may be willing to pay a premium for outstanding quality, whilst some companies strive to optimize the user's cost (Gitlow, et al, 1999:190). The company's culture (opinions beliefs, traditions and practices), also play a role in addressing quality costs (Gitlow, et al, 1999:192).

Quality management increases productivity, price flexibility, competitive position, demand, profit, customer satisfaction, healthy supply chain relationships, jobs and job security (Gitlow, et al, 1999:14). It reduces rework and customer dissatisfaction and associated costs in losing customers, thus the total cost per unit (Gitlow, et al, 1999:4 and 182).

Poor quality adds costs to firms, their suppliers and customers which result from internal failure-, external failure-, appraisal- and prevention costs. (Gitlow, et al, 1999:178). Some of these costs may be more obvious than others (such as over-time, inventory costs, space, inappropriate buffers to accommodate standard variations and potential loss of sales) (Gitlow, et al, 1999:184).

> *Internal failure costs* are those found prior to delivery to the customer (e.g. scrap; rework; analysis costs; inspections, re-inspections and retesting; negligence and price reductions resulting from poor quality) (Gitlow, et al, 1999:178). It includes costs related to defective inputs such as having to stop production and unfulfilled orders, resulting in dissatisfied customers (Beckford 1998:32).

> *External failure costs* occur after delivery to the customer and include warranty charges upon replacing or repairing products under warranty; complaints handling processes and discounts for accepting a substandard product (Gitlow, et al, 1999:179).

> *Appraisal costs* result from activities to assess the degree of conformance to quality requirements (e.g. inspections; quality audits; testing equipment maintenance; and testing quality of stock) (Gitlow, et al, 1999:179). These cannot be completely eradicated as inspections are necessary to provide information for decision making and strategic direction (Beckford, 1998:3).

Prevention costs relate to attempts to minimize failure and appraisal costs, including quality planning; product reviews; quality audits; supplier quality evaluation and training (Gitlow, et al, 1999:180).

The evaluation of quality concerns, assists in (i) quantifying resultant and subsequent problems if quality is not addressed; (ii) identifying other problem areas; (iii) identifying the exact cause of quality problems; and (iv) creates opportunities to identify cost saving and customer dissatisfaction reduction initiatives (Gitlow, et al, 1999:182).

2.4.2 The external perspective

Quality management is important for economic, social and environmental reasons (Beckford, 1998:3).

2.4.2.1 Economic reasons

Enablers of global trade such as improved information and transport systems have increased markets, competition and customers' choices, making quality a necessity (Beckford, 1998:5).

Increased competition through global trade has increased low cost strategies, encouraging greater emphasis on differentiation on the basis of quality service (Beckford, 1998:7). Addressing quality problems reduces lost opportunities from an inability to meet requirements, or from imports with perceived better quality (Beckford, 1998:6). Increased quality facilitates international trade investment, which benefits the greater economy (Beckford, 1998:8).

2.4.2.2 Social reasons

Poor quality wastes human capital and talent, which demoralizes individuals and contributes to destructive anti-social behaviour (Beckford 1998:7). Such waste must be minimized to maximize employee satisfaction, thus enhancing productivity (Beckford, 1998:10).

The need for quality is equally applicable to the public sector, as observations have been made of governments and society expressing dissatisfaction with public sector cost and effectiveness (Beckford, 1998:5). The public sector is required to deliver services at the same or lower cost to meet public expectations (Beckford, 1998:10). Application of total quality management in this sector has been slow (Evans and Lindsay, 2002:75).

2.4.2.3 Environmental reasons

Increased global awareness of the finite availability of natural resources has resulted in greater awareness of environmental considerations, requiring the minimization of waste and damage to protect limited natural resources (Beckford, 1998:8). Environmental management requirements are standardized through the International Standards Organization (ISO 14000) (Burt, et al, 2003:254).

2.5 TOTAL QUALITY MANAGEMENT

2.5.1 <u>The philosophy</u>

The quality function has grown from basic manufacturing, to the entire supply chain (Gitlow, et al. 1999:168). Customers, processors and suppliers form an integrated system in which each of these are responsible for quality and commit to engage with each other to ensure continuous improvement (Gitlow, et al, 1999:170). This requires an internal and external perspective on quality (Gitlow, et al, 1999:173), with contributions from all disciplines within an organization (finance operations, marketing, and strategic planning) (Gitlow, et al, 1999:173).

Quality affects all levels of the organization (Beckford, 1998:11). Although quality targets are achieved at operational level, this needs to be done against limits imposed by the organization's strategies, which define the scope of the organization's activities. (Beckford, 1998:12 and 14). Quality cannot be achieved unless it is an inherent part of strategy (Beckford, 1998:13).

Total Quality Management (TQM) philosophy has evolved from the involvement of all stakeholders and processes (Gitlow, et al, 1999:174). TQM is a system of activities to achieve customer satisfaction, empower employees and increase revenue, all at lower costs (Gitlow, et al, 1999:174). It is based on the following principles:

(1) Customer satisfaction determines quality, thus requiring proper needs identification from the perspective of the customer (Kanji, and Asher, 1996:1), and a proper understanding of these requirements (Pike and Barnes, 1996:24). All business aspects are aligned to meet customer needs as business goals and customer needs are inseparable (Pike and Barnes, 1996:24).

(2) It is based on a sound understanding of current and required performance measurement, and decisions, problem solving and strategies based on factual information (Kanji and Asher, 1996:2).

(3) The focus is on prevention to reduce costs (Develin and Hand, 1995:6) and facilitate continuous improvement (Kanji and Asher, 1996:5).

(4) Continuous improvement is inherent. Employees must have a behavioural orientation that there is always room for improvement (Develin and Hand, 1995:8). Work processes contain elements of variation that must be reduced through continuous improvement, to achieve quality (Kanji and Asher, 1996:3).

(5) Change is inherent to continuous improvement, thus requiring strong leadership and change management (Pike and Barnes, 1996:77).

(6) People are inherent to continuous improvement processes (Kanji and Asher, 1996:3). People based management is essential to ensure they understand what is required, what needs to be done, how to do it, and be provided with feedback and encouragement to take responsibility (Kanji and Asher, 1996:2). "People work in a system. The job of the manager is to work on the system to improve it continuously with their help" (Deming, in McLaughlin, 1995:35).

(7) The process is managed by interdependent relationships of cross-functional teams (Develin and Hand, 1995:8), with members who are committed to quality,

and involves every person, process, function and department (Pike and Barnes, 1996:24).

(8) There is a common view and commitment from top management to make quality the ultimate goal (Develin and Hand, 1995:8). This is promoted in all human activities through measurement and rewards (Pike and Barnes, 1996:24).

(9) Leadership by example requires the removal of employees' fear of management in general by actively removing barriers to cooperation and trust and to encourage teamwork and reward (Develin, and Hand, 1995:10).

(10) Getting it right first time, every time, but taking cognisance of human nature where errors result due to: inadequate time to do things properly; training and incompetence; inappropriate tools; inadequate information and material; human error; and poor motivation (Develin and Hand 1995:10 and 11).

(11) A realization that the benefits of quality management, outweigh the costs (Develin and Hand,1995:12 and Juran, 1988:4.4), thus, from this perspective "quality is free ... as doing things right the first time is always cheaper" (Crosby in Evans and Lindsay, 2002:106).

2.5.2 Enablers

Total Quality Management requires an environment, in which:

(1) There is commitment and continued active involvement by top management and their continued active involvement is critical (Juran and Gryna, 1988:22.4).

(2) There is a desire to: Exceed customer requirements; improve the organization's image, employee morale, communication, and documentation; improve the design and manufacturing of products, services and the physical environment; create a common mission, adopt best practice and standardized processes; and produce uniform products at low cost, suited to the needs of the market (Gitlow, 1994:32).

(3) Mission and purpose statements, responsibilities and accountability, and policies on customer-, supplier- and employee involvement are clear (Pike and Barnes, 1996:43).

(4) An appropriate culture with sound change management systems (Pike and Barnes, 1996:43).

(5) Quality management processes are carefully planned and involve middle managers from the outset (Pike and Barnes, 1996:43). Quality improvement programmes require a comprehensive and organized approach (Juran and Gryna, 1988:22.5).

(6) Proper coordination of quality functions (Juran and Gryna, 1988:7.21). In large and unique projects this would be done by a project manager (Juran and Gryna, 1988:7.23).

(7) Producing tangible results are fast tracked (Pike and Barnes 1996:43).

2.5.3 Barriers

In spite of the benefits of quality management, many challenges need to be overcome. These include:

(1) Fixation on existing systems and procedures increase resistance to change from current systems (Beckford, 1998:22), and/or reliance on specific techniques that focus only on specific aspects (Gitlow, et al, 1999:224). Values and beliefs are reflected in performance systems and procedures that signal performance priorities to staff. It is difficult to change such entrenched beliefs (Beckford, 1998:22). Set mindsets and inability to change the organisational culture impede change management (Gitlow, 1994:33). Resistance to change limits innovation, thus is a threat to continuous improvement (Beckford, 1998:23).

(2) Organisational politics and influential subgroups within an organization impact on the successes of change management. Factions and/or followers may pursue negative views expressed by such groups (Beckford, 1998:22).

(3) Management perceptions that productivity related measurements indicate superior performance cause them to focus on production rather than quality (Beckford, 1998:22), thus focusing on conformance only and neglecting customer needs (Juran and Gryna, 1988:7.21). Performance and selection criteria need to be redesigned to take customer expectations into account (Beckford, 1998:22).

(4) Penal attitudes towards errors detected, as opposed to learning and improvement opportunity recognition, result in employees not owning up to errors and not wanting to take responsibility (Beckford, 1998:25) which result in fear of being scrutinized (Gitlow, 1994:33).

(5) Lack of commitment and discipline to change, result in an inability to maintain and sustain momentum (Gitlow, 1994:33).

(6) Resistance to standardisation and fear of rigidity result in non-adoption of quality management initiatives (Gitlow, 1994:33).

(7) Resistance to concerns of increased workload (Juran and Gryna, 1988:22.5).

(8) Lack of organization and preparation for change (Juran and Gryna, 1988:22.5) including infrastructure, goals, plans, organization implementation mechanisms, time resources and budgets (Gitlow, et al, 1999:223).

(9) Conflicting targets between quality assurance and production, where these are within the same business unit, may result in quality assurance being sacrificed for the sake of production. Quality assurance components should be independent from production units (Beckford, 1998:26).

(10) Inadequate information systems (from report generation through to executive reporting, and general communications) inhibit effective quality management (Beckford, 1998:26). Systems need to generate the right information, in the right format, at the right time and to the correct users (Beckford, 1998:26).

(11) Understanding and articulation of roles may result in inefficiencies (e.g. decision making too far removed from operations and inability of senior management to focus on higher level strategies) (Beckford, 1998:28).

(12) Lack of required resources results in implementation difficulties (Gitlow, 1994:33).

(13) Sceptic views on new programs within the organization due to previously failed and/or abandoned attempts (Juran and Gryna, 1988:22.4).

(14) Different management styles create confusion. (Gitlow, 1994:33). Management must set the example and create a culture that quality is a cause for concern (Beckford, 1998:29).

(15) Focusing on short term results, results in the use of existing performance parameters, thus losing sight of the need for continuous improvement (Beckford, 1998:29).

(16) Failure to start small and learn from pilot projects (Gitlow, et al, 1999:223).

2.6 QUALITY CONTROL PROCESSES

Quality control is a process comprising of a universal sequence of steps used to meet quality standards (Gryna, 2001:141). Deming and Juran (in Evans and Lindsay, 2002:105) define the process as follows: Define what to control; establish measurement units to evaluate data objectively; establish performance standards; conduct a gap analysis and target specific actions to address the gap. Juran also advocates the use of a detailed programme for improvement, which identifies the need and specific quality improvement projects; ensures support activities and resources are planned; diagnoses causes and remedies to address them; tests effectiveness of solutions; and includes a proper control and maintenance system (Evans and Lindsay, 2002:105).

Self-control is the ultimate form of quality control and requires people to know the job content and technique, know their performance and have a system to regulate this (Gryna, 2001:141). Measurement and establishment of standards are central to this process (Gryna, 2001:133). These should be based on the organization's mission and be informed by the results of benchmarking, balanced scorecards and quality assessments. This information is obtained through employee participation, performance planning and evaluation systems (Gryna, 2001:124). This enables a holistic approach resulting in best practice standards that informs business processes, (including operational quality planning and improvement) and the broader strategic planning within the organization (Gryna, 2001:124).

2.7 QUALITY MANAGEMENT TOOLS AND TECHNIQUES

Quality management should be informed by statistical methods, as it provides a quantitative means for analysing problems, rather than depending on opinions and subjective preferences of individuals (Oberlender, 2000:323). Various authors discuss a range of different tools and techniques, those most commonly referred to in the literature are briefly outlined in the section below.

2.7.1 Process analysis

Process analysis outlines systems and helps to identify process and quality problems (Beckford, 1998:227). It can be used to identify standards and measures for critical parts of the process, identify gaps, and unnecessary activities and duplications in processes (Pike and Barnes, 1996:204). Flow charts provide a visual representation of all the steps in a process, links between them, source of inputs and resultant outputs (Develin and Hand, 1995:141). Such a system should factually record and cover the entire process and related activities, and allow for these to be questioned and verified. New processes should not be adopted until all quality problems and causes have been exposed (Beckford, 1998:232).

2.7.2 Quality management systems

A quality management system is a systematic approach that yields a formal record of an organization's quality management method and provides a basis for measuring and monitoring quality performance (Beckford, 1998:243). The system is certified by a third party as conforming to an acceptable standard, such as the International Standards Organization (Beckford, 1998:243). The system should be accurate, robust and generate meaningful data, thus employees at the "coal face" should be involved in its development, and be committed to the system for success (Beckford, 1998:238). It should contain the organization's quality policy, procedures for implementation and procedures, described in terms of the process, rather than broad functions (Beckford, 1998:240). A record system should be included to monitor adherence to the system (Beckford, 1998 :240).

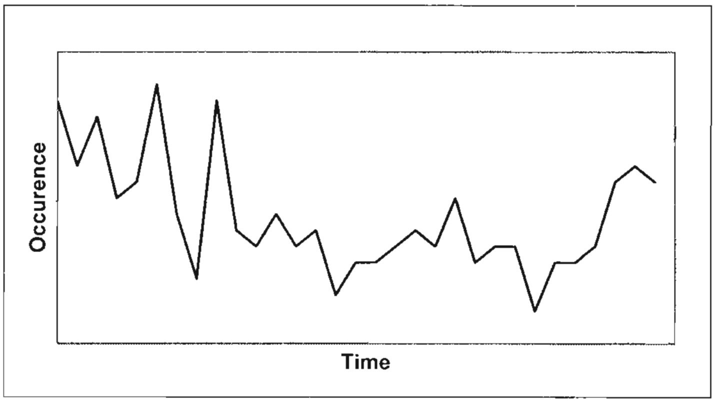
2.7.3 Statistical method

Data collection and analysis form the basis of quality assurance initiatives (Gitlow, et al, 1999:685). The collection of data may be done on a continuous measurement scale (variable data) or as a result of counting the occurrences of variations to attributes (attribute data). Various tools are available to collect and analyse data (Gitlow, et al, 1999:685). A number of computerized software programmes are available and are able to generate run charts, control charts, histograms, Pareto charts, scatter diagrams and other statistical analyses (Evans and Lindsay, 2002:729).

Statistical process control methods record and monitor the outputs of a system to identify aspects needing improvement (Beckford, 1998:255). It requires a predefined process; established measurement system and predetermined quality characteristics definitions that are understood and agreed to by all (Beckford, 1998:244). The system must indicate what is to be measured, where, recording and reporting method and timeframes (Beckford, 1998:245). It is based on performance limits against which performance is measured, taking cognizance of any input specifications (Beckford, 1998:245). Performance between limits indicates common (normal) variation where the process is deemed to be under control. Points outside the upper and lower limit indicate areas that may need intervention (Beckford, 1998:245). Causes may be common (random/chance types inherent in the process), or special (chronic cases) that need special intervention through quality improvement (Gryna, 2001:499). Gryna (2001:96) advocates that only chronic cases should be addressed through quality improvement projects.

2.7.3.1 **Run charts** (Figure 2.1 below) provide graphic representation of occurrences over time to indicate trends, cycles and other changes over time (Develin and Hand, 1995).

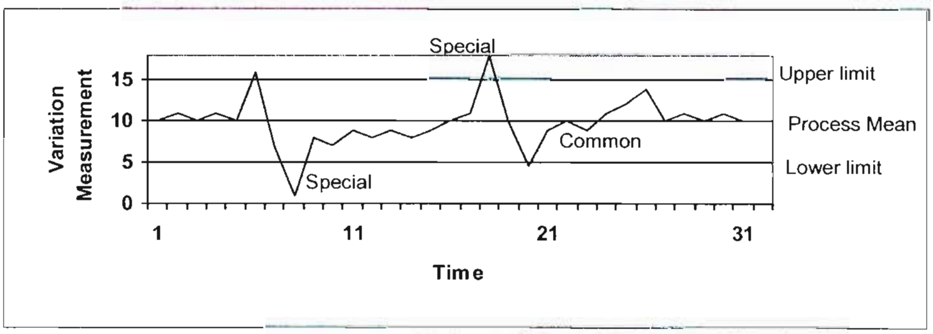
Figure 2.1 Run chart



(Adapted from Gryna,2001:248)

2.7.3.2 **Control charts** (Figure 2.2, below) are used to indicate variation that exceed set limits (Beckford, 1998:247), and to identify "special causes" needing intervention to reduce variation (Gryna, 2001:499). Upper and lower limits are normally set within 3 standard deviations from the mean (Beckford, 1998:247).

Figure 2.2 : Sample control chart



(Adapted from Evans and Lindsay, 2002:607)

Different types of charts and calculations should be used to indicate defective items or failures of components with reference to attributes, and whether constant samples or varied sample sizes can be taken (Beckford, 1998:247, Gryna, 2001:503). These charts indicate when the number of defective items or components is changing over time and differentiate between common/random variation from real variation caused by changes in a process (Kanji and Asher, 1996:194), as indicated in Table 2.1 below.

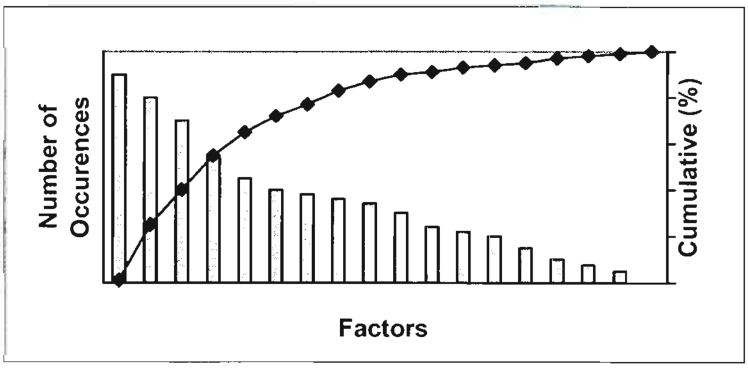
Table 2.1 : Attribute Control Chart types

	Sample Size	Chart type
Defective units	Varied	P chart
	Constant	NP chart
Component Failure	Varied (by more than 25% of the average sample size) (Kanji and Asher, 1996: 225)	U chart
	Constant (or does not vary more than 25% of the average sample size (Kanji and Asher, 1996:161).	C chart

(Adapted from Kanji and Asher, 1996:225)

2.7.3.3 **A Pareto** analysis is used to identify the most critical problems to be addressed for maximum impact (Kanji and Asher, 1996:56). The resultant charts (Figure 2.3, below), provide a graphic representation of factors in descending order of the frequency of occurrences (Develin and Hand, 1995:137), identify the starting point for problem solving, monitor progress and identify basic causes (Gitlow, et al, 1999:686). It is useful in six sigma approaches to identify critical processes (Gryna, 2001: 57, see also 7.4 below) and in supplier analysis during supplier selection (Gryna, 2001:426).

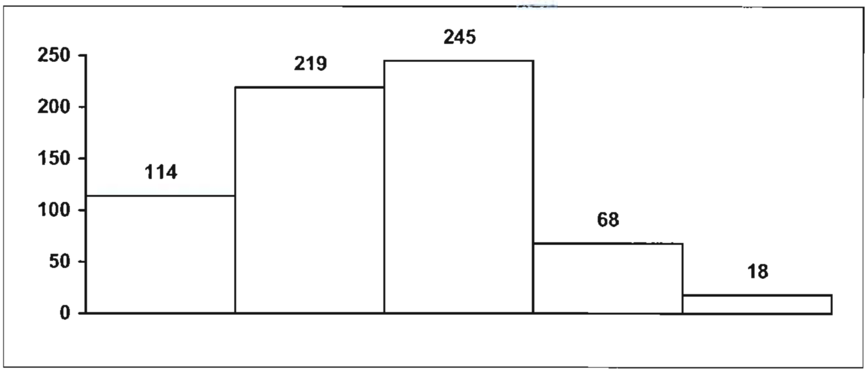
Figure 2.3 : Pareto chart



(Adapted from Develin and Hand, 1995:137)

2.7.3.4 **Histograms** (bar charts) are used to display the frequency distribution of an occurrence through the use of bar charts. It highlights the centre and amount of variation in a sample. It is simple to construct, thus effective in elementary data analysis (Beckford, 1998:251, and Gryna, 2001:244)

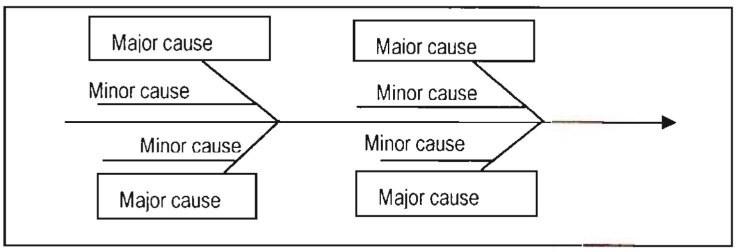
Figure 2.4 : The histogram



(Adapted from Beckford, 1998:252)

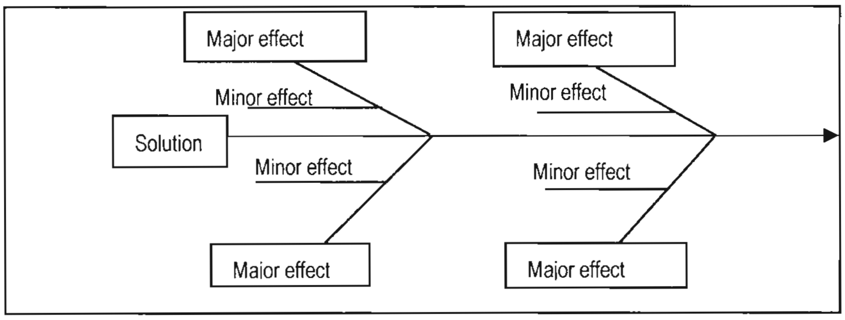
2.7.3.5 **Cause and effect diagrams** (Figure 2.5.1) are used to identify root causes of problems and indicate resultant effects. It allows for a holistic approach to problem identification and points to possible areas for investigation and data collection (Kanji and Asher, 1996:79).With adaptation the model can be used to indicate the potential consequences of proposed actions (Beckford, 1998:248), see Figure 2.5.2.

Figure 2.5.1 : Ishikawa or fishbone diagram



(Adapted from Beckford, 1998:250)

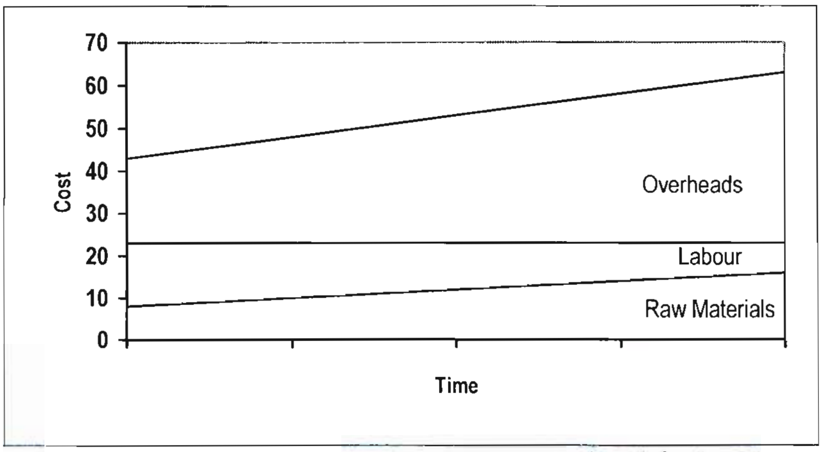
Figure 2.5.2 : Solution-effect diagram



(Adapted from Beckford, 1998:250)

2.7.3.6 **Stratification data** is presented in stratification charts (Figure 2.6). Bands of information are presented as cumulative totals of each type of occurrence to indicate which element is incurring the greatest costs, or greatest number of faults (Beckford, 1998:250). These can be used to indicate the relative importance of contributing factors to a process or problem and are typically easier to construct than Pareto charts (Beckford,1998:250).

Figure 2.6: Stratification chart

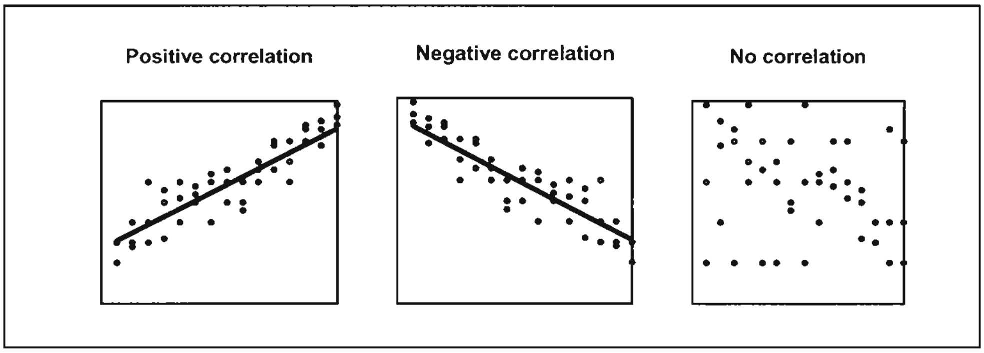


(Beckford, 1998:251)

2.7.3.7 **Check sheets** provide a simple method for collecting data on the occurrence of defects or values, in a wide range of areas (Kanji and Asher, 1996:164). It is used to collect numerical values of non-conforming aspects for Pareto analysis and/or histograms (Gitlow, et al, 1999:685).

2.7.3.8 **Scatter diagrams** are used in combination with statistical methods to determine whether there is a relationship between two variables (Develin and Hand, 1995:139). Points are plotted on a graph to ascertain whether there is a pattern in the distribution that would allow a line of best fit to be drawn with the same number of points on each side (Beckford, 1998:252).

Figure 2.7 : Scatter diagrams



(Adapted from Develin and Hand, 1995:139)

2.7.4 Six Sigma, a combined approach

Six sigma combines managerial and statistical techniques to reduce process variation (Gryna, 2001:57). Six sigma status means that a small amount of variation (denoted by a sigma) exceeds specification limits. Six standard deviations are recorded between the process mean and upper and lower limits. The closer the number of variations to six, the better (Gryna, 2001:57). The approach aims to identify, remedy and prevent future defects (Gryna, 2001:58), as does total quality management discussed earlier, thus from this perspective it is a means through which total quality can be achieved.

It comprises five phases which with reference to Gryna (2001:57-96) can be summarised as follows:

Phase 1- Definition phase: Identify and define projects and -teams (Gryna, 2001:58).

Phase 2- Measurement phase: Identify key parameters and process characteristics; data collection needs and measures current process capabilities (Gryna, 2001:63).

Phase 3- Analysis phase: Collect and analyse past and current performance data to identify causes for variation, including the development and testing of theories (hypothesis) on cause and effect relationships of variations identified (Gryna, 2001:70).

Phase 4- Improvement phase: Design a remedy to address causes of variation; test and prove effectiveness; develop and implement change management plan (Gryna, 2001:86).

Phase 5- Control phase: Ensure design and implementation of activities for maintenance and improvement of processes (Gryna, 2001:94).

Six sigma requires intensive coordination across organisational units and project improvement teams (Gryna, 2001:200).

2.7.5 Benchmarking

A benchmark is a reference point against which performance is measured. Such points may include the specification, customer desires, competition, best in the industry, and best in *any* industry (Gryna, 2001:105). Benchmarking is "a continuous, systematic process for evaluating the products, services and work processes of organizations that are recognized as representing best practices for the purpose of organisational improvement" (Spendoli, 1992:8 and Finnigan, 1996:5). It is the measurement of an organization's performance against best practices, determining how these are achieved and using this information for superior performance (Evans and Lindsay, 2002:413). It involves identifying characteristics to be benchmarked, choosing organizations or components against which to benchmark, collecting and analyzing data, determining who is considered to be the best in class, and then identifying the organization's own performance gap, relative to the benchmark partner (Gryna, 2001:105).

It is a total quality management tool for continuous improvement throughout an organization to achieve higher levels of customer satisfaction and productivity. It provides information for improving almost any business activity (Spendoli, 1992:33), and the key processes involved for competitive advantage (Finnigan, 1996:4). It forces organizations to look outside themselves and compare their business thinking, ideas and inspiration with their external environment, thus learning from the business-, industrial- and competitive environments for self-improvement (Spendoli, 1992:16).

2.7.6 Qualitative methods

2.7.6.1 Quality circles

Quality circles (workforce teams) comprise groups of people within each department who meet regularly to address quality problems within their particular components (Gryna, 2001:202). Such teams tend to focus on problems related to the personal well being of workers and their frustrations (Gryna, 2001:202). They have potential behavioural and motivational benefits that can contribute toward increased performance (Gryna, 2001:203).

2.7.6.2 Job design

People need to know the job requirements and how they should be executed, they should be suitable to the job, be trained and skilled thus also indicating the importance of proper selection and recruitment, and should be authorized to make decisions (Gryna, 2001:230). Delegation empowers people and is a motivational tool that could stimulate innovation (which is critical to continuous improvement), and illustrates management's trust in its employees (Gryna, 2001:230).

Continuous feedback on performance through effective appraisal and reward is a key element in improving work quality (Gryna, 2001:232).

2.7.6.3 Organisational structure

Recent trends indicate a shift from function based to processed based organization (Gryna, 2001:405), where quality management is assigned to all functional departments, focusing on internal and external customers. Decisions are delegated to lower levels and suppliers and customers are partners in quality improvement (Gryna, 2001:188). Upper management leads quality and is responsible for quality strategy development and implementation support (Gryna, 2001:190-192). Middle management is responsible for strategy execution; and the workforce for implementation and providing knowledge and experience type inputs (Gryna, 2001:196-7).

These trends increase coordination of quality activities (Gryna, 2001:189). Project teams could facilitate coordination and implementation of quality improvement projects (Gryna, 2001:199). Teams should comprise a project champion from upper management; team leader responsible for execution; project recorder for administrative functions; and cross functional team members (Gryna, 2001:199-200). Expertise may supplement the team to guide initial processes (Gryna:2001:201).

2.7.6.4 Supplier development and supply chain management

Poor quality component goods and services impact on the cost of quality (Gryna, 2001:403). Cost- and quality improvement in supply chain inventory management, (such as just-in-time), increase the need for quality inputs, as goods and services are provided only in the quantity and at the time they are required for production (Gryna, 2001:403). This also applies to the service sector (Gryna, 2001:403).

Gryna (2001:404) describes traditional and strategic approaches to purchasing process relationship. **Traditionally** supplier relationships are adversarial, short term, competitive and distrusting. Quality assurance is achieved through inspection on receipt. Many suppliers are used and managed, based on the norm. Purchasing plans are developed in isolation from end-users, and purchasing decisions are based on price. **Strategic** approaches use purchasing to build partnerships based on mutual trust to achieve long term symbiotic relationships that negates the need for incoming inspection. There are few, carefully selected suppliers who are managed individually. Purchasing plans are integrated with end-user requirements. The focus on purchasing decisions is on the total cost of ownership.

Burt, et al (2003:80-87) describe a continuum of three different types of supplier relationships, i.e. transactional, collaborative, and strategic alliances. The characteristics of each are briefly summarised in Figure 2.8, below.

Figure 2.8 Characteristics of Three types of Relationships

Continuum of Buyer-Seller

<table>
<tr><th>Type of Relationship</th><th>Transactional</th><th>Collaborative</th><th>Alliance</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Characteristic</td><td>Little or no concern about the other party's well-being. Win-lose orientation (Burt, et al, 2003:81)</td><td>An awareness of interdependence and necessity of cooperation and recognition of the benefits that this provides (Burt, et al, 2003:83).</td><td>Institutional trust (shared information on strategic plans, relevant cost information and forecasts; risks and rewards addressed openly and informal agreements are viewed as good as formal ones (Burt, et al 2003:84))</td></tr>
<tr><td>Communication</td><td colspan="2">High potential for problems</td><td>Systematic approach to enhance communication</td></tr>
<tr><td>Competitive Advantage</td><td colspan="2">Low</td><td>High</td></tr>
<tr><td>Connectedness</td><td colspan="2">Independence</td><td>Interdependence</td></tr>
<tr><td>Continuous Improvement</td><td colspan="2">Little</td><td>A focus</td></tr>
<tr><td>Contributions to New Product Development</td><td colspan="2">Few</td><td>Many early supplier involvement</td></tr>
<tr><td>Difficulty of Exit</td><td colspan="2">Low</td><td>Difficult, high impact</td></tr>
<tr><td>Duration</td><td colspan="2">Short</td><td>Long</td></tr>
<tr><td>Expediting</td><td colspan="2">Reactive</td><td>Proactive</td></tr>
<tr><td>Focus</td><td colspan="2">Price</td><td>Total cost</td></tr>
<tr><td>Level of Integration</td><td colspan="2">Little or none</td><td>High or total</td></tr>
<tr><td>Level of Trust</td><td colspan="2">Low</td><td>High</td></tr>
<tr><td>Number of Suppliers</td><td colspan="2">Many</td><td>One or few</td></tr>
<tr><td>Open Books</td><td colspan="2">No, secrecy</td><td>Yes, mutual visits, disclosures and assistance</td></tr>
<tr><td>Quality</td><td colspan="2">Incoming inspection, conformance to specification</td><td>Designed into system, fitness for use, continuous improvement.</td></tr>
<tr><td>Relations</td><td colspan="2">Inward looking, arms length</td><td>Concern with each other's well being</td></tr>
<tr><td>Resources</td><td colspan="2">Few, low skill level</td><td>Professional</td></tr>
<tr><td>Service</td><td colspan="2">Minimal</td><td>Greatly improved</td></tr>
<tr><td>Shared Forecasts (Plans)</td><td colspan="2">No</td><td>Yes</td></tr>
<tr><td>Supply Disruptions</td><td colspan="2">Possible</td><td>Unlikely</td></tr>
<tr><td>Technology Inflows</td><td colspan="2">No</td><td>Yes</td></tr>
<tr><td>Type of Interaction</td><td colspan="2">Tactical</td><td>Strategic synergy</td></tr>
</table>

(Adapted from Burt, et al, 2003:80, and Evans and Lindsay, 2002:405)

None of these relationships are good or bad (Burt, et al, 2003:81), and few are true to the type (2003:87) (hence a continuum). Collaboration and alliance relationships complement continuous improvement (Gryna, 2001:418). The CIDB (2006:4) indicates that a range of strategies should be available that would accelerate project completion times; provide shared incentives and shared risk; and allow phasing of work over longer periods of time. Burt, et al (2003:86-87) indicate several factors to be considered in determining the appropriate type of relationship, summarised in Table 2.2, below:

Table 2.2 Criteria in Selecting an Appropriate Relationship

Characteristic	Relationship
Many relatively undifferentiated suppliers providing interchangeable commodities.	Transactional.
Supplier has economic power and is willing to exert this over its customers.	Transactional or very carefully developed and managed collaborative.
Both parties recognize potential benefit of alliance but lack human resources.	Collaborative.
Desire to progress to strategic alliance.	Collaborative is the appropriate first step.
Supplier is superior in providing value (including price, innovation, adaptability, capacity, etc.).	Alliance.
Supplier is strategic to the organization's performance as it has a major impact on, and is a critical element in performance.	Alliance may be vital.
There are potentially great benefits to integrating supplier with the organization (e.g. shared ideas, resources, and product development initiatives).	Alliance.
Require high degrees of flexibility and speed of performance, due to customer requirements.	Alliance.

(Adapted from Burt, et al, 2003:86)

This indicates that there are areas where strategic alliances may be less appropriate, hence some companies segment their suppliers into categories based on their importance to the business, and manage them accordingly (Evans and Lindsay, 2002: 405).

Supply and purchasing management also involves specification of requirements; selection of suppliers; and management of the supply chain (Gryna, 2001:406). These are discussed briefly in the section below. The relevant specifications in the context of low-income housing in South Africa are discussed in the next chapter.

(a) Specifications and standardisation

"Specifications and standardisations are related topics in supply chain management" (Burt, et al, 2003:237).

"*Specifications* are targets and tolerances determined by designers of products and services. Targets are ideal values for which production is to strive; tolerances are specified because designers recognize the impossibility of continuously meeting targets in manufacturing (Evans and Lindsay, 2002:13). The degree of conformance to specifications, within the prescribed tolerance of deviation, is a means of defining quality (Evans and Lindsay, 2002:13).

Specifications are broadly categorised as simple or complex. Most firms use a combination. Specifications must be clear for the correct procurement of goods and services. They should concentrate on minimum requirements for cost effectiveness, as unnecessary precision adds risk and costs to suppliers, which in turn increases costs to the purchasing firm. This can be countered through standardized products (Burt, et al, 2003:251).

Standardisation is related to specification and can reduce cost and enhance quality. (Burt, et al, 2003:253). It can significantly improve efficiencies in time and cost of delivery of projects and improve quality and end user satisfaction (CIDB, 2006:8). Standardisation is performance goals for product and process features that are legitimate, customer focused, measurable, understandable, aligned and equitable (Gryna, 2001:132). ISO defines it as "documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products and services are fit for their purposes (Evans, et al, 2002:132). It is "a uniform identification that is agreed on" (Burt, et al. 2003:252).

Two broad types are found : (i) Industrial standardisation establishes agreed uniform specifications for "define characteristics of quality, design, performance, quantity, service and so on", and (ii) Managerial standardisation focuses on operating practices, procedures and systems" (Burt, et al, 2003:152). It is a means of reducing the number of variations in materials and components to reduce costs (Heizer, et al, 2004:424). Three sources exist: international; national and industry; and company standards (Burt, et al, 2003:253).

(1) International standards

The International Standards Organization (ISO) develops standards through its technical committees that are usually accepted world wide. These are developed through consultation with other national standards authorities such as the American National Standards institute (ANSI), German Institute for Standards; and British Standards Institute (Burt, et al, 2003:253). These standards have facilitated international trade as it provides a benchmark for acceptable quality process (ISO 9000) and environmental (ISO 14000) standards world wide (Burt, et al, 2003:254). The content of the ISO 9000 series is summarised in Table 2.3, below.

Table 2.3 : ISO: 9000 Standards

ISO Reference Code	Content
9000	Quality Management Systems - Fundamentals and Vocabulary.
9001	Quality Management Systems - Requirements.
9004	Quality Management Systems – Guidance for Performance Improvement.
19011	Environmental Management.

(Adapted from Evans and Lindsay, 2002:133 read with Burt et al, 2003:254)

(2) National and industry standards

Many countries develop their own standards with industry stake holders, and taking cognizance of international standards (Burt, et al, 2003:254). In the South African context, this includes the South African National Standards, as is more fully discussed in Chapter 3.

(3) Company standards

Companies may develop their own standards (Burt, et al, 2003:254). The National "*Norms and Standards for Low-income Housing*" of the National Department of Housing is such a standard.

(b) Selection of suppliers

The selection of suppliers involves "make or buy", and "in-source or outsource" decisions (Gryna, 2001:409). Outsourcing could facilitate superior quality and lower costs where an organization cannot easily develop or maintain elements. Core competencies should not be outsourced as this could expose the organization to exploitation (Gryna, 2001:410). Supplier selection (in addition the relationships issues outlined in Figure 2.8 and Table 2.2, above), should be based on: reputation of the supplier; qualification testing/screening (e.g. samples) facilities survey and supplier databases (Gryna, 2001:411).

Selection processes should consider the supplier's quality survey and evaluation processes (e.g. quality certification, warranties and inspection results of the product) (Gryna, 2001:412). Assessment criteria will depend on the product or service to be procured (Gryna, 2001:412). It may include management philosophy, commitment to quality, design aspects, manufacturing facilities and management, purchasing policies, quality management and coordination, inspection and tests, data and information management, and personnel performance results (Gryna, 2001:413). ISO9000 could assist such surveys (Gryna, 2001:414).

(c) Management of the supply chain

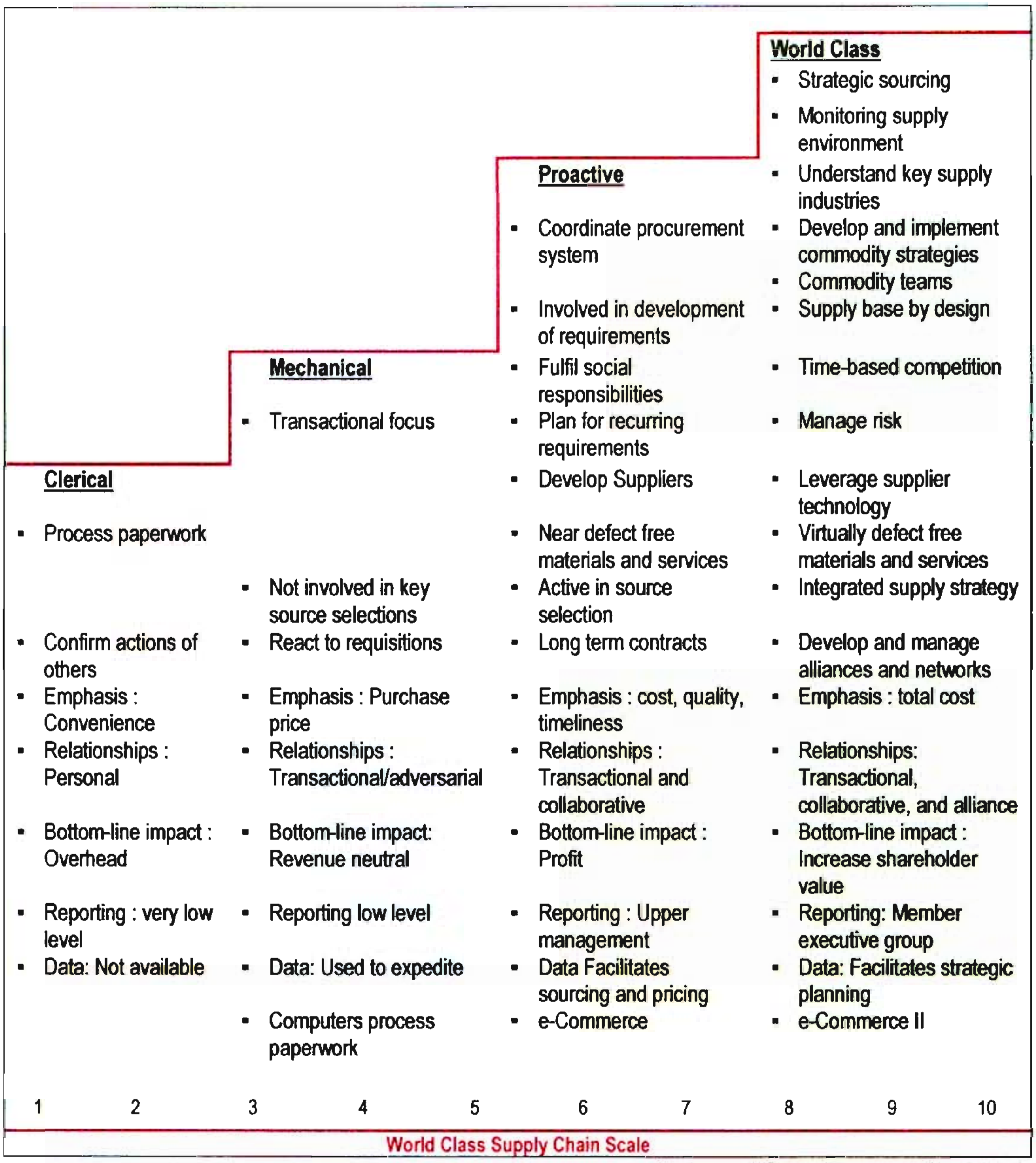
Management of the supply chain is affected by the quality of the relationship with suppliers and selection criteria (Gryna, 2001:428). Trends are moving towards partnerships in supply chain management and quality (Gryna, 2001:415). These partnerships can be facilitated through joint economic and technological planning (Gryna, 2001:416) and cooperation in execution of contracts (Gryna, 2001:418).

Joint economic planning should identify value adding activities rather than focusing on conformance to specification, to improve or maintain quality at lower costs. It should reduce ownership costs by identifying costs over the life cycle of the product to identify opportunities in order to reduce these in the interest of both partners (Gryna, 2001:416).

Joint technological planning should strive for a shared understanding of all requirements, (specifications and interpretations, processes, quality control and inspection requirements) and systems that are required to provide continuous and timely feedback, and responses (Gryna, 2001:417).

Effective supply chain management requires proper supply, demand and logistics management (Burt, et al, 2003:622). *Supply management* includes the effective management of suppliers, supplier networks and relationships with them (Burt, et al, 2003:623). *Demand management* seeks to ensure effective planning and management of information for procurement, deliveries and processes, between buyers and suppliers, to ensure a continuous flow of goods and services at the time, place and quantities in which they are needed (Burt, et al, 2003: 627). *Logistics management* focuses on the effective flow of goods from the point of origin, through the supply chain, to consumption (Burt, et al, 2003:634). Organizations achieve different levels of mastering world class supply chain management (Burt, et al, 2003:7), as summarised in Figure 2.9, below:

Figure 2.9: The Progression to World Class Supply Chain Management



(Adapted from Burt, et al, 2003:8).

Supply chain quality control is an integral part of the process and focuses on ensuring cooperation in the execution of contracts, supplier certification and rating, and quality measurement for supplier relationships (Gryna, 2001):418. Supplier product delivery is typically evaluated through different levels of inspection, as summarised in Table 2.4, below:

Table 2.4 Methods of evaluating supplier product

Method	Approach	Application
100% inspection	Every item is evaluated against some or all elements in the specification.	(1) Critical items where costs is justified by cost of risk of defects. (2) To establish quality level of new suppliers.
Sampling	Sample selection based on predefined sampling plan, and decision made to accept or reject, based on sample.	Important items where supplier has good quality track record.
Identifying inspection	Product examination to ensure correct delivery, only.	Less important item where quality record and supplier laboratory reliability has been established.
No inspection	Self explanatory.	Standard, non-critical items, not used in the product.
Supplier data (certification)	Supplier data or certification is used, thus no inspection based on certification from supplier.	Items where supplier has strong quality control record.

(Adapted from Gryna, 2001:419)

The choice of evaluation method will depend on factors such as (Gryna, 2001:420):

(1) Supplier's track record;

(2) Importance of the component part in overall performance and/or later operations;

(3) Warranty or use history;

(4) Supplier process capability and overall capacity;

(5) Nature of the process;

(6) Product homogeneity (e.g. greater homogeny requires smaller sample sizes); and

(7) Availability of required inspection skills, equipment and resources.

Proper measurement of the supplier, coupled with communication, feedback and awards, is critical (Evans and Lindsay, 2002:405). This requires ongoing surveillance and rating of supplier quality with appropriate measures (Gryna, 2001:419). These measures may include percentage of product not conforming; overall product quality; delivery against schedule; cost of defective products (including hidden cost) against purchase price), and other quantitative means that reflect critical supplier elements in relation to business outputs (Gryna, 2001:423).

2.8 SUMMARY

In this chapter different quality management definitions are put forward. Recent trends view quality management as an integrative process that involves the entire supply chain. It is applicable to both products and services, and both public and private enterprises. Evidence of its applicability to housing is found in the code of Hammurabi, circa 2000BC.

There are a number of tools and techniques available to assess quality and to set procedures in place to ensure continuous improvement. These should not be used in isolation, but should be combined to ensure proper analysis and appropriate application. The quality management process, however, cannot succeed unless there is sufficient and continued support from top management to the extent that quality management must be part of the organization's strategy, implementation and measurement systems.

There appears to be a progressive move towards partnerships with suppliers, but the nature of the task at hand, complexity, and capacity issues need to be evaluated first to assess the appropriate relationship type. Ideally, quality must be planned throughout the supply chain and integrated between buyers and suppliers at the point of interface. Standards and specifications have a role to play in ensuring performance, both from the perspective of the customer, and evaluation of suppliers, to ensure customer requirements are met.

The next chapter seeks to address the relevance of these in the context of housing.

CHAPTER 3 : QUALITY MANAGEMENT IN HOUSING

3.1 INTRODUCTION

The previous chapter dealt with the theoretical framework relating to quality management. This chapter provides an overview of recent research on quality management in the context of housing, and attempts to identify how it has been applied to low-income housing.

Quality management in housing is not new. The Code of Hammurabi, 2000BC stated that "if a builder has built a house for a man, and his work is not strong, and the house falls in and kills the householder, that builder shall be slain" (Gitlow, et al, 1999:15). Around 1450 BC quality control of component parts was undertaken by Egyptians and Aztecs (Central America) by inspecting and measuring the squareness of blocks (Gitlow, et al, 1999:15).

3.2 AN INTERNATIONAL PERSPECTIVE

Most recent international research relating to low-income housing has focused on slums clearance, upgrading of human settlement, and integrated development (International Housing Research Network website). The following international research and applications illustrate quality management in the context of housing:

3.2.1 <u>United States of America</u>

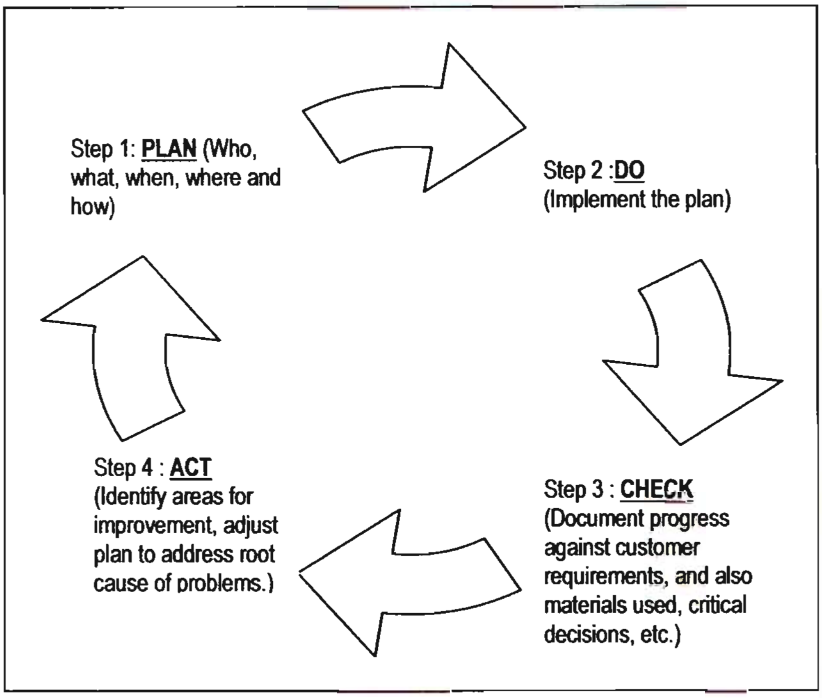
The NAHB Resource Centre (National Association of Homebuilders) has developed a quality assurance programme to assist industry leaders to deliver quality houses. It is the leading resource in America for quality related information in residential construction (NAHB Resource Centre, undated: paragraph 2). NAHB Resource Centre, American Department of Housing and Urban Development and other industry stakeholders, have developed quality certification programs. These include independent audits and reviews to verify compliance with quality assurance programs (NAHB Resource Centre, 1997a: paragraph 2). The NAHB Resource Centre literature covers a wide range of quality assurance matters, including general information, inspections and partnerships (NAHB

Resource Centre, 2005b: paragraph 2). These will be discussed briefly in the section below.

3.2.1.1 NAHB Resource Centre Quality Assurance Systems

NAHB Resource Centre advocates that the ISO 9000 quality assurance standard be implemented through the "Deming wheel" system of Plan, Do, Check and Act, (NAHB Resource Centre, 2005a: paragraph 4 and Gryna, 2001:127) as indicated in Figure 3.1, below:

Figure 3.1 : NAHB Quality Assurance System Approach



(Adapted from NAHB, 2005a: paragraph 4 and Gryna, 2001:127)

NAHB Resource Centre (2005c: paragraph 1) notes that customer expectations in the building industry are increasing. Some builders address this by additional inspections which increase construction costs. The Resource Centre suggests that this can be reduced drastically by "building it right first time" (NAHB Resource Centre, 2005c: paragraph 3), as advocated by Crosby in Lindsay and Evans, (2002:106).

Proper quality plans are needed for this. These should address: Clearly defined specifications and required results; quality craftsmen with training, demonstrated skills, experience and abilities that have been certified and verified; approved materials with performance certification; proper tools and equipment; and a documented process (NAHB Resource Centre, 2005c:paragraph 4).

The Resource Centre (2005d: paragraph1) advises that "quality doesn't cost – it pays", thus supporting Crosby's notion of "quality is free" (Evans and Lindsay, 2002:107). The Resource Centre advised that findings from a survey indicated that quality assurance programmes reduced "call-backs" for some contractors by 50%, reduced operating costs, and improved builder satisfaction ratings (NAHB Resource Centre, 2005e: paragraph1). This involves the inclusion of continuous improvement into work plans (NAHB Resource Centre, 2005d: paragraph 4).

A formal quality assurance programme is critical in demonstrating that, in the event of a lawsuit, every reasonable effort has been made to ensure quality construction (NAHB Resource Centre, 2005f: paragraph 7). ISO 9000 is often used by lawyers to determine quality negligence. The following are often called into evidence, and are elements of a sound quality assurance system (NAHB Resource Centre, 2005f: paragraph 3):

(1) Well defined specifications (drawings/designs, construction details and materials, tolerances, etc).
(2) Detailed work procedures.
(3) Recruitment and qualification criteria of labour.
(4) Pre-work-, compliance- and completion inspection systems.
(5) Corrective and evaluation systems.
(6) Documented proof that the system is applied consistently, e.g. inspection records.

(NAHB Resource Centre, 2005f: paragraph 3)

The Resource Centre suggests a, "100%, Zero defects" approach to housing delivery (NAHB Resource Centre, 1997a: paragraph 3). Buyers assess quality at the time of delivery. Faith in the builder is lost once customers detect defects before they are fixed. The hundred percent, zero defect approach (by Crosby Evans and Lindsay, 2002:106), in the context of house construction, suggests houses be inspected for defects, documented (snagged) and fixed before final inspection by the customer. This increases customer satisfaction, referral rates and trust, that problems would be addressed, if any, whilst also reducing warranty items to resolve (NAHB Resource Centre, 1997a: paragraph 3).

It also recommends the following be maintained on site to ensure high performance:

(1) Detailed installation instructions (including step-by-step illustrations and work procedures, tolerances, environmental conditions, specialized tools, storage requirements and limitations on use);
(2) Approved materials lists described in detail (by brand, type, dimensions, etc);
(3) Craftsmen qualification requirements defined in detail;
(4) Standard contracts, clearly defining expectations, roles and responsibilities;
(5) Jobsite inspection forms to be completed at specified inspection points, and to include critical job conditions, materials used and state of satisfaction of work completed; and
(6) Quality manual, consistent with the requirements of ISO 9000.

(NAHB Resource Centre, 2005g: paragraph 1).

The above forms part of ISO 9000 recommended quality assurance programmes that includes: (1) quality controls that should ensure qualified materials and clear installation procedures are followed, and qualified installers are used; (2) a list on site specifying tasks to be performed and person/s responsible; (3) specified quantities and qualities of products and monitored and documented usage; (4) sales and other that clearly describe work requirements, roles and responsibilities; (5) availability of competent staff to read the contract and ensure that obligations are fulfilled correctly; (6) construction specification and specific instructions; (7) jobsite inspections with findings and corrective measures documented on checklists; and (8) periodical audits of quality systems and work progress must to ensure adherence, and to effect improvements, (NAHB Resource Centre, 1997b: paragraph 5 and 1997c: paragraph 1).

3.2.1.2 NAHB Resource Centre on inspections

Continuous improvement should form part of "work in progress" inspections thereby greatly reducing problems on snag lists (punch lists) (NAHB Resource Centre, 2005h: paragraph 4). This can be achieved by:

(1) Inspecting work of all trades against specifications, as work progresses.

(2) Attending to repairs as work progresses.

(3) Walking the house often as it nears the completion stage.

(4) Testing appliances, tubs and fixtures.

(5) Ensure finer details and clean ups are attended to at defined stages.

(6) Record and review findings to improve systems.

(NAHB Resource Centre, 2005h: paragraph 6).

Quality inspection checklists are useful to ensure critical items are addressed (NAHB Resource Centre, 2005i: paragraph 1). Inspections should be a verification process that work has been completed correctly against designs and specifications and in terms of the scope of work, by qualified personnel, with the correct type, quantity and quality of materials, and that any quality problems have been addressed (NAHB Resource Centre, 1997b: paragraph 15). The aforementioned should be included in standardized check lists that should provide information on the site establishment, start date, product description, and state of readiness for work to commence (including suitability of building and environmental conditions that may affect quality) (NAHB Resource Centre, 2005i: paragraph 3).

Current non-routine problems may be addressed through "hot spot" checklists that need specific interventions. "Hot spot" check lists and inspections are tailored to address extraordinary situations that could impact on quality performance. Once the problem is resolved, the item is removed from the checklist (NAHB Resource Centre, 2005j: paragraph 4, bullet 6).

Inspection efforts should not be duplicated unnecessarily as these add unnecessary costs. ISO 9000 provides some guidance with regard to inspection frequency, which could reduce dependency on inspections, and "by doing the job right the first time" (NAHB Resource Centre, 2005c: paragraph 2).

The Resource Centre (NAHB Resource Centre, 2005k: paragraph 2) cautions against the use of building practice that is considered normal, but incorrect (such as incorrect roof ties and truss attachments and framing techniques). Building techniques can vary widely.

“Self”-inspection could ensure that a contractor’s own practices adhere to recommended building codes (NAHB Resource Centre, 2005k: paragraph 3).

The role of inspection staff and supervisors must not be underestimated as they can provide valuable inputs in quality improvement efforts, problem and solution analysis, change management systems and feedback on quality management effectiveness. The responsibility for improving production systems and leading quality improvement should remain with management, but inspection staff and supervisors should be engaged in these efforts (NAHB Resource Centre, 2005l:paragraph 3).

Quality inspectors at production level should be transformed to quality managers that take ownership of construction processes and quality improvement initiatives, through reliable processes aimed at delivering defect free units. This involves developing process thinking, problem solving and quality control system skills (NAHB Resource Centre, 2005m: paragraph 6).

3.2.1.3 NAHB on partnerships

Leadership is essential to setting consistently high performance standards and achieving quality and performance excellence (NAHB Resource Centre, 2005n: paragraph 7). This can be facilitated through partnerships. These should include product manufacturers, as quality products and proper installation are a foundation for quality in the end product (NAHB Resource Centre, 2005g: paragraph 2).

Collaborative efforts that focus on skills development also contribute towards quality efforts. This should include joint efforts to secure quality craftsman training, both from trade schools and product manufacturers; collaborative quality and safety plans that details all resources, qualifications and specifications and inspection requirements; and define inspection and control systems and interaction (NAHB Resource Centre, 1999b: paragraph 2).

The Resource Centre supports the PATH initiative (Partnership for Advancing Technology in Housing), that aims to improve housing durability and reduce maintenance cost by 50% by 2010. This includes “reducing the cost of home ownership, improving energy efficiency and environmental performance of new and existing homes and reducing failures due to natural disasters (NAHB, 1999c:2). Durability in this sense relates to the expected service life of a house or component parts under standard conditions of use with standard maintenance (NAHB, 1999c:3).

Baselines for durability performance must be set, and strategies need to be adopted in partnership with manufacturers and users of building materials. These should include improving the performance of existing products and materials; ensuring selection and use of more durable products; minimizing premature failure due to manufacturing and installation problems; and encouraging preventative maintenance and early detection of maintenance areas needing attention (NAHB Resource Centre, 1999c:5-7). The Resource Centre recognizes that home owners and occupants have varied levels of skills in attending to maintenance issues and recommends that businesses consider this as an additional service that could assist owners in extending the durability of their homes (NAHB Resource Centre, 1999c:7).

The above illustrates that total quality management is applicable to housing construction and provides many benefits. In spite of this, quality issues still prevail in low-income housing, especially rental schemes where landlords refuse to repair and maintain buildings, even though inspections are done (Clampet-Lundquist, 2003:135).

3.2.1.4 Mixed income developments and Quality

Smith (2002:2) suggests that mixed income housing developments can de-concentrate poverty and contribute to delivering affordable units of high quality. He states that low-income housing in America is stigmatized as poor quality high density developments with standardized designs, providing little private space, for the lowest income groups (2002:10). He suggests that mixed income developments may contribute to high quality units and subsequent maintenance of these developments to a higher standard (2002:11). This is postulated on the theory that such developments need to attract a variety of income groups, thus having to raise the standard to attract higher income earners that seek market rated designs. Likewise maintenance is likely to improve as landlords need to ensure that the expectation of higher income earners are satisfied (Smith, 2002:11).

This approach requires careful consideration of environmental factors such as the condition of the housing market, nature of the target market, population dynamics, financing, size of project, community dynamics and feasibility of income mixes (Smith, 2002:2).

3.2.1.5 Housing quality and health

Krieger and Higgins (2002:758) identify substandard housing as a major public health issue as scientific evidence has demonstrated a relationship between housing and health, and substandard housing and increased risk of chronic diseases. Substandard housing is associated with the lack of safe drinking water, absence of hot water for washing, ineffective waste and food disposal and carriers of disease (Krieger and Higgins, 2002:758). Crowding and lack of housing in temporary shelters are found to contribute to respiratory diseases and the spread of tuberculosis (Krieger and Higgins, 2002:758).

Conditions resulting in damp, such as overcrowding in units and water penetration, nurture an environment for mites and cockroaches, viruses and molds, which increase respiratory diseases such as asthma, as well as recurrent headaches, nausea, vomiting and sore throats. Children with asthma exposed to these conditions have an increased risk to hospitalization, whilst mouse allergens increase morbidity (Krieger and Higgens, 2002:758), whilst such poor living conditions and health impact on mental health (Krieger and Higgins, 2002:759). Injuries occur more commonly in low-income housing due to exposed heating sources, unprotected upper-storey windows and low sills, slippery surfaces, poorly designed stairs and poor lighting; coupled with a lack of resources to repair them (Krieger and Higgins, 2002:759-760).

The above factors result from structural defects that permit entry of cockroaches and rodents; leaking pipes; inadequate food storage and disposal facilities; inefficient thermal qualities; toxic substances such as lead in paint and other volatile particle substances (e.g. particle board and floor coverings); asbestos exposure; and poor ventilation (Krieger and Higgins, 2002:759).

Krieger and Higgins (2002:763) suggest that this calls for enhanced housing codes, to include health factors to new and existing stock, and greater involvement of public health departments. The article however, also demonstrates the need for quality management to be implemented in low-income housing and to include health aspects in standards and specifications, thus for public health departments to become partners in housing quality management.

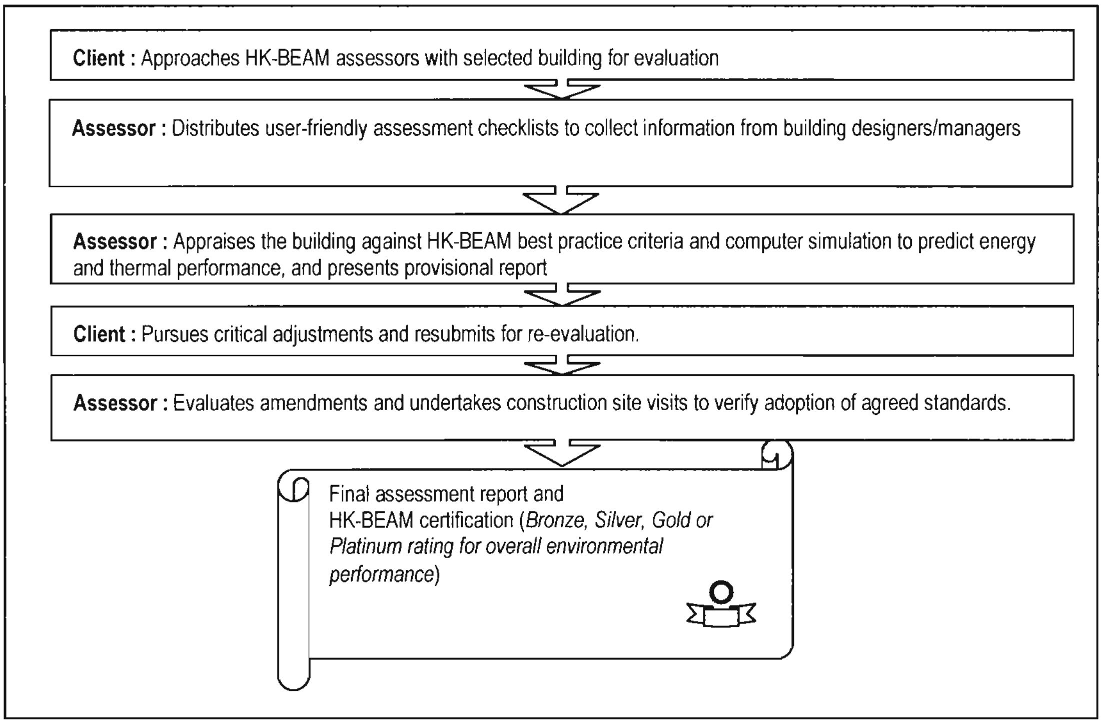
3.2.2 Hong Kong

Environmental management and sustainability has received growing attention in Hong Kong and has been incorporated into government policies. Programmes have been developed to replace old housing stock with more environmentally and financially sustainable housing (Keung and Edmunds, 2004:2), thus improving quality.

The Hong Kong Building Environment Assessment Method (HK-BEAM), has played an important part in achieving these objectives. HK-BEAM was established in 1996 as an independent certification programme aimed at stimulating sustainable and environmental friendly developments and meeting its requirements through "best environmental practice" (Keung and Edmunds, 2004:11 and 2).

HK-BEAM has developed standards for both new and existing developments. (Keung and Edmunds, 2004:3). The most significant environmental issues are assessed at each stage of the building's life cycle, from planning through to construction (Keung and Edmunds, 2004:5). It includes site and locational aspects; material selection (including usage and waste management); energy use; water consumption (including quality and conservation); indoor environmental quality (such as thermal comfort, air, lighting, and noise); and innovation (Keung and Edmunds, 2004:6). The process of evaluation is summarised in Figure 3.2, below.

Figure 3.2 : The HK-BEAM Assessment Process



(Adapted from Keung and Edmunds, 2004:4)

HK-BEAM has assisted in increasing the sustainability and efficient use of resources in housing in Hong Kong, through partnerships with all stakeholders in the building industry (Keung and Edmunds, 2004:11). This sustainability is seen as a key to becoming a world class city (Keung and Edmunds, 2004:10).

3.2.3 Singapore

The Singapore government provides low cost housing to low-income groups through its Housing Development Board. Its policy (including aspects of design, construction and renewal programmes) is driven by community dynamics and sustainability (Meng and Yin, 2004, paragraphs 1 and 2). It aims to promote community bonding and building by meeting the needs of the community. Developments are aimed at ensuring lifetime homes, which are facilitated through ongoing research into new housing forms to ensure community needs are met (Meng and Yin, 2004, paragraph 3), thus ensuring quality.

Programmes are in place to replace old units, aimed at improving quality and amenities on par with new ones. This is facilitated by pre-cast technology which reduces disturbance of the family, reduces cost and other inconvenience factors, thus increasing the speed of delivery (Meng and Yin, 2004, paragraph 4).

Designs are aimed at improved convenience, accessibility and design efficiency (Meng and Yin, 2004, paragraph 3). Family units are self contained flats with ample living space, a kitchen and bathroom. There are different size options and the needs of the elderly are accommodated in elderly friendly features such as barrier free entry and non-slip tiles (Meng and Yin, 2004, paragraph 3). This is similar to aspects of the Department of Housing's urban renewal programme of renewing old buildings, but this is not as "generous" as the Singapore policy.

3.2.4 Namibia

Namibia is focusing its low-income housing policy on informal settlement upgrades (The World Bank, 2002:7). Quality is controlled in terms of National policy which requires:

(1) minimum sanitation of a communal toilet within 30 meters;
(2) access to communal potable water within 200 meters;
(3) roofed structure of durable materials of not less than $6m^2$;
(4) minimum plot size of $300m^2$ unless consented to by the Minister where justified by design, implementation or marketing concepts.

(The World Bank, 2002:8).

In addition to this, the Windhoek City Council has set the following principles and guidelines:

(1) Services in all development options should be based on reasonable health standards.
(2) Appropriate technical development levels to be used.
(3) Reasonable social acceptance and understanding of development concepts and options.
(4) Promotion of community initiative and responsibility to gradually improve developments, in order to manage and optimize financial and institutional resources.
(5) Permanent ownership forms to be promoted.
(6) Minimization of financial risk to the Council and its clients.

(7) Standardized, yet flexible costing, pricing and administrative systems for land sales and leases to be applied.

(8) Optimization of all natural, human and financial resources.

(9) Environmental, social and financial sustainability to be ensured.

(10) Full cost recovery and "the user pays" should be the underlying principle of low-income programmes.

(The World Bank, 2002:14).

Six different levels of development packages have been formulated, with different levels of services, for different target groups to ensure affordability (The World Bank, 2002:14). The top-down setting of standards/service levels may lead to inappropriate service levels which are not affordable to the greater majority, and waste occurs in the provision of infrastructure and services that people don't need. This highlights the need to involve communities in the planning and implementation of housing schemes that affect them (The World Bank, 2002:18).

3.3 LOW-INCOME HOUSING QUALITY MANAGEMENT IN SOUTH AFRICA

3.3.1 Research initiatives

The South African government's policy on housing for the poor (1994) was originally based on maximising the volume of delivery. Many stakeholders have raised concerns regarding the resultant quality of units that have been delivered (Department of Housing, undated*(a)*:1, and Sisulu, 2005a:5). This study is informed by the following research initiatives:

3.3.1.1 CSIR (Council for Scientific and Industrial Research)

The CSIR is a statutory body which undertakes research in a number of fields, including infrastructure, materials, engineering and technology (CSIR, 2005a: paragraph 1). Its research focus is more on the technical aspects, product innovation and suitability of alternative construction materials and building practice (CSIR, 2005b: paragraph 1).

3.3.1.2 Construction Industry Development Board (CIDB)

The Construction Industry Development Board (CIDB) has suggested best practice for labour intensive technology for earthworks and pre cast concrete products, bricks and block making. Both guides include best practice suggestions to ensure proper tools and inspections are undertaken (CIDB, 2005:15). It also incorporates building standard requirements of the South African Standards (SABS/SANS), and provides a template for inspections and recommended quality control checks. This includes items; (materials, production and other operations), properties; tests and its sources; and frequency (CIDB, 2005:19). The CIDB has also developed supplier improvement programmes, screening and registration, to improve quality in the construction industry (Hodgson and Milford, 2005:7).

The CIDB has also published *"Inform practice notes"* to guide implementers on best practice principles in construction procurement and delivery (CIDB, 2006:1). Whereas the construction output needs to double in volume over the next 5 to 10 years, the first practice note "identifies systematic problems and outlines approaches to contracting strategies that increase the size and duration of contracts to enable enhanced delivery and the efficient use of resources; and sustainable enterprise growth, employment, workforce skills development and sustainable empowerment" (CIDB, 2006:1).

It suggest that a range of contracting options be used that would accelerate project completion times; provide shared incentives to meet contractor and customer requirements; appropriate risk sharing; and phasing of projects. This could be achieved through partnering approaches (CIDB, 2006:4). It also suggests the use of larger contracts to attract larger firms. This would increase access to expertise in contract management, technical skills, quality assurance and financial capacity; increase delivery rates at large scale; and benefits derived through economies of scale, such as reduced risk, reduction of fees and better resource utilisation (CIDB, 2006:6).

It also recommends projects over longer periods of time, but phased appropriately through a systems and programme management approach. This could enhance economies of scale benefits; allow developers to develop their staff and subcontractors over time; thus improving proficiencies in performing on contracts; increase predictability of work flow; and supports long term jobs and skills development (CIDB, 2006:8).

3.3.1.3 National Department of Housing

A policy review commissioned by the National Department of Housing for the period 1994 to 2003 confirms perceptions of poor quality houses (Charlton, et al, 2003:10). The report highlights that slightly better quality is achieved where people built their own homes through the "People's Housing Process", but the roll out of such a programme at a large scale may be limited. The report also identifies the need for more environmentally and energy efficient housing (Charlton, et al, 2003:10), to improve asset value (Charlton, et al, 2003:53). It identifies the need for long term usage of houses with improved designs, positioning and construction that enables a range of uses (Charlton, et al, 2003:10), through innovative design (Charlton, et al, 2003:53). It acknowledges that construction quality improvement research is required but that this should not detract from deeper concerns of location and integrated development (Charlton, et al, 2003:17). The report also identifies inadequate aftercare from provincial and municipal levels.

3.3.1.4 Eastern Cape Province

The Provincial Eastern Cape Government developed "A Basic Guide to Quality Housing Development Norms and Standards", aimed at residential structures delivered through government-subsidised low-income houses, built by the people themselves. The document reflects standards, materials, quantities, sample plans and graphic representation of mixing methods, and general construction requirements to deliver a completed $40m^2$ unit. It also incorporates a checklist for inspections, from site preparation, through to completion and handover to the occupant (Province of the Eastern Cape, 2005:3).

3.3.1.5 NHBRC

The National Home Builder's Registration Council (NHBRC) is a statutory body that aspires to achieve quality to protect home owners (Department of Housing, 2005e). It has identified the following quality concerns in house construction in general, supported with photographic evidence, but the extent in the context of low-income housing is not provided:

(1) Poor quality bricks.

(2) Insufficient cement in mortar mix.

(3) Poor plaster applications to exterior walls.

(4) Poor storm-water management.

(5) Structural failure due to poor founding conditions.

(6) Incorrect use of brick force.

(7) Incorrect or no brick bonding.

(8) Vertical cracks in plaster – poor quality sand and mix.

(9) Not built to plan.

(10) Poor workmanship.

(11) Structural defects.

(12) Use of substandard building material.

(13) Lack of general maintenance.

(14) Storm-water management control non-existent.

(15) No on-site quality control and supervision.

(16) Sagging and leaking roofs.

(NHBRC, 2002a: paragraph 1).

The NHBRC on its website (NHBRC, 2002a: paragraph 3) identifies the shortage of project management skills, construction and financial management skills and construction execution skills as major challenges. It has identified the building of high quality houses in the government-subsidised houses as a major challenge that needs to be assessed (Department of Housing, 2005e: paragraph 4).

3.3.2 Institutions that affect Standards and Specifications in Low-income Housing in South Africa

3.3.2.1 International standards

International Organization for Standardisation (ISO) is a network of technical committees with representatives from 156 national standard organizations. The coordinating committee is situated in Switzerland. Standards are debated between member countries. Democratic votes determine acceptance of the standard. The ISO standards are voluntary and are aimed at improving quality (ISO, undated: paragraph 3).

3.3.2.2 National and industry Standards

(a) Standards South Africa

The Standards Division of the South African Bureau of Standards (SABS) changed its name to "Standards South Africa". The National standards formerly designated "SABS" are now "SANS" (ASOSH, undated : paragraph 1). It is mandated by the Standards Act, 1993 (Act 29 of 1993), to develop and publish standards for products and services, developed in conjunction with interest groups such as the CIDB. It works closely with the International Standards Organization to protect interests, whilst adopting international standards where appropriate (STANSA, 2005a: paragraph 5). It is also involved in certification schemes, quality system certification and consignment inspection services (ASOSH, undated: paragraph 2). It also provides: technical advice; arbitrates disputes lodged by builders against approval authorities; compiles technical reports of building defects for legal purposes; improves legislation; workshops stakeholders on legislation; and evaluates qualifications of building control officers, in relation to construction matters (SABS, undated: paragraph 2).

(b) Construction Industry Development Board (CIDB).

This Board was established by the Construction Industry Board Act, 2000 (Act 38 of 2000). It is responsible for developing standards relating to good practice, procedures, and procurement and delivery management within the construction industry. It has developed a code of conduct for procurement practice in the industry (CIDB, 2002b: paragraph 1). These have been regulated (Republic of South Africa, 2004b: paragraph 2).

It is also involved in developing methods for monitoring and regulating performance and registration of projects and contractors (CIDB, 2002c).

(c) National Home Builders Registration Council (NHBRC)

The Council is a statutory body established in terms of the Housing Consumer Protection Measures Act 1995, (Act 95 of 1995), to protect the interest of housing consumers and to regulate the home building industry (Department of Housing, 2005e: paragraph 2). Its *Home Building Manual* provides guidelines from practical experience in implementing the National Building Regulations, and is applicable to low-income urban developments. The manual deals with general requirements, design-, and construction standards which have been incorporated into the Department of Housing's Procurement Documents (Department of Housing, 2002(b):1.1).

3.3.2.3 "Company" standards

(a) Department of Housing

The Department is responsible for housing and delivery of low-income housing through the housing subsidies. The Minister must determine national housing policy, including national norms and standards (Act 107 of 1997, section 3(2)(a)). The Department's "*National Housing Code*", which contains national norms and standards for low-income housing, is binding on the provincial and local spheres of government (Act 4 of 2001, section 3(b)). It addresses basic product types and fixes the amount to be spent in respect of municipal services and dwelling, respectively. The amount is revised annually when the subsidy quantum is revised (Department of Housing, 2000:178-180).

(b) Municipalities

Municipalities have by-laws that govern town planning and engineering design and construction issues (including land use controls, minimum lot sizes, omnibus servitudes, building line distances, etc). These vary between municipalities. The Department of Housing acknowledges this need and allows for some flexibility, provided the standards are not less than that prescribed by the Department (Department of Housing, 2002b:1.1).

3.3.3 <u>Standards and specifications in the South African government-subsidised low-income housing initiatives</u>

The specifications and standards applicable to government-subsidised housing are briefly summarised below. These include simple specifications (function and fit-, market grade- and qualified product specifications); and complex specifications (commercial standards, design specifications, engineering drawings and material- and-method of manufacture).

3.3.3.1 Simple specifications

These are very basic types that require few resources and description. It is used to define simple products or services, e.g. "a 30 cm standard stationery ruler" (Burt, et al, 2003:239).

"*Function and fit*" specifications are used to describe what a product/service is required to do. The desired performance is described in detail, including functions to be performed, its relationship to other components, and design outcomes required (Burt, et al, 2003:240), e.g., the "deemed to satisfy" standards in the application of national building regulations (SABS, 1990:4).

Market grade is used to describe and determine the quality and or standard ranges of commodity type products. Trade associations, standard setting authorities and government agencies determine grades for specific commodities (Burt, et al, 2003:243).

Qualified product specifications are used where it is critical to know up front whether a product or service would be able to comply with expectations, e.g. research equipment. The product and/or service is pre-qualified through a review and qualification testing process, and registered on an approved list of suppliers (Burt, et al, 2003:243-244), such as the use of building contractors registered with the National Home Builder's Registration Council (NHBRC), in low-income housing (Department of Housing, 2005f: paragraph 3).

3.3.3.2 Complex specifications

Complex specifications are far more detailed and describe exactly what the buyer wants. They include commercial standards, design specifications, engineering drawings and material and method-of-manufacture (Burt, et al, 2003:244).

Commercial standards are developed by industry and government where there is a high frequency of recurring needs for certain materials and or/performance requirements. They entail a complete description of the materials, quality, finishing, testing methods and standards, dimensions, composition, etc. They form part of most mass production systems, and provides a measurement for quality standards (Burt, et al, 2003:244-245), e.g. Standards South Africa.

Design specifications set detailed specifications for non-standardized materials, to meet specific design requirements (Burt, et al, 2003:245). In the South African context, these require Agrément Certification (Agrément South Africa, 2002: paragraph 2, and SABS, 1990:44).

Engineering drawings form part of design specifications and to specify shapes, dimensions, spatial relationships of technical details of a product. These require explicit descriptive instructions and details. It is an accurate and precise form of specification commonly used in construction projects or where high mechanical outputs are required (Burt, et al, 2003:245-246).

Material-and-Method of Manufacture is very prescriptive. Prospective suppliers are given precise instructions in the use and processing of materials. It is costly as it requires very detailed preparation of documents and detailed inspections to ensure compliance with requirements (Burt, et al, 2003:246). This may apply to areas such as specific foundations designed by an engineer or sanitation systems.

3.3.4 Standards and specifications applicable through the project life cycle

A number of specifications and standards are applicable throughout the life cycle of a low-income housing project, i.e. procurement, preparation, planning and design of township and engineering services, and house construction (NHBRC, 2002c: paragraph 1). These will be discussed briefly in the section, below.

3.3.4.1 Procurement

Legislation governs the manner in which funds are spent by organs of state, and the manner in which service providers are procured (a schedule of such legislation, is attached ***(Appendix 1)***.

The Department of Housing has developed standard procurement documents that include CIDB and South African Standards requirements. The specifications came into effect on 1 April 2003 (Department of Housing, 2002b:1.1), and include essential features of standardized documents for a particular contract option (Department of Housing, 2002a:2.1). A summary is attached ***(Appendix 2)***.

The Construction Industry Development Board (CIDB) has published regulations (Notice 63 of 2004, Government Gazette No 26427), to ensure transparent and uniform procurement procedures and practices relevant to construction (CIDB, 2004b, paragraph 1). These became applicable to all organs of state undertaking procurement for construction, from 14 November 2005 STANSA, 2005b: paragraph 7, and Republic of South Africa, 2004b: paragraph 2). It is noted that the Department of Housing documents have not been updated to reflect this standard.

Standards South Africa has developed standard procurement specifications in response to the CIDB regulations aimed at ensuring uniformity, transparency and predictability of the procurement of construction services (CIDB, 2002c: paragraph 4). Different suites have been developed to describe key characteristics and to ensure maximum order in the procurement of each type of service relating to civil engineering construction (STANSA, 2005b: paragraph 1), (see ***Appendix 3***).

3.3.4.2 Project preparation

The Department of Housing's standard procurement documents include all requirements relating to preparatory work, including procedures and documents required for land identification and purchasing, project motivations and technical reports such as geotechnical site investigations and environmental impact assessments where required (Department of Housing, 2002b:1.1 and 2002e:1.1). Refer to ***Appendix 4 and 5***, for a summary of geotechnical investigation and environmental impact assessment requirements and contents of specifications.

ISO has revised its versions of its ISO 14001 and ISO 14004 standards, aimed at setting standards for efficient environmental management systems. ISO 14001 addresses the control and continuous improvement of companies' activities, products and services of its impact on the environment. ISO 14004 focuses on the implementation of environmental management systems (STANSA, 2005c: paragraph 7). The auditing standards of environmental systems have been revised by ISO 19011, and provide a single set of guidelines for all aspects relating to quality and/or environmental management system audits. The standards can be extended to other audit types, such as production and regulatory compliance (STANSA, 2005d: paragraph 8). ISO 14001 and 14004 have been adopted as South African National Standards, published under SANS 14001, *Environmental Management Systems*, and SANS 14004, *Environmental management systems-general guidelines on principles, systems and support techniques* (STANSA, 2005c: paragraph 1).

3.3.4.3 Planning and design for township establishment

The Department of Housing has standardized documents and specifications for procurement of services for town planning and engineering. The town planning specifications outline the qualification criteria for a town planner, and key outputs required. The planning activities; minimum information and aspects to be addressed in the motivation and commentary; relevant sources to be consulted; mapping; and reporting requirements are specified (Department of Housing, 2002c:Introduction).

The Department's specification for the design and construction of services are performance based. It provides the minimum requirements for engineering infrastructure (roads, storm water, drainage, sanitation and water and high mast security), based on the Departments norms and standards, National Home Builder's Registration Council

(NHBRC) requirements, and SANS requirements that prevailed at the time (Department of Housing, 2002c: Introduction).

The minimum level of service in terms of the National Housing Code (Department of Housing, 2000:180) is summarised in Table 3.1, below.

Table 3.1: Department of Housing minimum norms and standards for services

TYPE OF SERVICE	DESCRIPTION
Water	Single standpipe per stand (metered)
Sanitation	Ventilated Pit Latrine (VIP)
Roads	Access to each stand with graded or gravel paved road
Storm-water	Lined open channels
Street lighting	High mast security lighting for residential purposes where feasible and practical

(Department of Housing, 2000:180)

The NHBRC has specific requirements for drainage capabilities to also ease maintenance; and storm-water disposal systems to prevent soil erosion or flooding that may adversely affect housing structures (Department of Housing, 2002c:Introduction).

SANS specifications cover all aspects pertaining to engineering design and construction activity, including earth works, erosion control, storm- water drainage, sanitation systems, etc (SABS, 1990:5). The headings of the different standards are self explanatory, as reflected in ***Appendix 6.***

The specifications provide a breakdown of civil engineering components and define the needs and performance requirements for each. These include pipe dimensions, -diameters, -gradients and -velocities for storm-water drainage and water supply, slopes and gradients for roads (Department of Housing, 2002c:Introduction).

3.3.4.4 House construction

House construction is the final part in the project delivery cycle. A number of standards impact on house construction. The Department has specified a minimum house size of 30m^2 gross floor area, (Department of Housing, 2000:181). It developed performance based standard specifications for the design and construction of houses that incorporates the mandatory requirements of the National Building Regulations, SABS, NHBRC

(Department of Housing, 2002g:1.1). The content of the specifications is summarised in ***Appendix*** *7.*

(SABS0400-1990*) Code of Practice for the application of the National Building Regulations* was developed to ensure a proper interpretation of the National Building Regulations and Standards Act, 1977 (Act 103 of 1977), (SABS, undated). It was approved by the former Council of the South African Bureau of Standards on 23 August 1993. "The Code sets out prescriptive provisions that are deemed to satisfy the technical aspects of the National Building Regulations"(SABS,1990:4). It deals with all the technical aspects relating to building construction and sets out the minimum requirements to ensure that buildings are designed and built in a manner that ensures people could live and work in a safe and healthy environment. It was intended to minimize regulations and to focus primarily on health and safety aspects. It was also intended at informing innovation - not to impede it (SABS, 1990:3). The regulations are the basis upon which inspections are conducted by the Department of Housing (Shabalala, 2006). See ***Appendix 8*** for a summary of the content of the document in the context of low-income housing. Standards applicable to house construction in the government-subsidised housing scheme are listed in ***Appendix 9****.*

3.3.5 Standards and specifications in low-income housing : Benefits and challenges

3.3.5.1 Benefits

(a) Enables mass production

Standardisation increases the potential to use interchangeable parts (Burt, et al, 2003:254), e.g. use of standard different window frames across projects. It stabilizes production processes and encourages continuous improvement (Burt, et al, 2003:254). The experience and learning curve effect is expedited as a standard product is built within a particular project.

(b) Enables customisation

Standards facilitate the production of a wide variety of finished products from a relatively small number of parts (Burt, et al, 2003:255), e.g., a range of different house designs are possible, using the same quantities, but this is limited to the placement of windows, doors, internal wall and plumbing, and roofs. Houses built by people themselves may allow more flexibility as the cost of labour is replaced by the builder's own sweat equity. Additions and materials purchased by owner builders from other sources may be used to achieve customization.

(c) Improves supplier coordination

Standardized parts and specifications facilitate a clear understanding of dimensions, characteristics and performance standards (Burt, et al, 2003:255). It enables proper quantification and need estimates that inform negotiations for bulk supplier/customer discounts. This is very relevant to housing projects as it is critical to ensure that the right quantity of sand, water and cement is available to ensure the correct mixture of concrete for the desired purpose (e.g. slabs versus plastering), and to ensure that the cement is not delivered prematurely, to guard against the theft and/or expiry of the material.

(d) Improves quality

The standard products and design facilitate the experience and learning curve effect, which lowers defects (Burt, et al, 2003:255) as the same process and product are delivered throughout a particular project.

(e) Enables simplification

Standards facilitate the identification of bare minimum quantities and qualities of materials required to deliver the desired performance standard, thus resulting in the simplification of the product (Burt, et al, 2003:255). Standards guard against exploitation to ensure that the absolute minimum still complies with health and safety requirements, as determined by the relevant standards and regulations (SABS, 1990:40).

(f) Lowers inventories

Where the product is standardized, quantities and delivery needs can be more accurately projected, thus reducing waste with regard to disposable items, and keeping inventory levels low, thus improving inventory and quality control (Burt, et al, 2003:255). Items such as cement have a limited shelf life. Steel products also are at risk of rusting and would require special storage (and security against theft). Low inventory levels reduce this risk.

(g) Other potential benefits

Standard products and processes reduce risk perceptions, compared to those that are unknown or untested. Budgets are easier to compile as quantities, features and quality costs are more predictable as prices are easier to compare.

It creates a comparable base for tender evaluation as the minimum requirements are transparently defined in standardized procurement specifications. Financial controls are enhanced as payment and performance can be measured against standard specifications.

Mass production is enabled through standardisation, which increases the speed of delivery, and reducing costs through economies of scale. Uniform product reduces perception of discrimination amongst same income profile housing beneficiaries in different regions. Expected product features and performance is also easy to communicate, and to inspect.

3.3.5.2 Challenges

(1) The referencing system used for SABS (now SANS) standards, is complicated, and in some cases a vast number of references need to be explored before the appropriate standards are found. This is also applicable to the organization's electronic referencing system. The standards are not readily available unless they are ordered through the organization, and can only then be obtained at a cost. This could be a limiting factor, as one could search for specifications in the Department of Housing's documents, only to find that additional sources need to be obtained, at additional costs, which may be limiting to owner builders and emerging concerns.

(2) Product innovation, customization and competition based on product differentiation and low cost is extremely limited. The subsidy is set at a fixed amount with which a product is to be delivered to meet the Department's minimum norms and standards.

(3) The housing process and documents required for the procurement of services and approval of projects are complicated, especially for emerging contractors who may be less familiar with the specified procedures.

(4) Building Regulations are "deemed to satisfy rules", the interpretation of which is manipulated by unscrupulous developers who still abuse subsidy funds through fraud and poor substandard or very borderline materials.

3.4 SUMMARY

Quality management in housing is not new. Most recent international research relating to low-income housing has focused on slums clearance, upgrading of human settlement and integrated development.

In the international arena, the National Association of Home Builders (United States of America) has developed extensive literature on quality management in relation to housing. This is based on total quality management philosophies.

Research indicates that mixed income development also appears to facilitate quality in housing, as higher income earners demand better quality, thus also benefiting low-income earners.

In Hong Kong, quality efforts are aimed at creating environmentally friendly and sustainable housing. These are facilitated through the HK-BEAM system (Hong Kong Built Environment Assessment Method.

Singapore is focusing its efforts on urban renewal and views quality as ensuring a life time asset.

Quality improvement is not only important from an economic perspective. Poor quality house construction may have adverse health implications to its occupants.

The National Home Builder's Registration Council has identified a number of generic quality defects in housing in South Africa, but these have not been quantified. There are a number of standards and specifications that guide house construction in the low-income market, relating to houses subsidised by government. These have benefits such as enabling mass production, customization, simplification, improving quality and inventory management, costing and financial programming and speed of delivery. It also has several challenges, such as complicated coding of norms and standards, duplication between several organisations, limiting differentiation, accessibility to information, and manipulation of interpretation of "deemed to satisfy" rules.

The CIDB suggests that larger contracts, phased over a period of time using a programmatic systems approach, coupled with a variety of contract strategies such as partnerships, can enhance efficiencies through economies of scale. This could also assist with skills development over the longer term and increase quality.

From the literature consulted it appears that research in relation to quality management systems in low-income housing in the local arena has been extremely limited. This study investigates the local quality management systems in low-income housing in the Pietermaritzburg area. The research methodology is explained in the next chapter.

CHAPTER 4 : RESEARCH METHODOLOGY

4.1 INTRODUCTION

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. The problem statement has been formulated in Chapter 1 (paragraph 1.2.1), as follows : *Ongoing quality concerns in lo-income housing have allegedly not been addressed adequately.*

Chapter 1 (paragraph 1.2) details the motivation for this study, and refers to recent concerns on quality in low-income housing. Limited research has been done in the local context regarding quality management in house construction, in spite of prevailing concerns sited by the NHBRC (2002a: paragraph 1) and the National Minister of Housing (Sisulu, 2005c:4) and notwithstanding the applicability of norms, standards and specifications (as outlined in Chapter 3, paragraph 3.3 hereof).

Government has allocated an average of R34 million to low-income housing delivery initiatives in the Pietermaritzburg area (Provincial Treasury, 2005:300), which is to be spent in a cost effective, transparent and equitable manner (Republic of South Africa, 1999: sections 2 and 38 and 2004a, section 2). Juran (Juran and Gryna, 1988:4.4), Gitlow (1999:14), Gryna (2001:10) and Evans and Lindsay, (2002:25) all indicate that a holistic approach to quality management can achieve this.

4.2 RESEARCH QUESTIONS

The following questions need investigation:

(1) Are there quality problems in projects in the Pietermaritzburg area?
(2) What is the nature and extent thereof and how does it measure against acceptable industry norms?
(3) What are the perceived causes of quality concerns?

(4) What systems, norms and standards are in place to ensure sustained quality management?

4.3 RESEARCH OBJECTIVES

In answering the research questions, the following objectives were set:

(1) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(3) To identify how house construction quality issues are currently being addressed.

4.4 RESEARCH DESIGN

Research was aimed at identifying quality problems in the construction of low-income houses, within the Pietermaritzburg area, funded through government's conditional grant. Ethical clearance was granted by the University ***(Appendix 10).***

The research comprises of two phases. **Phase 1** deals with *Objective 1*, (see paragraph 4.3(1) above).

Phase 2 deals with *Objectives 2* and *3*, (see paragraph 4.3(2) and 4.3(3) above).
The research design for each phase is discussed separately in the sections below.

4.4.1 Phase 1

4.4.1.1 Population

The population is all low-income units in the Pietermaritzburg area.

4.4.1.2 Sample and limitations

This was **all** completed and inspected housing units, of which inspections were done by the same team in order to increase the reliability of data in terms of its stability (i.e. the extent to which repeated results with the same measure of the same items with the same instrument will yield the same results (Cooper and Schindler, 2001:215). Convenience sampling was used (Wegner, 2002:171). The following limitations were applied:

(1) The units were inspected during 1 April 2005 to 31 December 2005 with complete datasets;

(2) The units were from low-income housing projects that have been initiated by the municipality, aimed at addressing slums clearance;

(3) The units were all from active projects (i.e. more housing unit construction is still underway);

(4) The units were inspected by the same inspection team.

The timeframe in (1) above was selected as this is the latest financial year following the most recent announcements regarding quality concerns (Sisulu, 2005a:2, and 2005e:4-5). More consistent approaches over this shorter time frame can also be expected, thus increasing the reliability of data.

The projects from which the sample was drawn, were those initiated by the municipality, (see (2) above), as purely developer driven projects may have different quality perspectives (e.g., less stringent quality requirements and bureaucracies).

The slums clearance initiative (see (3) above), is currently a high priority area at National level (Anonymous, 2005), and has been a Provincial Priority since 2000 (Makhaye, 2000:15). Most of the projects in the Pietermaritzburg area are aimed at addressing slums (Janse van Vuuren, 2006).

Active projects were chosen as the data is more recent and it should, thus, be easier to verify details.

A total of 1838 completed units were inspected during the said timeframe (Department of Housing Inspection Records). The data collection process (see paragraph 5, below) yielded 1359 units that complied with the limitations set out above, thus the sample size is 1359 units, which represents 74% of the total number of units inspected over the time frame.

One thousand and thirty two (1032) units have been paid for over this period in six (6) projects (Cinderella Park; Matshaheni Phases 1, 2 and 3; Slangspruit; and Edendale H) in the Pietermaritzburg area. A total of one thousand three hundred and thirty two units (1332) have been built and paid for in the entire Pietermaritzburg area, over the same period of time (Janse van Vuuren, 2006).

4.4.2 <u>Phase 2</u>

The population and sample for this phase was the same for both objectives.

4.4.2.1 Population

This comprised three distinct groups in the supply chain, as follows:

(1) Officials responsible for low-income housing projects within the municipality ;

(2) Developers involved in projects as defined in the sample for Phase 1 of the research (see 4.4.1.2 above). There are four (4) developers involved in low-income housing construction in Pietermaritzburg, at the time of the study.

(3) Officials from the Department of Housing : Province of KwaZulu-Natal, involved in low-income housing projects in the Pietermaritzburg area.

4.4.2.2 Sample

Judgement sampling (Wegner, 2002:171) was applied. The subjects chosen were only those directly responsible for quality management in the context of low-income housing, thus increasing reliability (Cooper and Schindler, 2001:218), and for the following reasons:

(1) The Msunduzi municipality has a newly established Housing Unit. The following four (4) unit managers were approached:

(i) Manager responsible for low-income housing.
(ii) Official responsible for quality assurance and housing construction evaluation.
(iii) Manager responsible for the building inspectorate.
(iv) Process Manager responsible for the above activities.

The above represent all the units involved in the construction aspects of low-income housing in the municipality (Janse van Vuuren, 2006). Only 2 responses were received (50 %), being that from the manager responsible for housing delivery, the other being the manager responsible for quality assurance (Denoted in the findings as Respondent 1 and 2, respectively);

(2) Only one (1) developer was involved in the nature of units outlined in Phase 1 (see 4.4.1.2, above) (Department of Housing, 2006). The developer's project managers involved in the construction aspects of these units were approached. There were 3 project managers of which responses were received from 2 (thus 67% response rate). One respondent was a former employee of the Department and responsible for monitoring the projects in the sample for Phase 1. The other was a senior project manager, with over 12 years experience in this market. These are denoted as respondents 3 and 4, respectively; and

(3) The Department of Housing has three project management units in three regions. The Pietermaritzburg area falls within the Inland Region. There are four teams in the Inland Region, responsible for various municipalities. (Janse van Vuuren, 2006). The entire technical team responsible for housing delivery in the Pietermaritzburg area was approached. This comprised two inspectors and two monitors responsible for the projects in the sample outlined in Phase 1 (Respondents 6 to 8). A 100% response rate was achieved.

4.5 METHODOLOGY

4.5.1 Phase 1

4.5.1.1 Data type

Data collection was aimed at identifying the number and type of defaulted units using discrete ratio scaled data. Discrete data can only have whole number values (Wegner, 2002:11). Ratio scaled data is quantitative and can be used to perform the widest range of statistical analysis (Wegner, 2002:10). Whereas the defaults will be categorised in the data collection process, the data will become ordinal scaled, thus reducing the range of statistical methods that can be applied (Wegner, 2002:8 and 10). Ordinal scaled data is normally associated with qualitative data (Wegner, 2002:10).

4.5.1.2 Data collection and tools

Internal records from the Department of Housing, for which approval had been obtained from the Head of Department, were used. The Department keeps inspection records as it is required to verify work prior to the release of payment to developers. (Department of Housing, 2000:212). These comprised manual snag sheets, triplicate book copies and electronic data on sites passed. The snag sheets contained information regarding defects to be addressed. The triplicate book copies contained information on units passed. The electronic database contained information on units inspected and passed (Shabalala, 2006). The advantage of internal records is that it reduces any bias. The disadvantage of this type of data collection is the inability to probe into findings (Wegner, 2002:12).

Units were selected based on the sample criteria and limitations outlined in 4.4.1.2 above.

A spread sheet (see ***Appendix 11***) was designed through a simplified process analysis, in consultation with technical supervisors and inspectors from the Department of Housing. Process analysis outlines systems and helps to identify process and quality problems (Beckford, 1998:227). This was achieved by listing issues typically inspected where problems have been found historically, and guided by defects found by the NHBRC (see Chapter 3, paragraph 3.3.1, hereof). These were grouped into 3 broad categories, based on the construction inspection stages (i.e. foundation and slab, wall plate (before roof is constructed) and completion, as summarised in Table 4.1, below (also appended as ***Appendix 12*** for ease of reference).

Table:4.1 Summary of default categories and descriptions

MAIN CATEGORY	SUBCATEGORY	INSPECTION STAGE/ DEFECTIVE UNIT	COMMENTS
A : MAJOR STRUCTURAL ISSUES These will cause the stage to be failed by the inspector	(1) Workmanship (Construction)	Foundation and Slab	Includes leveling, waterproofing, major cracks, pad and lintels, etc.
		Wall Plate	Includes: block work; mortar mix; lintels; plumpness of building, windows and door; brick force, brick courses (building height), etc.
		Completion	Structural design, pitch, ties, beam spacing, and fixture (screw spacing, etc), overhang and overlap, etc)
	(2) Materials (quality)	Foundation and Slab	Lintels, concrete, blocks and DPC (Plastic membrane for waterproofing)
		Wall Plate	Blocks, mortar mix, lintels (windows, doors and partitions, where applicable).
		Completion	Sheeting type, thickness and rust free, beams and purlins to specification and SABS/SANS compliant
B : INCOMPLETE WORK These will cause the inspector to fail the unit as it is not habitable, or cannot be accessed for inspection.	(1) Inadequate services	Water, Sanitation, Access	These should be completed before the house is occupied, but needs to be available to ensure that the plumbing and water supply is in working order, and that the property is accessible.
	(2) Other	Incomplete/ not ready	Includes outstanding pre-certification by engineer/building professional.
		Access/Keys	Where keys are not available, or the unit could not be accessed for final inspections,
C : FINISHING	(1) Clearance		Used in records to describe both site preparation, and clearing materials after construction.
	(2) Plumbing		
	(a) Workmanship	Toilet	Entire system, including pipes and rodding eyes
		Outlet and gulley	Fitting, leaks, gradient of fall, and positioning over the gulley and condition of gulley
		Pipes	For water, and including taps
		Basin	Fitting
		Shower	System and all fittings
	(b) Materials (quality)	Tap	
		Gully	
		Water tank	
	(3) Other finishes		
	(a) Workmanship	Block work	
		Fillings	
		Plaster	(and/or bag washing, where applicable)
		Fitting windows, glass and door frames	
		Glazing	
		Screed	(Topping of slab)
	(b) Materials (quality)	Window and/or door frames	
		Plaster/Cement/Bag wash material	
		Door	
		Glazing	

Subcategories were developed to assess the extent of the quality concerns, (i.e. whether a sizable portion of the sample has quality problems), and the nature thereof. Photographs of such examples are attached as ***Appendix 13***.

The nature of the quality concerns were assessed against the extent to which it related to major structural issues and/or incomplete work that would cause the unit to fail the inspection; or finishing. Finishing type causes would typically not result in the unit being failed outright, depending on the seriousness and number of issues reported (Shabalala, 2006).

Provision was also made to categorise defects to indicate whether they related to workmanship or materials. These were used to identify the cause of quality concerns in terms of either poor workmanship, or due to quality of materials received from suppliers.

The spreadsheet also reflected:

(1) The number of completed units inspected in three stages, being foundation and slab; wall plate (to roof height excluding the roof); and completion (Department of Housing, 2000:211). Photographic examples of the different stages in construction are attached as ***Appendix 14***.
(2) The date of each inspection was recorded in the format month, day, year.
(3) The number of units inspected without any quality concerns (i.e. "defect free").
(4) The type of default or comment made by the inspector, categorised in terms of its severity, as indicated in Table 4.1 above.
(5) The number of defaults in each type of category of the sample (per project) and percentage thereof.
(6) Timeframes between the three relevant stages of inspection (foundation, wall plate and completion).
(7) The mean, mode, median of each default type, and of data relating to timeframes, as well as the minimum and maximum number of occurrences in respect of each.

4.5.1.3 Data processing

Data was captured onto an electronic spreadsheet. 1838 Units were captured in total. The data was then sorted against site numbers to eliminate duplications and was then refined. This yielded 1359 units, as summarised in **Table 4.2**, below:

Table 4.2 : Summary of units, per project

Project	Number of units from inspection records	Duplicated sites	Revised sample size	Foundation/slab dates omitted	Second revised sample size	Inspection out of sequence (Slab and Completion)	Third revised sample size	Wall plate dates omitted	Revised Total number of units
Cinderella Park	346	0	346	0	346	0	346	0	346
Edendale Unit H	809	55	754	43	711	57	654	0	654
Matshaheni (Phases 1, 2 and 3)	548	13	535	223	312	33	279	32	247
Slangspruit	135	0	135	4	131	3	128	16	112
Total	**1838**	**68**	**1770**	**270**	**1500**	**93**	**1407**	**48**	**1359**

In addition to this, the time frames were compared to the "*Housing Project Programming Guide*" (Department of Housing, 1997:42-49).

4.5.1.4 Analysis tools

(a) Check sheets

The spreadsheet used for data collection is a type of check sheet. Check sheets provide a simple method for collecting data on the occurrence of defects or values, in a wide range of areas (Kanji and Asher, 1996:164). It is used to collect numerical values of nonconforming aspects for Pareto analysis and/or histograms (Gitlow, et al., 1999:685). The frequency of each default type was calculated as a portion of the sample to identify the most common default types, and presented in graphic and tabular format.

(b) Pareto analysis

A Pareto analysis was used to identify the most critical problems to be addressed for maximum impact (Kanji and Asher, 1996:56). The resultant charts provide a graphic representation of factors in descending order of the frequency of occurrences (Develin and

Hand, 1995:137), to identify the starting point for problem solving, monitor progress and identifying basic causes (Gitlow, et al, 1999:686). It is also known as the 80/20 principle in which 80% of problems are caused by 20% of the observations and these are the critical areas to be addressed for maximum impact (Kanji and Asher, 1996:58). It is a useful technique to present facts and reach consensus on the prioritization of issues to be resolved. The Pareto analysis was used to identify the most critical quality concerns in the sample.

(c) Descriptive statistics

Descriptive statistics were used to summarize data relating to defects in low-income housing, represented by the sample and to confirm the validity of the research. Descriptive statistics is an appropriate tool to summarize data and extract essential information through summary measures (Wegner, 2002:5). These include measures of central location and dispersion (Wegner, 2002:6).

(1) Measures of central location quantify where the majority of data is concentrated around a central value (Wegner, 2002:54). It includes the mode, median and mean.

The "mode" is the most frequently occurring value in a set of data (Wegner, 2002:58).

The "median" represents the value of the point at which an ordered dataset is divided in two equal parts (Wegner, 2002:61).

The "mean" is the average number of occurrences of a characteristic (Wegner, 2002:55). Field and Hole (2003:126) view it as the best model of a data set, as it takes into account all values in a set of data.

(2) Measures of dispersion quantify the spread of observations around the central value and guide the reliability thereof – the lower the concentration of data, the wider the dispersion thereof, and the lower the reliability of the central value (Wegner, 2002:84). It is also a means of confirming validity in terms of content. Content validity measures the extent to which a sample represents the population (Cooper and Schindler 2001:211). Measures of dispersion indicate the extent to which a mean represents data (Wegner,

2004:84), and from this perspective provide a means to judge content validity. Dispersion measures include the range, variance, standard deviation and skewness.

The "range" is the difference between the highest and lowest value.

The "sample variance" is most commonly used as a power statistic to measure dispersion (Wegner, 2002:87), indicating variability in the data and accuracy of the mean. Lower variability indicates that the mean is a reliable measure to represent data (Field and Hole, 2003:128).

The "standard deviation" describes the average spread of observations around the mean (Wegner, 2002:92) and indicates how well the mean represents the sample (Field and Hole, 2003:131). A low figure indicates a low rate of deviation, thus data is dispersed closer to the mean, which indicates that the mean represents the data well (Field and Hole, 2003:131). Where data distribution is almost symmetrical, 68% of data will fall into 1 standard deviation from the mean, while 95,5 % of the data will fall within 2 standard deviations (Wegner, 2002:92).

"Skewness" is the degree of departure from symmetry (Wegner, 2002:94). If positive, data dispersion is skewed to the right, indicating that there are few relatively large values in the dataset (Wegner, 2002:94). The more extreme the skewness, the less effective the mean becomes in representing the data (Wegner, 2002:69).

(d) Frequency distribution and histogram

An analysis of timeframes and completion inspections was done to compare whether time frames are in accordance with the model developed by the Department of Housing's "Housing Project Programming Guide". The aim of this was to investigate delivery rates as it could be an indicator of service delivery quality as customers require a reduced cycle time, as part of quality improvement (Gryna, 2001:625). The Department used a medium risk approach in modeling development timeframes in its guide (Department of Housing, 1997:9) and assumes a timeframe of 129 days from the start of construction to the final inspection (Department of Housing, 1997:49). The histogram was used as a graphic means of the frequency distribution (Wegner, 2002:37), specifically to illustrate the distribution of completion inspections over 30 day intervals. A histogram is effective in elementary data analysis (Beckford, 1998:251, and Gryna, 2001:244), as was used in this study. The 30 day interval was used to simulate a monthly cycle.

4.5.1.5 Hypothesis testing versus Poisson probability

Hypothesis testing is normally used to indicate whether a generalisation based on findings in a sample is a true reflection of the entire population (Wegner, 2002:214), thus it is a means to confirm the reliability and validity of data.

Field and Hole (2003:259) suggest that the Chi squared test would be applicable where frequencies are used in the sample (as is the case in this study). However, the results of such a test are only valid when the subject contributes to ***one*** category only (Field and Hole, 2003:262). The nature of this study provides for the possibility of more than one defect type per unit, thus the Chi squared test would not be suitable.

Hypothesis testing for a single population mean would also not be sufficient if the sample mean, sample size and/or the population standard deviation is unknown, as these elements are required to use the "z" statistic hypothesis test (Wegner, 2002:222).

Due to the nature of this study, and whereas the research was dependent largely on qualitative information, detailed hypothesis testing was not done. Cooper and Schindler, (2001:138) explain that it is difficult to accept or reject a hypothesis based on this type of data (Cooper and Schindler, 2001:138).

In view of the above, **Poisson probability analysis** was done through the application of Excell software descriptive statistics to test the probability of finding defects in low-income housing projects in Pietermaritzburg, thus as a means to confirm reliability. The Poisson analysis can be used where data is discrete and relates to random variables in a predetermined time, space, volume or interval (Wegner, 2002:141). Data in this study was discrete and was taken from a sample over a predetermined time.

4.5.2 <u>Phase 2</u>

4.5.2.1 Data type

Qualitative, interval scaled data was collected as it was aimed at identifying the causes of house construction quality problems in low-income housing within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal; and how house construction quality issues are currently being addressed, by the entities responsible for these projects.

4.5.2.2 Data collection and tool

Data collection was done through a ***closed question, self-administered questionnaire*** that offered respondents choices from a predetermined selection, based on issues identified in the literature review (***Appendix 15***), to obtain qualitative data. It was administered to pre-identified respondents who were directly responsible for quality management in the context of low-income housing, thus a judgement sampling technique was used (Wegner, 2002:171). This served as a survey mechanism and was hand delivered to the pre-identified respondents. A three week timeframe was given for the return of information, with an individually agreed collection arrangement.

This collection tool reduces the disadvantage of low response rates and provides control by ensuring knowledgeable responses are received (Wegner, 2002:16). It also provided an opportunity to explain the purpose and requirements of the investigation and agree on the method of collection. Its main advantages are that results are collected fairly quickly, and questions are generally better understood (De Vos, 2002:180). It also provides a structured means for data collection (Wegner, 2002:15). Interviewer bias is limited. Respondents have time to consider the responses and whereas anonymity is ensured, more honest responses and willingness to provide personal information is increased (Wegner, 2002:16). However, some information may be missed as the responses are limited to the options provided (De Vos, 2002:180).

A ***Likert scale*** was used to record and analyse responses. Field and Hole (2003:45) explain that this tool is used to record the extent of agreement to responses (Field and

Hole, 2003:45). The data is interval scaled. Such data provides a means to quantify the qualitative random variables as ratings are provided on a continuum with extreme positions (Wegner, 2002:10). The Likert scale in this study reflects a continuum of agreement. Disagree reflects a negative perception of the statement, agree reflects a positive perception. In this study, **0** presents a strong negative perception; **4** reflects a strong positive perception; **2** indicates that the respondent disagrees generally, but agrees slightly; **1** indicates that the respondent disagrees with the statement, more than is the case with a score of 2; and **3** indicates that the respondent agrees more with the statement than he/she disagrees. "Not sure" presents a neutral position and no score is allocated.

The questionnaire comprised three sections:

Section 1 : The objective of this section was to establish possible causes of quality concerns in respect of low-income housing in the Pietermaritzburg area, from the perspectives of the Department of Housing officials, developers, and the municipality, respectively. Questions were grouped as follows:

Question 1 : Perception on existence of quality concerns.
Questions 2 and 3 : Nature of defects.

Questions 4 to 9: Confirmation of possible causes, as identified in the spreadsheet used for Phase 1, ***Appendix 11 and 12***. These were grouped as follows:

Question 4 : Confirmation of possible causes : Resources
Question 5 to 7 : Confirmation of possible causes : Materials quality
Question 8 : Confirmation of possible causes : Workmanship
Question 9 : Possible causes of poor workmanship

Question 10 : Perception of acceptability of defects rates.
Questions 11 and 12 : Perceptions of impact of quality management.
Questions 13 and 14 : Use of warranties.
Questions 15 to 22 : Perception on delivery rates and measurement.
Question 23 : Provision for respondent to list other possible causes.

Section 2 : The objective of this section was to establish which systems are in place in each organization and to review the efficiency of these. Questions were based on total quality management theory, grouped as follows:

Question 1 : Presence of a quality management system and its focus in terms of customer orientation.

This question was designed to confirm the existence of a quality management system within each institution, and to confirm whether all internal and external role players are involved. Theoretically, both internal and external views on quality are important (Gryna, 2001:15) as customer satisfaction, from both perspectives is central to quality improvement (Kanji and Asher, 1996:1).

Question 2 : Correlation of quality management system with ISO 9000.

This question was designed to confirm whether regular company wide assessments were done, and whether ISO 9000 principles were applied. Gryna (2001:45) indicates that all organizations should undertake such assessments.

Question 3 : Application of different approaches for chronic and sporadic problems.

The question was designed to investigate whether the institution treats chronic problems and sporadic ones differently, and whether a diagnostic approach is followed. Chronic cases need more time and resources, thus, are the type that needs concerted effort in relation to major quality issues (Gryna, 2001:49). Improvement processes should address chronic issues (Gryna, 2001:96). A diagnostic approach is an important aspect to achieving quality leadership as it allows for decisions to be made on facts (Gryna, 2001:105).

Question 4 : Continuous improvement through benchmarking and tapering quality systems to a spectrum of customer needs.

The question was designed to identify whether the institution applies benchmarking, and customizes quality management approaches. Benchmarking facilitates continuous improvement (Gryna, 2001:105). In order to sustain quality, the different quality needs and values need to be determined to facilitate proper product or service planning (Gryna, 2001:118). This also needs to be reflected in the quality policy, which serves as a broad guideline for action (Gryna, 2001:185).

Question 5 : Quality control and responsibility.

This question looked at quality control and perceptions of responsibility, understanding of all role players of quality control requirements and processes, and the extent to which inspections take place. A quality score card is central to quality control processes as it is a performance management vehicle that also informs strategic initiatives (Gryna, 2001:123). It is important for all role players to understand the system so as to know what to expect, and to guide acceptable tolerances (Gryna, 2001:544). The extent of inspections may vary, and should be flexible in relation to product features and processes (Gryna, 2001: 563). No inspection may be done where prior testing occurred; small samples including the first and last few units are typically used where product and processes are inherently the same; large samples may be needed for new processes, products, or product elements and 100% inspections may be needed where defect rates are high, or specialized products (Gryna, 2001:564).

Question 6 : Strategic quality management.

The question was designed to get insight into some aspects of strategic quality management issues, including the existence of typical obstacles, such as lack of leadership, infrastructure, skeptics, exhortation, attempting too much too soon and lack of use of statistical tools (Gryna, 2001:184).

Question 7 : Quality culture.

This question was designed to explore the organisational culture and the extent to which it is conducive to total quality management implementation. An enabling culture practices situational leadership, participative management, and management by fact. It also measures team and individual performance regularly and provides constructive feedback on progress. Staff are also encouraged to share ideas, feelings and needs in an open and trusting manner (Gryna, 2001:218).

Question 8 : Inclusion of customer needs.

The question explores the extent of customer orientation within the institution. Total quality management is customer focused, thus market research is critical (Gryna, 2001:329).

Question 9 : Supply chain management and quality control.

The question seeks to identify the extent to which supplier performance is measured as it affects quality (Gryna, 2001, 425, and Burt, et al, 2003:332), and to which suppliers are certified. Certified suppliers can be expected to deliver consistent quality standards (Burt, et al, 2003:149 and Gryna, 2001:428). The question also looks at other quality control methods and the extent to which self control (also self regulation, Beckford:1998:296) is used. Gryna (2001:442) views self control as the ultimate form of quality control, and as a means to differentiate between worker controllable aspects and those that need management intervention. Self control requires role players to understand how and what to do and how this is measured (Gryna, 2001:442). These aspects have been incorporated in the question.

Question 10 : Statistical control system.

The question seeks to identify whether institutions use statistical control measures. These provide management with a basis for making decisions based on facts (this process is also called "management by fact") and this is an enabling factor for total quality management (Gryna, 2001:495).

Questions 11 : Quality management in administration and support activities.

This question aims to identify the extent to which support functions (administration, finance and information technology) are measured in terms of quality, using typical measures in literature (as illustrated by Gryna, 2001:639). These activities could benefit by applying quality management principles (Gryna, 2001:639).

Question 12 : Quality management information systems.

A quality management information system is a formalised method of collection, storing, analyzing and reporting information, thus is a key element in quality improvement initiatives at all levels (Gryna, 2001:656).

Question 13 : Presence of a quality systems audit and assurance programme.

Quality assurance is a means to provide confidence that a predetermined quality standard will be achieved, thus providing a measure of performance expectation. Quality audits are independent performance reviews of elements that impact on quality (Gryna, 2001:681).

Section 3 : Provision was made here to list any additional concerns, comments and/or suggestions regarding quality management in the context of Government subsidised low-income housing, thus providing some additional information that may otherwise have been missed in the closed question questionnaire.

4.5.2.3 Data processing

Questionnaires were delivered and/or collected by hand and captured on an Excell software spreadsheet to facilitate the counting of scores allocated by respondents.

Data for Section 1 was dealt with as a collective response from all respondents, as the purpose of this section was to identify perceived causes of quality defects. Scores of 3 and 4 ("Agree" and "Strongly Agree"), were recorded as "Agree". Scores of 0, 1 and 2 ("Strongly Disagree", "Disagree", and "Slightly Agree") were recorded as "Disagree". "Slightly Agree" was recorded as "Disagree" as this category provided for responses where the respondent did not completely disagree, or had felt a slight sense of agreement, but disagreed with the statement in general terms. "Not sure" was recorded as such. These findings are presented in tabular format in Chapter 5, and in accordance with the groupings of question statements as described in 4.5.2.2, above.

Data for Section 2 was summarised in accordance with the extent of agreement between respondents per institution (municipality, developer and Department of Housing). Scores were recorded on the same basis as was used for Section 1. The findings are described in Chapter 5.

Section 3 recorded any additional information provided by respondents.

4.5.2.4 Data analysis

Responses were analysed against quality management literature reviewed, and the findings presented in Chapter 5.

Data analysis for Section1 of the questionnaire entailed quantifying the extent to which respondents agreed, disagreed, or were not sure, in responding to the statement, as a percentage of the number of responses received.

Data analysis for Section 2 was dealt with descriptively as a summary of responses received, per institution, and based on those responses where responses correlated, and against quality management theory.

Data analysis for Section 3 entailed mainly presenting comments from respondents and evaluating these against quality management theory.

4.5.2.5 Hypothesis Testing

Hypothesis testing was not done, due to the qualitative nature of the research, as explained in paragraph 4.5.1.5, above.

4.6 SUMMARY

This chapter described the research questions, objectives, population and sample. The research was approached in two phases. Phase one was designed to identify whether quality concerns existed in the low-income housing projects in the Pietermaritzburg area; and to identify the nature and the extent thereof.

Phase 2 was designed to explore the perceived causes of quality concerns, and to identify the systems used by the municipality, its developing agent and the Department of Housing, to ensure sustained quality management.

The chapter set out the data type, collection methods and total quality management tools applied in the process. It was noted that the Poisson Probability analysis was used as a means to indicate the probability of defects occurring in the entire population of low-income housing in Pietermaritzburg.

The findings are presented in Chapter 5.

CHAPTER 5 : FINDINGS

5.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area.

In answering the research questions (see Chapter 4, paragraph 4.2), the following objectives were set:

(a) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(b) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(c) To identify how house construction quality issues are currently being addressed.

Research was aimed at quality problems in the construction of low-income houses, within the Pietermaritzburg area, funded through government's conditional grant. It comprised of two phases. **Phase 1** dealt with *Objective 1*, (see paragraph (a) above).

Phase 2 dealt with *Objectives 2* and *3*, (see paragraphs (b) and (c) above).

Details of the research design are outlined in Chapter 4. This Chapter will focus on the findings. Each phase will be presented separately.

5.2 PHASE 1 : FINDINGS

5.2.1 Data refinement

Table 5.1 : Data refinements

Project	Number of units from inspection records	Duplicated sites	Revised sample size	Foundation/slab dates omitted	Second revised sample size	Inspection out of sequence (Slab and Completion)	Third revised sample size	Wall plate dates omitted	Revised Total number of units
Total	**1838**	**68**	**1770**	**270**	**1500**	**93**	**1407**	**48**	**1359**
Units paid	**1332**								

Results: Data of 479 units were deleted (26%), resulting in the sample of 1359 units, due to duplicated site numbers, omission of inspection dates, and inspection recorded out of sequence. The developer has been paid for 1332 units of 1359 inspected.

5.2.2 Defects analysis

A number of defects were found. The findings are presented in section 5.2.2.1 and 5.2.2.2. The defects analysis findings of major defect types that caused units to fail the inspections are presented in section 5.2.2.2(a). Defect types relating to incomplete work is presented in section 5.2.2.2(b), and defects relating to finishing are addressed in section 5.2.2.2(c). Industry statistics on defects in this sector were not obtainable. This was mainly as a result of none of the projects in the Pietermaritzburg area having been enrolled with the National Home Builders Registration Council (Janse van Vuuren, 2006). The only published guide obtainable was the Departments Housing Project Programming Guide, which was used to inform the timeframe analysis in section 5.2.3 hereof.

5.2.2.1 Defects in Sample

Table 5.2 : Number of defects in sample

DEFECTS ANALYSIS	No. Defects	% of Sample
Total number of sites	1359	100.00
Totally Defect free	799	58.79
Number of Units with defects	560	41.21
Total number defects in sample	742	54.6
Total Re-inspections	79	5.81

Results : 58,79 % of the units inspected were defect free throughout each stage of the inspection. 41,21% of units had defects. 5,81% of the inspections in the sample related to rework.

5.2.2.2 Frequency of defects in sample

(Refer to ***Appendix 11*** for a description of the defects)

Table 5.3 : Frequency of defects per category

	POTENTIAL FAILURE				Clearance	*FINISHING*			
	MAJOR STRUCTURAL		OTHER			PLUMBING		OTHER FINISHES	
	Construction	Material	Access/ Not Ready	Inadequate Services		Workman-ship	Material	Workman-ship	Material
Total per defect Sub- category	75.00	22.00	33.00	90.00	65.00	93.00	5.00	269.00	90.00
% No. Defects	10.11	2.96	4.45	12.13	8.76	12.53	0.67	36.25	12.13
% of Sample	5.52	1.62	2.43	6.62	4.78	6.84	0.37	19.79	6.62
	Major Structural		**Other**			**Plumbing**		**Other Finishes**	
Total per main category	97.00		33.00	90.00	65.00	98.00		359.00	
% No. Defects	13.07		4.45	12.13	8.76	13.21		48.38	
% of Sample	7.14		2.43	6.62	4.78	7.21		26.42	
	Potential Failure of Unit					**Finishing**			
Total per level of severity	220.0				65.00	457.00			
% No. defects	29.65				8.76	61.59			
% of Sample	16.19				4.78	33.63			

Results:

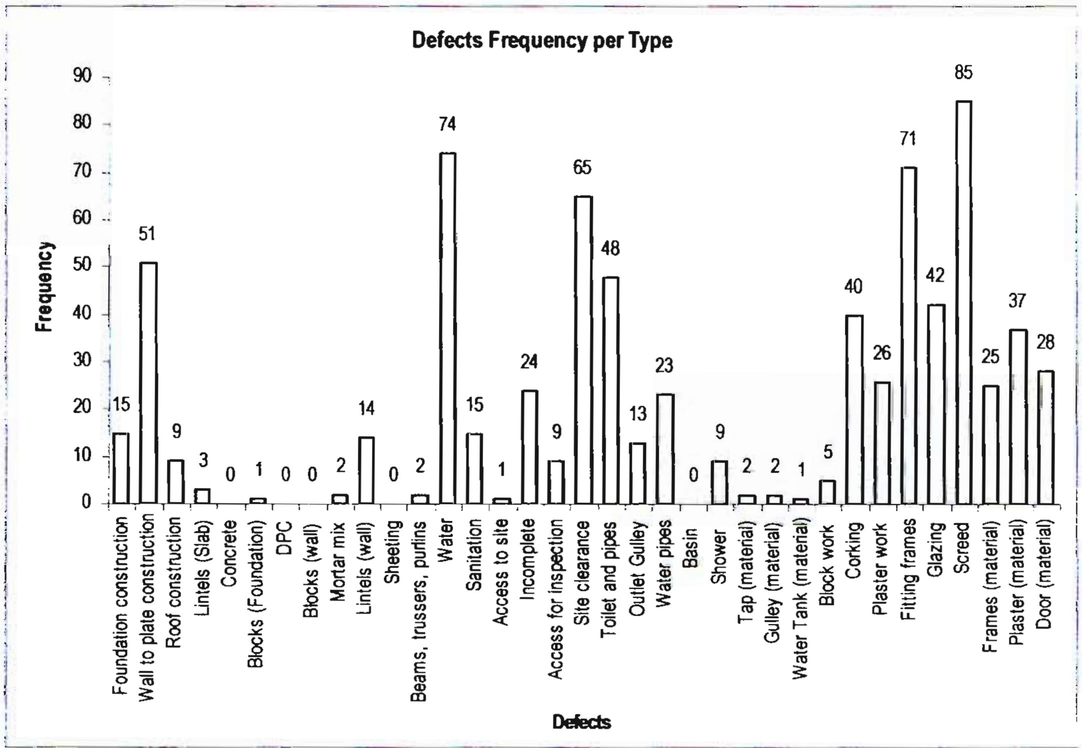
(1) 61,59% of all defects related to "finishing", and this is found in one third of the sample. 13,21% of the defects related to plumbing matters, whilst 48,38% related to other finishes. Workmanship matters contributed more to defects found in all

finishing related activities (48,78% of all defects), than is the case in materials (12.8% of all defects).

(2) 29,65% of all defects resulted in units being failed at inspection, and this was found in 16,19% of the sample. 13,07% of all defects related to major structural issues, whilst 16,58% related to matters other than structural. Defective materials used in the main construction activities contributed to 2,96% of all defects.

(3) Materials contributed the least to all defects (15,76% of all defects). Workmanship contributed the most to all defects (58,89%).

Figure 5.1 : Frequency of defects in sample



Results: Most defects were due to poor screeding (85 occurrences), followed by inadequate water supply (74 occurrences), and then by site clearance (65 occurrences). Construction of wall plates was the highest occurring error in the main construction process and caused 51 units to fail the inspection.

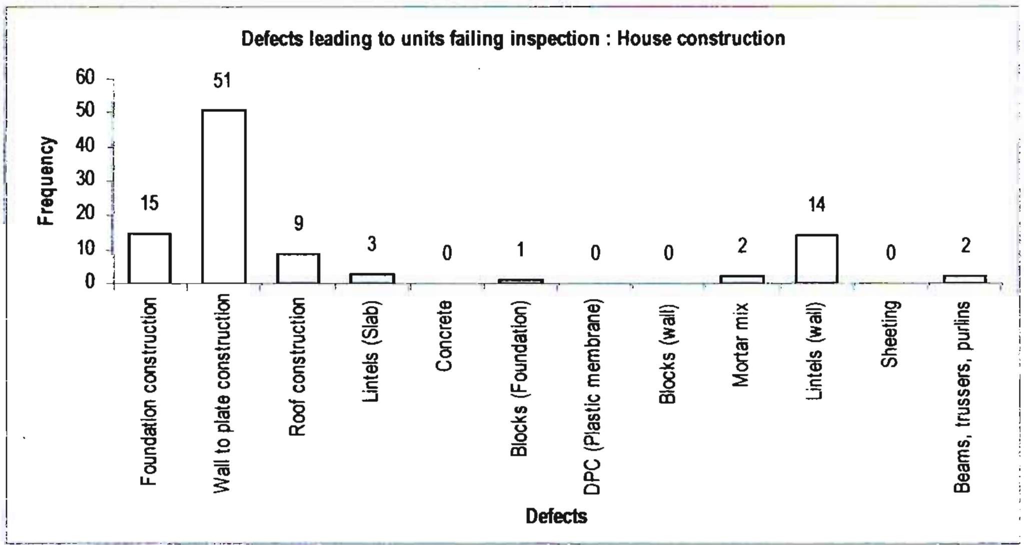
No defects were found in materials relating to concrete in the foundation; plastic waterproofing material of the foundation; blocks for the wall; roof sheeting; and basin.

(a) Defects leading to units failing inspections

Table 5.4 : Defects leading to units failing inspections

	MAJOR STRUCTURAL												OTHER		INADEQUATE SERVICES		
	Construction			Materials													
				Foundation				Wall			Roof						
	Foundation and Slab	Wall to plate	Roof	Lintels	Concrete	Blocks	DPC	Blocks	Mortar mix	Lintels (window , door, partitions	Sheeting (thickness and rust free	Beams and Purlins	Incomplete/not ready	Access/Keys	Water	Sanitation	Access
Total (per defect type)	15	51	9	3	0	1	0	0	2	14	0	2	24	9	74	15	1
% No. Defects	2.02	6.87	1.21	0.40	0	0.13	0	0	0.27	1.89	0	0.27	3.23	1.21	9.97	2.02	0.13
% of Sample	1.10	3.75	0.66	0.22	0	0.07	0	0	0.15	1.03	0	0.15	1.77	0.66	5.45	1.10	0.07
	Construction			Materials									Other		Inadequate Services		
Total per defect sub category	75			22									33		90		
% No. Defects	10.11			2.96									4.45		12.13		
% of Sample	5.52			1.62									2.43		6.62		
	Main Structural Activities												Other		Inadequate Services		
Total per main category	97												33		90		
% No. defects	13.07												4.45		12.13		
% of Sample	7.14												2.43		6.62		
Overall position with regard to defect leading to units failing inspections																	
Total per level of severity															220		
% No. of defects															29.65		
% of Sample															16.19		

Figure 5.2 : Defects leading to units failing inspections (excluding incomplete work)



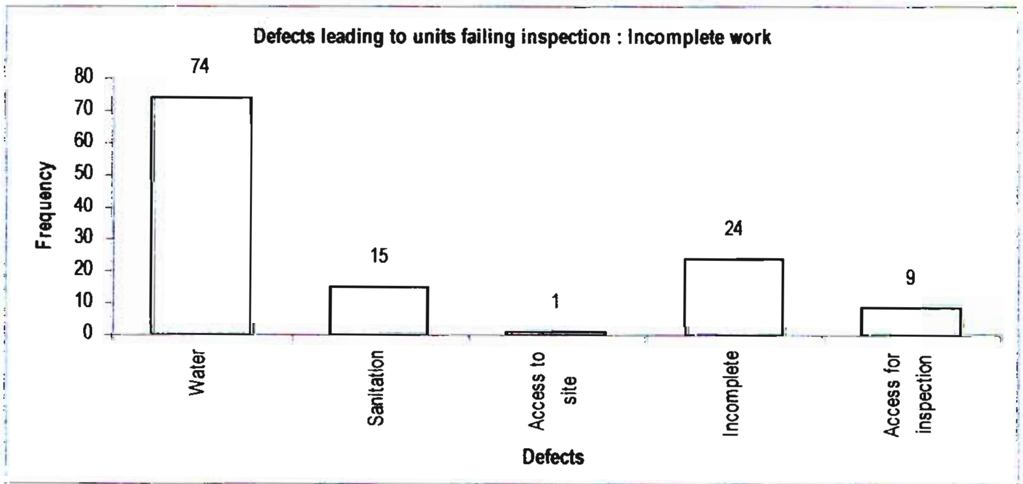
Results: Construction issues are the second highest cause of units failing inspection (as a sub-category with 75 cases (6%). Wall plate construction problems contribute to most construction failures, (51 cases in the sample, representing 4%) and is the second highest contributing factor with regard to units being failed through inspection. Materials quality contributed the least to quality concerns (22 cases, representing 2%, mainly due to faulty lintels used for windows, doors or internal partitions).

(b) Defects relating to incomplete work

Table 5.5: Units failed due to incomplete work

	OTHER		INADEQUATE SERVICES		
	Incomplete/ not ready	Access/Keys	Water	Sanitation	Access
Total (per defect type)	24	9	74	15	1
% Number Defects	3.23	1.21	9.97	2.02	0.13
% of Sample	1.77	0.66	5.45	1.10	0.07
	Other		Inadequate Services		
Total per defect sub category	33		90		
% Number Defects	4.45		12.13		
% of Sample	2.43		6.62		

Figure 5.3 : Units failed due to incomplete work



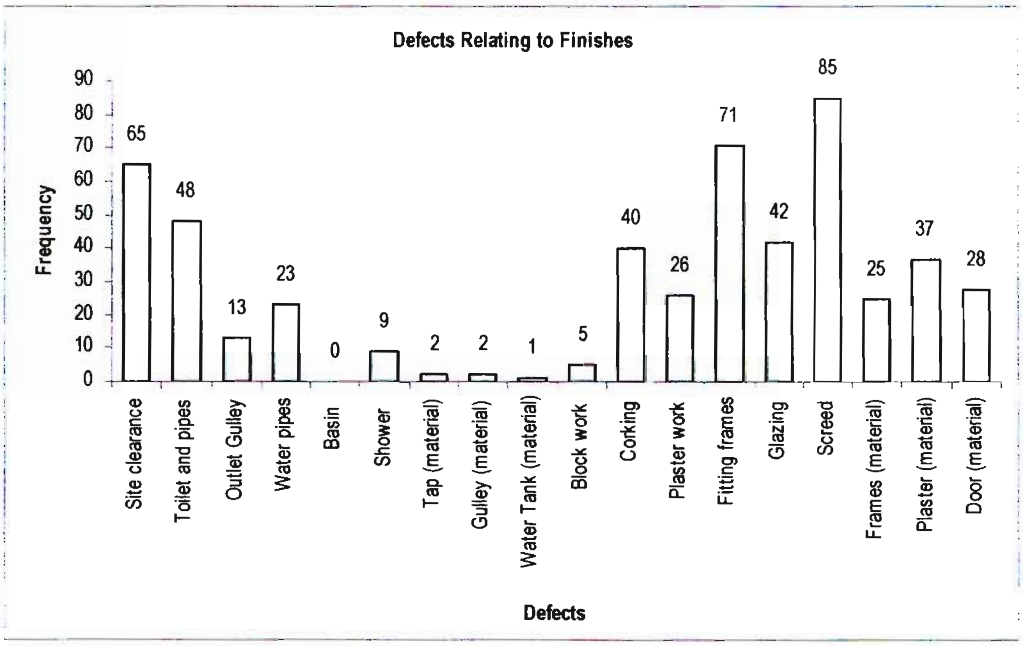
Results: Inadequate services caused most failures (90 occurrences =12,13% of all defects in the sample). Inadequate water supply was the highest cause in this subcategory, contributing 9,97% to all defects, and 5,45% of the entire sample.

(c) Defects relating to finishing

Table 5.6: Defects relating to finishing

Findings (Rounded off to one decimal)	PLUMBING								OTHER FINISHES								
	Workmanship					Material			Workmanship						Material		
	Toilet , pipes and rodding eyes	Outlet and Gully	Water pipes and taps	Basin	Shower	**Tap**	**Gully**	**Water tank**	Block work	Cork/Fill/Grout	Plaster	Fitting window-, and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	Door
Total (per defect type)	48	13	23	0	9	2	2	1	5	40	26	71	42	85	25	37	28
% No. Defects	6.5	1.8	3.1	0	1.2	0.3	0.3	0.1	0.7	5.4	3.5	9.6	5.7	11.5	3.4	45.0	3.4
% of Sample	3.4	1.0	1.7	0	0.7	0.2	0.2	0.1	0.3	2.9	1.9	5.2	3.1	6.3	1.8	2.7	2.0
Total per defect sub category	93					5			269						90		
% No. Defects	12.5					0.7			36.3						12.1		
% of Sample	6.8					0.4			19.8						6.6		
Total per main category	98.0								359								
% No. defects	13.21								48.4								
% of Sample	7.2								26.4								
Total per level of severity	457.0																
% No. of defects	61.6																
% of Sample	33.6																

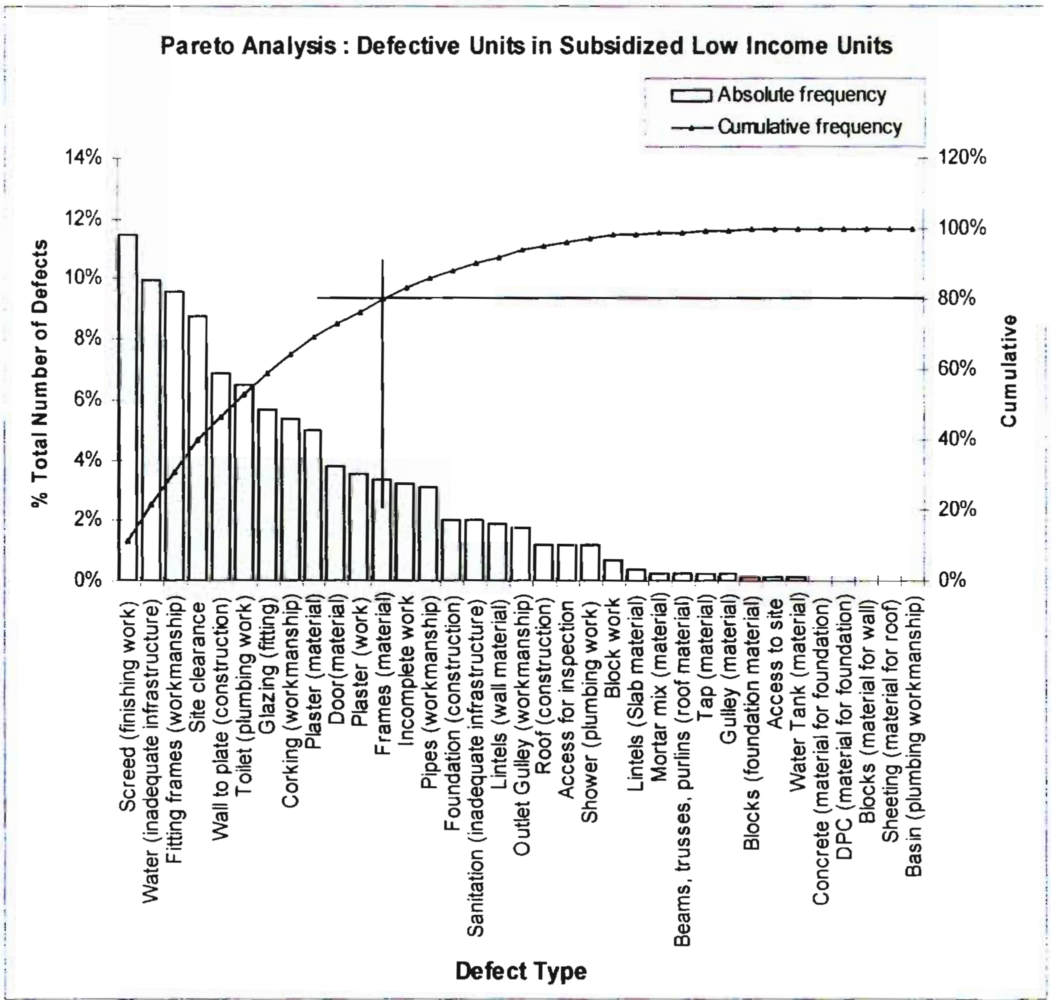
Figure 5.4: Defects relating to finishing



Results: Workmanship had the most significant impact on finishing type defects (48.78% of all defects, representing 26,63% of the sample as a whole). Screeding had the highest defect count (85 cases representing 6% found in sample, and 11% of all defects found in the sample), followed closely by fitting windows, glass and door frames (71 cases). Materials have the lowest defects count (less than 5% each, and 7% overall).

5.2.2.3 Pareto analysis

Figure 5.5: Pareto analysis of defective units in subsidised low-income units



Results : 12 of 35 defect types contribute to 80% of the defects in the total sample, and need to be addressed to have a significant impact of quality improvement. These are presented in Table 5.7.

Table 5.7 : Pareto analysis of critical defects to be addressed

Main Category	Sub-category	Cause	Activity	Number of Occurrences	Cumulative %	Priority
Finishes	Other finishes	Workmanship	Screed (Finishing work)	85	11.46%	1
Incomplete work	Inadequate services	-	Water (inadequate infrastructure)	74	21.43%	2
Finishes	Other finishes	Workmanship	Fitting frames (workmanship)	71	31.00%	3
Finishes	Clearance	-	Site clearance	65	39.76%	4
Major structural	Construction	-	Wall to plate (construction)	51	46.63%	5
Finishes	Plumbing	Workmanship	Toilet (plumbing work)	48	53.10%	6
Finishes	Other finishes	Material	Glazing (fitting)	42	58.76%	7
Finishes	Other finishes	Workmanship	Corking (workmanship)	40	64.15%	8
Finishes	Other finishes	Material	Plaster (material)	37	69.14%	9
Finishes	Other finishes	Material	Door(material)	28	72.91%	10
Finishes	Other finishes	Workmanship	Plaster (work)	26	76.42%	11
Finishes	Other finishes	Material	Frames (material)	25	79.78%	12

5.2.2.4 Descriptive statistics

(a) Defects per unit

Table 5.8: Descriptive statistics : Defects per unit

Descriptive statistics	Defects per unit
Number of defects	742
Mean	0.546
Standard Error	0.025
Median	0
Mode	0
Standard Deviation	0.925
Sample Variance	0.856
Skewness	1.794
Range	5
Minimum	0
Maximum	5
Sum	742
Count	1359
Largest(1)	5
Smallest(1)	0
Confidence Level (95.0%)	0.049

Results: The *mode* indicates that most units are defect free. The largest number of defects per unit was 5, the lowest number of defects was 0. The *mean* indicates an average of 0.546 defects per unit. In reality, the presence of a defect is absolute, thus, this may be viewed as an average of 1 defect per unit. The *standard error* of 0.03 is low, thus the mean is a good representation of the population. The *standard deviation* 0.93 is low, indicating that there is not a significant distribution of scores away from the mean, thus the mean is a good representation of the data (Field and Hole, 2003:131). The *sample variance* of 0.86 is also low, thus indicating that the mean is a good representation of the data. *Skewness* : The data is positively skewed to the right, indicating that there are relatively few large values in the data set (i.e. not many unit have close to 5 defects per unit), indicating that the frequent scores are at the lower end of the distribution. The confidence level (at 95%) indicates that hypothesis testing would result in accepting any hypothesis (H_0) seeking to prove that the population mean is equal to the sample mean at a 95% significance level, as the z-calc statistic used for this purpose indicates that the resultant value lies between -1,96 and +1,96 (Wegner, 2002:219). Hypothesis testing may result in accepting the hypothesis which may not be true. The population standard deviation required for a meaningful calculation (Wegner, 2002:222) is unknown, thus making hypothesis testing less reliable. Hypothesis testing, thus would be inappropriate throughout this study, as explained in Chapter 4, paragraph 4.5.1.5.

(b) Defects per type

(i) Major structural (excluding defects observed with a zero (0) count)

Table 5.9 : Descriptive statistics : Major construction defects

Descriptive statistics	**Construction**			**Materials**				
				Foundation				
	Foundation and Slab	Wall to plate	Roof	Lintels	Blocks	Mortar mix	Lintels (window -, door, partitions	Beams and Purlins
Number of defects	15	51	9	3	1	2	14	2
Mean	1	1	1	1	1	1	1	1
Standard Error	0	0	0	0	8.3E-15	0	0	0
Median	1	1	1	1	1	1	1	1
Mode	0	0	0	0	0	0	0	0
Standard Deviation	0	0	0	0	≈0	0	0	0
Sample Variance	0	0	0	0	≈0	0	0	0
Skewness	0[1]	0[1]	0[1]	0[2]	0[2]	0[2]	0[1]	0[2]
Range	1	1	1	1	1	1	1	1
Minimum	0	0	0	0	0	0	0	0
Maximum	1	1	1	1	1	1	1	1
Sum	15	51	9	3	1	2	14	2
Count	15	51	9	3	1	2	14	2
Largest(1)	1	1	1	1	1	1	1	1
Smallest(1)	0	0	0	0	0	0	0	0
Note 1: Standard Deviation = 0, thus 0								
Note 2: Fewer than 3 data points, and Standard Deviation=0, thus 0								

Results: The *mode* indicates that most units are free from any of the defects identified. The largest number of defects per unit was at least 1, the lowest number of defects was 0. This is the case in respect of all defect types relating to major construction. The *mean* indicates an average of 1 defect per unit in all instances. The *standard error* in all cases is 0. The standard error in respect of "Blocks" is insignificant, thus also close to 0. This indicates that the *mean* is a good representation of the population. The same is found in respect of the *standard deviation*, and *sample variance*, thus supporting indications that the mean represents the data well. *Skewness* is 0, thus the data is not skewed, indicating that data in all instances is distributed around the mean.

(ii) Incomplete Work (excluding defects observed with a zero (0) count)

Table 5.10 : Descriptive statistics : Incomplete work

Descriptive statistics	**OTHER**		**INADEQUATE SERVICES**		
	Incomplete/not ready	Access to unit	Water	Sanitation	Access to property
Number of defects	24	9	74	15	1
Mean	1	1.111	1	1	1
Standard Error	0	0.111	0	0	8.3E-15
Median	1	1	1	1	1
Mode	0	0	0	0	0
Standard Deviation	0	0.333	0	0	≈0
Sample Variance	0	0.111	0	0	≈0
Skewness	0[1]	3	0[1]	0[1]	0[2]
Range	1	1	1	1	1
Minimum	0	0	0	0	0
Maximum	1	2	1	1	1
Sum	24	10	74	15	1
Count	24	9	74	15	1
Largest(1)	1	2	1	1	1
Smallest(1)	0	0	0	0	0
Note 1: Standard Deviation = 0, thus 0					
Note 2: Fewer than 3 data points, and Standard Deviation=0, thus 0					

Results: The *mode* indicates that most units are free from any of the defects identified. The largest number of defects per unit was at least 1, the lowest number of defects was 0. This is the case in respect of all defect types relating to incomplete work. The *mean* indicates an average of 1 defect per unit in all instances. The *standard error* in all cases is very low, thus indicating that the mean is a good representation of the population. The same is found in respect of the *standard deviation*, and *sample variance*, thus supporting indications that the mean represents the data well. *Skewness* for units that were incomplete or not ready for inspection; inadequate water and sanitation; and access is 0, thus the data is not skewed, indicating that data in all instances is distributed around the mean. Data for access is positively skewed, indicating that the low number of defects (9) are skewing the data to the right, and is increasing the value of the mean.

(iii) Finishes (excluding defects observed with a zero (0) count)

Table 5.11 : Descriptive statistics : "Finishing" defects

Descriptive Statistics	Clearance	PLUMBING							OTHER FINISHES								
		Workmanship				Material			Workmanship					Material			
	Site clearance	Toilet , pipes and rodding eyes	Outlet and Gully	Water pipes and taps	Shower	Tap	Gully	Water tank	Block work	Cork/Fill/Grout	Plaster	Fitting windows-, and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	Door
Number of defects	65	48	13	23	9	2	2	1	5	40	26	71	42	85	25	37	28
Mean	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Standard Error	0	0	0	0	0	0	0	8.23 E-15	0	0	0	0	0	0	0	0	0
Median	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mode	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Standard Deviation	0	0	0	0	0	0	0	≈0	0	0	0	0	0	0	0	0	0
Sample Variance	0	0	0	0	0	0	0	≈0	0	0	0	0	0	0	0	0	0
Skewness	0[1]	0[1]	0[1]	0[1]	0[1]	0[2]	0[2]	0[2]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	01	0[1]
Range	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sum	65	48	13	23	9	2	2	1	5	40	26	71	42	85	25	37	28
Count	65	48	13	23	9	2	2	1	5	40	26	71	42	85	25	37	28
Largest(1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Smallest(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Note 1: Standard Deviation = 0, thus 0																	
Note 2: Fewer than 3 data points, and Standard Deviation=0, thus 0																	

Results:

The *mode* indicates that most units are free from any of the defects identified. The largest number of defects per unit was at least 1, the lowest number of defects was 0. This is the case in respect of all defect types relating to finishing. The *mean* indicates an average of 1 defect per unit in all instances. The *standard error* in all cases is 0, thus indicating that the mean is a good representation of the population. The same is found in respect of the *standard deviation*, and *sample variance*, thus supporting indications that the mean represents the data well. *Skewness* is 0, thus the data is not skewed, indicating that data in all instances is distributed around the mean.

5.2.2.5 Poisson analysis

(a) Number of defects per unit

Table 5.12: Poisson probability analysis : Number of defects per unit

Probability sample value	% Probability
0.546	100
≥0	100
1	100

(b) Major construction

Table 5.13 : Poisson probability analysis : Major construction defects

Poisson results : Using Overall Sample Mean : % Probability of occurrence												
Probability sample value	MAJOR STRUCTURAL											
	Construction			Material/s								
				Foundation				Wall			Roof	
	Foundation and Slab	Wall to plate	Roof	Lintels	Concrete	Blocks	DPC	Blocks	Mortar mix	Lintels, (window-, door, partitions	Sheeting (thickness and rust free	Beams and Purlins
0.546	100	100	100	100	100	100	100	100	100	100	100	100
0	100	100	100	100	100	100	100	100	100	100	100	100
≥1	100	100	100	100	100	100	100	100	100	100	100	100

(c) Incomplete work

Table 5.14: Poisson probability analysis : Incomplete work

Using Sample Mean : % Probability	OTHER		INADEQUATE SERVICES		
Probability sample value	Incomplete/not ready	Access/Keys	Water	Sanitation	Access
0.546	100	100	100	100	100
0.00	100	100	100	100	100
≥1.00	100	100	100	100	100

(d) Finishing

Table 5.15: Poisson probability analysis : "Finishing" defects

Poisson results : Using Sample Mean : % Probability																		
		PLUMBING								OTHER FINISHES								
		Workmanship					Material			Workmanship						Material		
Probability sample value	**Clearance**	Toilet , pipes and rodding eyes	Outlet and Gully	Water pipes and taps	Basin	Shower	**Tap**	**Gully**	**Water tank**	Block work	Cork/Fill/Grout	Plaster	Fitting window-, and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	Door
0.546	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
≥1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Results : There is a 100% probability of a unit not having any defects and there is an equal probability that one or more defects may occur (Table 5.12). There is also a 100 % probability of any one defect type not occurring in housing projects in Pietermaritzburg and an equal probability of any one such defect occurring (Tables 5.13, 5.14 and 5.15).

5.2.3 Time frame analysis

5.2.3.1 Inspections conducted

Table 5.16: Inspections completed

INSPECTIONS COMPLETED (During 1April 2005 to 31 December 2005)			
STAGE	Foundation and slab	Wall Plate	Completion
No. inspections	236	758	1359
% of Sample	17	56	100

Results : Only 17% of the units inspected from foundation stage were completed in the 9 month cycle. 56% of the units inspected at wall plate stage were completed over the same time. This translates to 9 months to complete 236 units from foundation through to completion (thus an average of 26.3 units/month), and 758 units from wall and plate level to completion (thus an average of 84.2 units/month).

5.2.3.2 Descriptive statistics

Table 5.17: Time frame analysis : Descriptive statistics

DESCRIPTIVE STATISTICS	STAGE INSPECTION			TIME FRAMES		
	SLAB	WALL PLATE	COMPLETION	Slab to wall	Wall to completion	Total
Average	-	-	-	173	135	307
Mode	-	-	-	0	0	84
Frequency	-	-	-	98	69	137
Median	-	-	-	146	101	316
Standard Deviation				147.38	112.2	170
Sample Variance				21723	12596	28888
Skewness				0.61	1.092	0.095
MIN	24-Feb-03	11-Feb-04	2-Feb-05	0	0	0
MAX	23-Nov-05	20-Dec-05	20-Dec-05	655	510	779
Range	1003	678	321	655	510	779
Stage inspections per day	1.36	2.01	4.24	2.08	2.67	1.75
Average no. stage inspections per month (30 days)	40.68	60.18	127.10	62.29	80.00	52.37
Difference between first slab and last completion stage (Days)						1030
Average number of completed units/day						1.32
Average number of completed units/month (30 days)						39.61

Results: The first slab inspection in the sample was done on 24 February 2003. The last slab inspection was 23 November 2005, thus a total of 1003 days between the first and the last slab inspection. The first wall plate inspection in the sample was 11 February 2004, while the last was on 20 December 2005, thus 678 days from the first wall plate level inspection to the last. The first completion inspection in the sample was 2 February 2005, and the last inspection was 20 December 2005, thus a total of 321 days between the first and last completion inspection in the sample. 1030 days separate the first slab and last completion inspection.

5.2.3.3 Time frame comparison

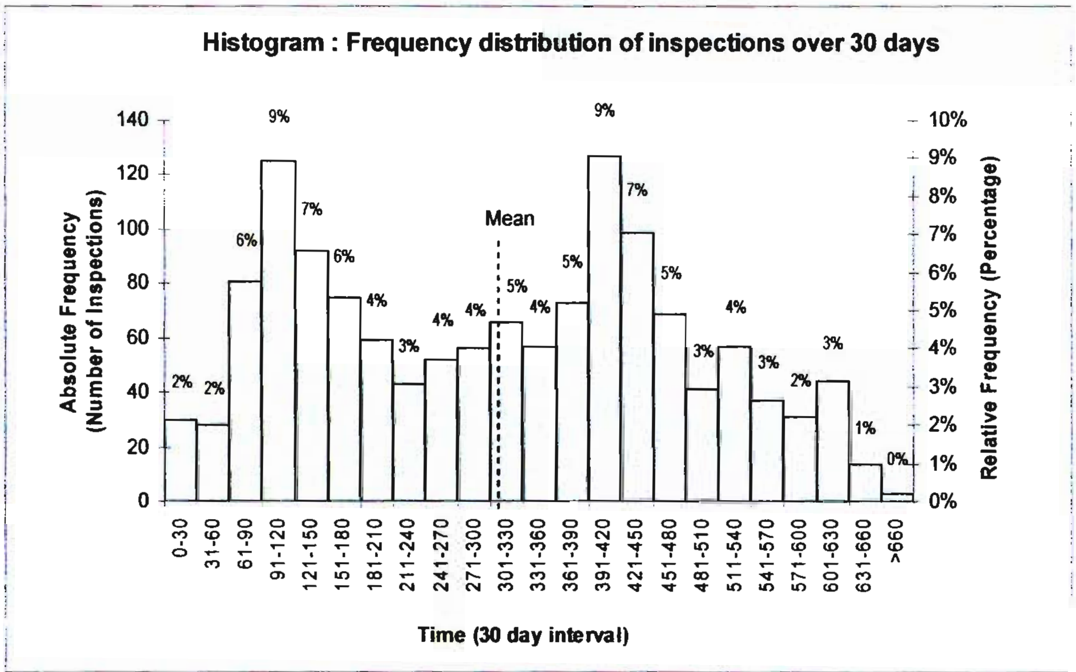
The Department of Housing's Programming Guide uses a medium risk approach in modelling development timeframes (1997:9). In terms of this, it assumes a timeframe of 129 days from the start of construction to the final inspection (1997:49)

Thus, based on the mode it appears that completion inspections are done well within the timeframe. However, this may be due to the fact that some units (8 in sample) were inspected from start to finish in one day, thus skewing the mode and making it a less reliable indicator.

The average timeframe of 307 days indicates that the completion inspections exceed the Department of Housing model of 129 days (1997:49), thus confirming lengthy periods of time to completion inspections. However, the data is highly variable around the mean, and very slightly skewed positively to the right, thus indicating there are very few values that are very high.

5.2.3.4 Frequency distribution : Completion inspections

Figure 5.6: Histogram of inspection frequency



Results : The histogram confirms that data around the mean is highly variable. There is a high frequency of completion inspections that have occurred below the mean of 307 days and in the 91 to 120 day interval, which is the case for approximately 9% of the inspections in the sample. Inspection frequencies below the mean also occurred during the 61 to 90; and 121 to 150 interval (approximately 15% of the units). These coincide with the Department's model that suggests 129 days. Approximately 19 to 25% of inspections are done within 129 days. Most inspections exceed the 129 day timeframe.

Less than a quarter of the completion inspections are done within 129 days, based on the Department of Housing's model in the "Housing Project Programming Guide". The majority of the units fall outside the Department's model.

5.3 PHASE 2 : FINDINGS

This phase of the research dealt with the perceived causes of quality concerns (Section 1 of the questionnaire); exploring the existing systems and efficiencies (Section 2); whilst also providing for additional comments from respondents regarding quality issues in low-income housing (Section 3). These were all done from the perspectives of the municipality, developer, and Department of Housing. Copies of the questionnaire and a summary of scores are attached as ***Appendix 15.***

Findings are presented in accordance with the responses, where agreement between respondents from the same institution falls within the categories of agreement (i.e. indications that the respondents agree or strongly agree, are viewed as "agree". Responses relating to disagree, or strongly disagree, are viewed as "disagree"). Where agreement was not clear, these are recorded as "mixed responses".

5.3.1 Section 1 : Possible causes of quality concerns

The objective of this section was to confirm perceptions of possible causes of quality concerns in the Pietermaritzburg area. Findings for this section are, thus, presented for the group collectively, and are presented in tabular format, in accordance with the groupings of questions as outlined in Chapter 4, paragraph 4.5.2.2.

Note : Shaded areas in each table in Section 5.3.1.1 to 5.3.1.7 reflect the minority number of responses to the statement.

5.3.1.1 Question 1 : Perception on existence of quality concerns

Table 5.18 : Perception on existence of quality concerns.

No.	Statement	Agreed (%)	Disagree (%)	"Not sure"(%)
1.	Quality concerns exist in low-income housing in Pietermaritzburg	**75.00**	**25.00**	**0.00**

Results : Most respondents agree that quality concerns exist in low-income housing.

5.3.1.2 Questions 2 and 3 : Nature of defects

Table 5.19 : Nature of defects

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
2.	Most defects in the area relate to structural issues.	**37.50**	**62.50**	**0.00**
3.	Most defects relate to finishing.	**75.00**	**25.00**	**0.00**

Results : Most respondents agree that most defects relate to finishing.

5.3.1.3 Questions 4 to 9: Confirmation of possible causes

(a) Resources

Table 5.20 : Confirmation of possible causes : Resources

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
4.	Defects are caused mainly through the availability of resources, in terms of:			
(a)	- Finance	**75.00**	**25.00**	**0.00**
(b)	- Skilled labour	**100.00**	**0.00**	**0.00**
(c)	- The following major materials			
	Cement	**25.00**	**62.50**	**12.50**
	Sand	**12.50**	**75.00**	**12.50**
	Stone	**12.50**	**75.00**	**12.50**
	Steel	**12.50**	**75.00**	**12.50**
	Timber	**25.00**	**75.00**	**0.00**
	Water	**12.50**	**62.50**	**12.50**

Results : Most respondents agreed that lack of finance and skilled labour contributed to resource related quality causes. All respondents agreed that skilled labour was such a cause. Most respondents disagreed that availability of materials was such a cause.

(b) Materials quality

Table 5.21: Confirmation of possible causes : Materials quality

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
5.	Defects are caused mainly by poor quality material.	**37.50**	**62.50**	**0.00**
6.	Materials are SABS or Agrément compliant.	**25.00**	**62.50**	**12.50**
7.	Material and product samples are regularly tested against SABS or Agrément requirements.	**37.50**	**50.00**	**12.50**

Results : Most respondents disagree that defects are caused mainly through poor quality material. Most respondents disagree that materials are SABS or Agrément compliant and/or that sample tests are undertaken regularly against these requirements.

(c) Workmanship

Table 5.22 : Confirmation of possible causes : Workmanship

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
8.	Defects are caused mainly through poor workmanship	**62.50**	**37.50**	**0.00**

Results : Most respondents agree that defects are caused mainly through poor workmanship.

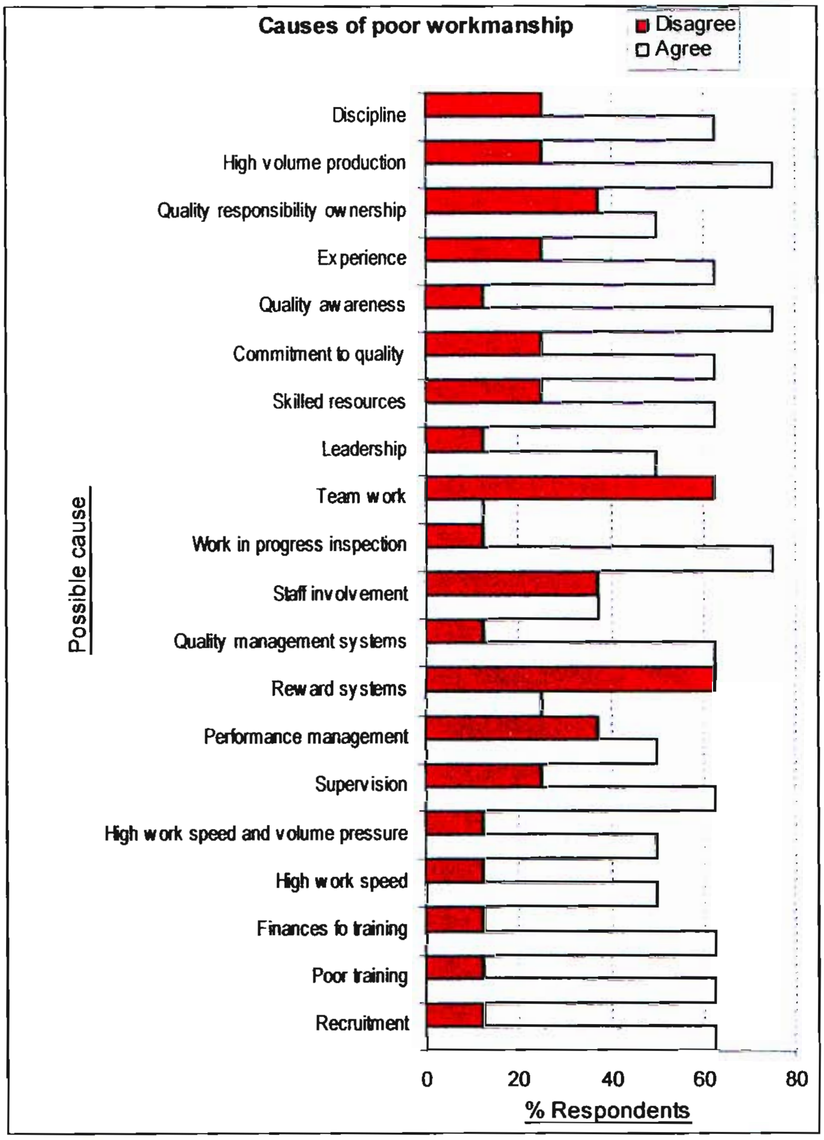
(d) Causes of poor workmanship

Table 5.23 : Perceptions of causes of poor workmanship

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)	Item not selected
9.	Poor workmanship is caused by:				
(a)	- Inappropriate recruitment processes.	**62.50**	**12.50**	**0.00**	**25.00**
(b)	- Poor training.	**62.50**	**12.50**	**0.00**	**25.00**
(c)	- Lack of financial support for training	**62.50**	**12.50**	**0.00**	**25.00**
(d)	- High work speed requirement	**50.00**	**12.50**	**0.00**	**37.50**
(e)	- Pressure (stress) relating to high volume and short time frames.	**50.00**	**12.50**	**0.00**	**37.50**
(f)	- Lack of supervision.	**62.50**	**25.00**	**0.00**	**12.50**
(g)	- Lack of performance management.	**50.00**	**37.50**	**0.00**	**12.50**
(h)	- Lack of reward systems.	**25.00**	**62.50**	**0.00**	**12.50**
(i)	- Lack of proper quality management systems	**62.50**	**12.50**	**0.00**	**25.00**
(j)	- Lack of staff involvement in problem solving.	**37.50**	**37.50**	**0.00**	**25.00**
(k)	- Lack of inspection during production processes.	**75.00**	**12.50**	**0.00**	**12.50**
(l)	- Lack of team work.	**12.50**	**62.50**	**0.00**	**25.00**
(m)	- Lack of leadership.	**50.00**	**12.50**	**0.00**	**37.50**
(n)	- Lack of competently skilled resources.	**62.50**	**25.00**	**0.00**	**12.50**
(o)	- Lack of commitment to quality.	**62.50**	**25.00**	**0.00**	**12.50**
(p)	- Lack of quality awareness.	**75.00**	**12.50**	**0.00**	**12.50**
(q)	- Lack of experience.	**62.50**	**25.00**	**0.00**	**12.50**
(r)	- Lack of quality responsibility ownership.	**50.00**	**37.50**	**0.00**	**12.50**
(s)	- High volume production within shortest possible timeframes.	**75.00**	**25.00**	**0.00**	**0.00**
(t)	- Lack of discipline	**62.50**	**25.00**	**0.00**	**12.50**

These findings are graphically represented in Figure 5.7, below.

Figure 5.7 : Possible causes of poor workmanship



Results : These perceived causes of poor workmanship are: Lack of inspection during production processes; high volume production within the shortest possible time frames; lack of quality awareness, competently skilled resources, commitment to quality, proper quality management systems, experience, supervision, and discipline; inappropriate recruitment processes; poor training; and lack of financial support for training.

5.3.1.4 Question 10 : Perception of acceptability of defects rates

Table 5.24 : Perception of acceptability of defects rates

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
10.	Quality defect rates are within acceptable tolerances.	**12.50**	**75.00**	**12.50**

Results : Most respondents do not agree that defect rates are within acceptable tolerances.

5.3.1.5 Questions 11 and 12 : Perceptions of impact of quality management

Table 5.25 : Perception of impact of quality management

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
11.	Quality defects result in major rework and/or re-inspections.	**25.00**	**62.50**	**12.50**
12.	Quality defects impact on cash flow.	**62.50**	**25.00**	**12.50**

Results : Most respondents do not agree that quality defects result in major rework and/or re-inspections. Most respondents agree that quality defects impact on cash flow.

5.3.1.6 Questions 13 and 14 : Use of warranties.

Table 5.26 : Use of warranties

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
13.	Product warranties are in place.	**25.00**	**62.50**	**12.50**
14.	Claims against warranties are measured.	**12.50**	**75.00**	**12.50**

Results: Most respondents do not agree that product warranties are in place. Most respondents do not agree that claims against warranties are measured.

5.3.1.7 Questions 15 to 22 : Perception of delivery rates and measurement.

Table 5.27 : Perception of delivery rates and measurement

No.	Statement	Agreed (%)	Disagree (%)	"Not sure"(%)
15.	The average yield of 40 units per month (completed and passed for payment) is acceptable.	**25.00**	**62.50**	**12.50**
16.	Construction stages (foundation and slab : wall plate : completion) are programmed and monitored.	**12.50**	**75.00**	**12.50**
17.	Delivery rates between timeframes are acceptable.	**0.00**	**75.00**	**12.50**
18.	Product specifications and timeframes are stipulated in the contract.	**50.00**	**37.50**	**12.50**
19.	Timeframes, costs and product specifications are adhered to at all times.	**0.00**	**75.00**	**25.00**
20.	Variations to the contract are negotiated with all stakeholders and are formalised.	**0.00**	**87.50**	**12.50**
21.	Quality concerns are addressed at site meetings	**25.00**	**62.50**	**12.50**
22.	Repetitive quality problems are included in organisational strategies.	**25.00**	**62.50**	**12.50**

Results : Most respondents agree that product specifications and timeframes are stipulated in the contract; and disagree that the yield is acceptable, construction stages are programmed and monitored, delivery rates are acceptable, variations to contract or negotiated with all parties are formalised, quality concerns are addressed at site meetings, and/or that repetitive quality problems are included in organisational strategies.

5.3.1.8 Question 23 : Provision for respondent to list other possible causes.

Table 5.28 : Comments received regarding other possible causes

Respondent No.	Comment
1.	Poor selection of contractors.
	Lack of Cooperation from Implementing Agent.
3.	Poor education to the end user. Customers are first time home owners and need thorough education on how to care for their new homes.
4.	There is a direct correlation between finance, experienced and qualified skills and supervision. The product is financially constrained, limited to local semi skills, and appropriate supervision for the aforementioned is not affordable.
6.	Unskilled supervisors contribute to quality concerns.
	Scope of work not being fully explained to work force.
	Lack of competent and higher qualified trainers or instructors on site.
	National Building Regulations unknown or not practiced by contractors.
8.	Lack of proper equipment.
	Lack of proper site supervision, engineer or building professional on site.
	Lack of inspection resources within municipality.

5.3.2 Section 2 : Quality Management Systems and Efficiencies

The objective of this section was to explore current quality management systems and efficiencies within the municipality, implementing agents and the Department of Housing, respectively, and specifically in relation to low-income housing projects in the Pietermaritzburg area. Findings are recorded in tabular format, in accordance with the groupings of questions as outlined in Chapter 4, paragraph 4.5.2.2. A Mixed response is interpreted as "inconclusive".

Note : Shaded areas in each table in Section 5.3.2.1 to 5.3.2.13 reflect areas with mixed, unsure, or not selected responses, resulting in inconclusive findings on the direct responses.

5.3.2.1 Question 1 : Presence of a quality management system and its focus in terms of customer orientation

Table 5.29 : Presence of quality management system and customer focus

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
1.1	Your organization has a quality management system.	Agree	Agree	Disagree	Disagree
1.2	In your organization, quality management involves **all** internal components.	Disagree	Mixed	Disagree	Disagree
1.3	In your organization, quality management involves **all** external role players	Disagree	Mixed	Disagree	Disagree
1.4	Quality concerns are defined by:				
(a)	- Primarily the customer.	Mixed	Mixed	Mixed	Mixed
(b)	- Primarily the developer.	Mixed	Agree	Disagree	Disagree
(c)	- Primarily the municipality	Agree	Mixed	Disagree	Disagree
(d)	- Primarily the Department of Housing.	Agree	Agree	Agree	Agree
(e)	- All of the above.	Mixed	Mixed	Disagree	Disagree
(f)	- None of the above.	Mixed	Mixed	Mixed	Mixed
1.5	The responsibility for quality lies with:				
(a)	- Primarily the customer.	Disagree	Mixed	Disagree	Mixed
(b)	- Primarily the developer.	Agree	Agree	Disagree	Agree
(c)	- Primarily the municipality.	Agree	Mixed	Disagree	Agree
(d)	- Primarily the Department of Housing.	Agree	Mixed	Agree	Agree
(e)	- All of the above.	Mixed	Mixed	Mixed	Mixed
(f)	- None of the above.	Disagree	Mixed	Disagree	Mixed

Results : The municipality and the developer appear to have a quality management system, but internal and external role players are not involved in the process in either of the systems. The Department of Housing does not have a formalised system. All respondents view quality as primarily the responsibility of the Department of Housing.

5.3.2.2 Question 2 : Correlation of quality management system with ISO 9000

Table 5.30 : Correlation with ISO 9000

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
2.1	Your organization undertakes regular company wide quality assessments (at least once a year).	Disagree	Mixed	Disagree	Disagree
2.2	Your organization follows ISO 9000 quality standards.	Mixed	Mixed	Disagree	Disagree
2.3 (a)	Quality management in your organization is customer focused.	Mixed	Agree	Agree	Disagree
(b)	Quality management is practiced with effective leadership.	Mixed	Agree	Disagree	Disagree
(c)	Quality management follows a process approach.	Mixed	Agree	Disagree	Disagree
(d)	Quality management supports a systems approach to management.	Mixed	Agree	Disagree	Mixed
(e)	Quality management focuses on continuous improvement.	Mixed	Agree	Disagree	Mixed
(f)	Quality management includes a factual approach to decision making.	Mixed	Agree	Disagree	Mixed
(g)	Quality management is aimed at mutual beneficial supplier relationships.	Mixed	Agree	Disagree	Disagree
(h)	Quality management is practiced with effective leadership.	Mixed	Agree	Disagree	Disagree

Results:

(1) The municipality and Department of Housing do not undertake regular company wide quality assessments. Information regarding this in respect of the developer is inconclusive.

(2) The Department does not follow ISO 9000 quality standards. Information regarding this aspect from the municipality is inconclusive. The Developer appears to follow ISO quality management principles listed in question 2.3(a)-(g).

5.3.2.3 Question 3: Application of different approaches for chronic and sporadic problems

Table 5.31 : Flexibility of problem solving approaches

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
3.1	Different approaches are followed for quality problems that occur less often and/or are less severe, than those that happen often and/ or have a major impact on delivery.	Mixed	Agree	Agree	Disagree
3.2	A diagnostic approach is followed in solving quality management problems.	Mixed	Agree	Agree	Mixed

Results: Information from the municipality is inconclusive. The developer and monitors within the Department appear to have a more flexible approach to problem solving than the inspectors.

5.3.2.4 Question 4 : Continuous improvement through benchmarking and customisation of quality systems to range of customers

Table 5.32 : Benchmarking and customization of quality management system

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
4.1	Quality is benchmarked against competitors.	Mixed	Mixed	Disagree	Disagree
4.2	Quality management in your organization recognizes a range of different customers with different needs.	Disagree	Mixed	Disagree	Mixed
4.3	A quality management policy is in place.	Disagree	Mixed	Disagree	Disagree

Results : Information from the developer is inconclusive in all of the above aspects. None of the organs of state has a quality management policy, nor are the quality management approaches customised to recognise different needs with regard to quality.

5.3.2.5 Question 5 : Quality control and responsibility

Table 5.33 : Quality control and responsibility

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
5.1	Quality control includes a quality score card.	Mixed	Disagree	Disagree	Mixed
5.2	Final inspections are the responsibility of:				
(a)	- Primarily the customer.	Mixed	Agree	-	Mixed
(b)	- Primarily the developer.	Mixed	Agree	-	Agree
(c)	- Primarily the municipality.	Mixed	Agree	-	Agree
(d)	- Primarily the Department of Housing.	Mixed	Agree	Agree	Agree
(e)	- All of the above.	Mixed	Agree	-	-
(f)	- None of the above.	Mixed	Agree	-	Mixed
5.3	Inspections are carried out by:				
(a)	- Primarily the customer.	Mixed	Agree	-	Mixed
(b)	- Primarily the developer.	Mixed	Agree	-	Mixed
(c)	- Primarily the municipality.	-	-	-	Agree
(d)	- Primarily the Department of Housing.	Mixed	Agree	Agree	Agree
(e)	- All of the above.	-	-	-	-
(f)	- None of the above.	-	-	-	-
5.4	All stakeholders are aware of the criteria used in inspection processes.	Mixed	Mixed	Mixed	Mixed
5.5	Inspection processes are based on prior knowledge of product quality, similarity within the lot and allowable risk.	Mixed	Agree	Agree	Mixed
5.6	The following is typical of inspections :				
(a)	- No inspection.	-	-	Mixed	-
(b)	- Small samples.	Mixed	Mixed	Mixed	-
(c)	- Large samples.	-	Mixed	-	-
(d)	- 100% inspection.	-	Mixed	Mixed	Mixed
(e)	- Snags are done prior to final inspections.	Agree	Mixed	Mixed	Disagree
(f)	- Snags are addressed properly and within the given time.		Mixed	Mixed	Disagree

Results : Mixed responses were received in most instances, however, most of the respondents perceive final inspections as being the responsibility of the Department, and agree that these are being carried out by the Department.

5.3.2.6 Question 6 : Strategic quality management

Table 5.34 : Strategic quality management

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
6.1	Quality is part of the strategic management process to ensure long term customer satisfaction goals.	Disagree	Mixed	Disagree	Agree
6.2	In your organization:				
(a)	Quality management is lead and supported by top management.	Mixed	Agree	Disagree	Mixed
(b)	Proper infrastructure (including plans, goals, organisational mechanisms and resources, performance measurement and rewards) exist at all levels to implement a quality management system.	Disagree	Agree	Disagree	Disagree
(c)	Role players are not skeptic about the need for new quality management programmes.	Mixed	Disagree	Disagree	Mixed
(d)	Management relies ***principally on strong motivational technique to encourage improvement,*** once statistical strong evidence has been used to convince all of the seriousness of the problem.	Agree	Disagree	Mixed	Mixed
(e)	An incremental approach is followed is solving quality problems *(i.e. prioritization of quality problems to address, as opposed to trying to resolve all problems simultaneously).*	Mixed	Agree	Disagree	Disagree
(f)	Different techniques are used to achieve quality goals *(Please refer to Appendix 1 for typical tools and kindly indicate the 5 most frequently used in your organization).	Mixed	Agree	Disagree	Disagree
(g)	Sufficient time and resources are available to address quality, and the need to change priorities as a result thereof is supported by management).	Disagree	Mixed	Disagree	Disagree
6.3	Quality strategies are implemented throughout all line function activities.	Disagree	Agree	Disagree	Disagree

Results : Quality does not appear to be part of the municipality's strategy. Information on this aspect is inconclusive with regard to the other institutions. Neither the municipality nor the Department appear to have the necessary infrastructure in place, and quality strategies do not appear to be implemented throughout all line function activities. Whilst the developer appears to use an incremental approach, this does not appear to be the case within the Department.

*<u>Note</u>: Respondents indicated that the following techniques are used:

(1) Municipality: Typical tools used in quality management include process analysis; specification and standardisation; and Gantt Charts. Supply chain management was rated between 4 and 5, representing a transactional focus.

(2) Developer: Tools used by the project manager include process analysis and histograms. The senior project manager also uses run charts, control charts, and organisational structure. Both respondents use specification and standardisation; and Gantt charts. Supply chain management was rated between 5 and 6, thus between transactional and proactive.

(3) Department of Housing: The inspectors typically use check sheets and standards and specifications. Project monitors use Process analysis, run charts, specification and standardisation. Supply chain management was rated between 4 and 5, representing a transactional focus.

5.3.2.7 Question 7 : Quality culture

Table 5.35: Quality culture

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
7.1	Quality is part of the organization's vision.	Mixed	Agree	Mixed	Mixed
7.2	Decision making styles (command, consultative and consensus/agreement) are adapted to suit the situation at hand).	Mixed	Mixed	Disagree	Disagree
7.3	Management creates an environment that encourages learning from mistakes to encourage improvement.	Disagree	Disagree	Mixed	Disagree
7.4	Employees participate in quality related decision and take ownership of work related thereto.	Mixed	Mixed	Disagree	Disagree
7.5	Individual and team performance is measured regularly and are provided with feedback on progress.	Disagree	Disagree	Disagree	Disagree
7.6	Management base decisions on facts and scientific instruments.	Disagree	Agree	Disagree	Disagree
7.7	Staff is encouraged to share ideas, feelings and needs freely, in an open and trusting manner without fear of punishment.	Disagree	Agree	Disagree	Disagree
7.8	Managers act as role models for ethical practices.	Disagree	Agree	Disagree	Disagree

Results: Only the developer is conclusive that quality appears to be part of its organisation's vision. The management culture within each of the organisations does not encourage learning from mistakes. Team and individual performance does not seem to be measured and communicated. Only the developer appears to base decisions of fact and encourages staff to share ideas openly. Management within the developer's organisation are perceived as role models for ethical practice. This is not perceived to be the case within the organs of state.

5.3.2.8 Question 8 : Inclusion of customer needs

Table 5.36 : Inclusion of customer needs

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
8.1	Customer needs are well understood.	Disagree	Mixed	Disagree	Disagree
8.2	Customer needs defined based on proper market research.	Disagree	Mixed	Disagree	Mixed
8.3	Customer satisfaction is measured in terms of product features and freedom from deficiencies.	Disagree	Agree	Disagree	Disagree
8.4	Customer satisfaction surveys inform product development.	Disagree	Mixed	Disagree	Disagree

Results: Customer needs considerations are excluded within the organs of state. The information is inconclusive in respect of the developer, although it appears to measure customer satisfaction in terms of product compliance to specifications.

5.3.2.9 Question 9 : Supply chain management quality control

Table 5.37 :Supply chain management and quality control

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
9.1	Suppliers are evaluated regularly against quality defaults.	Mixed	Agree	Disagree	Disagree
9.2	Supplier quality problems are resolved through partnerships.	Mixed	Agree	Disagree	Disagree
9.3	Certified suppliers are used.	Mixed	Mixed	Disagree	Mixed
9.4	Suppliers understand all specification and standards clearly, and these are stated in quantitative terms.	Mixed	Agree	Mixed	Mixed
9.5	All role players understand **what** they should be doing. *(Please rate each of the role players listed in (a) to (e) below).*				
(a)	- Implementing agent, project manager or developer	Mixed	Agree	Mixed	Agree
(b)	- Suppliers	Mixed	Agree	Agree	Mixed
(c)	- Department of Housing	Mixed	Agree	Agree	Mixed
(d)	- Municipality	Mixed	Mixed	Agree	Mixed
(e)	- Community	Mixed	Mixed	Disagree	Disagree
9.6	All role players know **how to** undertake their functions.*(Please rate each of the role players listed in (a) to (e) below).*				
(a)	- Implementing agent, project manager or developer.	Mixed	Agree	Mixed	Mixed
(b)	- Suppliers.	Mixed	Agree	Agree	Mixed
(c)	- Department of Housing.	Mixed	Agree	Agree	Mixed
(d)	- Municipality.	Mixed	Agree	Disagree	Mixed
(e)	- Community.	Mixed	Agree	Disagree	Mixed
9.7	All stakeholders have suitable, controllable processes to meet specifications. *(Please rate each of the role players listed in (a) to (e) below).*				
(a)	- Implementing agent, project manager or developer.	Disagree	Agree	Disagree	Mixed
(b)	- Suppliers.	Mixed	Agree	Mixed	Disagree
(c)	- Department of Housing.	Disagree	Agree	Disagree	Mixed
(d)	- Municipality.	Disagree	Mixed	Agree	Disagree
(e)	- Community.	Disagree	Mixed	Disagree	Disagree

Results : Information is largely inconclusive in respect of the organs of state. The Department, however, does not appear to evaluate suppliers against defaults and also do not tend to resolve problems through partnerships. This is perceived to be occurring within the developer's organisation. The developer also perceives itself and the Department to understand what needs to be done, and that all role players understand how this should be done. Departmental monitors do not appear to agree with this statement.

5.3.2.10 Question 10 : Statistical control system

Table 5.38 : Statistical control system

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
10.	Statistical process control systems are used to measure and analyse all processes .	Disagree	Agree	Disagree	Mixed

Results : The organs of state do not use statistical process. The developer appears to use the tool.

5.3.2.11 Question 11 : Quality management in administration and support

Table 5.39 : Quality management in administration and support activities

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
11.	Rate the extent to which the administration and support activities in 11.1 to 11.3 are measured in terms of quality.				
11.1	Finance *(Rate the extent to which items (a) to (d) is measured by your organization).*				
(a)	- monetary value of invoices paid late.	Disagree	Agree	Disagree	Mixed
(b)	- average number of days to issuing of invoices.	Mixed	Mixed	Disagree	Disagree
(c)	-% of invoices returned due to errors.	Mixed	Agree	Disagree	Disagree
(d)	-monetary value of unrecoverable accounts receivable.	Not sure	Mixed	Mixed	Agree
11.2	Personnel *(rate the extent to which items (a) to (d) are measured by your organization).*				
(a)	-% resumes (cv's) received that result in interviews	Not sure	Mixed	Mixed	Disagree
(b)	-number of candidates interviewed before an offer is made and accepted.	Not sure	Mixed	Mixed	Disagree
(c)	-average number of days from request for personnel to initial employment date.	Not sure	Agree	Mixed	Disagree
(d)	-% certified/qualified workers in critical activities.	Not sure	Agree	Mixed	Disagree
11.3	Information technology *(rate the extent to which items (a) to (e) are measured by your organization)..*				
(a)	-% system uptime *(i.e. when systems can be used).*	Not sure	Agree	Agree	Mixed
(b)	- Mean (average) time between failures.	Not sure	Agree	Agree	Agree
(c)	- Mean (average) time to restore services.	Not sure	Agree	Agree	Agree
(d)	- Turnaround time for reports *(how long it takes to get reports out of the system).*	Mixed	Agree	Disagree	Mixed
(e)	- Software/programming errors.	Not sure	Agree	Agree	Mixed

Results : Information from the municipality is largely inconclusive, other than confirming that monetary value of invoices paid late are not measured. The developer appears to measure all support functions, whilst the department al representative agree that within the Department, system failures and time to restore information systems are measured.

5.3.2.12 Question 12 : Quality management information systems

Table 5.40 : Quality management information systems

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
12.	A quality information system is in place and includes the following items listed in (a) to (l) below:				
(a)	- Key Performance Indicators.	Disagree	Mixed	Disagree	Disagree
(b)	- Action Plan for Improvement	Disagree	Mixed	Disagree	Disagree
(c)	- Progress on action plan	Disagree	Mixed	Disagree	Disagree
(d)	- Evaluation and feedback mechanism.	Disagree	Mixed	Disagree	Disagree
(e)	- Customer satisfaction data.	Disagree	Mixed	Disagree	Disagree
(f)	- Product design, specification and standards information.	Disagree	Agree	Disagree	Disagree
(g)	- Material, equipment and supplier test results.	Disagree	Agree	Disagree	Disagree
(h)	- Work in progress.	Disagree	Agree	Disagree	Disagree
(i)	- Complaints.	Disagree	Mixed	Disagree	Disagree
(j)	- Management control.	Disagree	Mixed	Disagree	Disagree
(k)	- Delivery cycle timeframe projections, actual and variation.	Disagree	Mixed	Agree	Disagree
(l)	- Variation data and problem solving process management data.	Mixed	Agree	Disagree	Disagree

Results: None of the organs of state appear to have a quality management information system. The developer appears to have such a system but the emphasis appears to be on product design, material, equipment and testing results, and variation data.

5.3.2.13 Question 13 : Presence of a quality systems audit and assurance programme

Table 5.41 : Quality systems and audits

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
13.	A quality audit and assurance programme is in place.	Disagree	Disagree	Disagree	Disagree

Results: None of the institutions have a quality audit and assurance programme.

5.3.3 Section 3 : Comments, Concerns and Suggestions

Additional comments and concerns from respondents in relation to quality management are presented in Table 5.42 below.

Table 5.42 : Additional comments received from respondents

Respondent No.	Comment
2	"Quality Management systems: For the Infrastructure, Planning and Survey Unit (Housing Delivery is a section of this unit) a new committee has been put in place called the Quality Management Committee. The first meeting was on 28 June, 2006. Its purpose is to address processes and procedures in the work environment to manage quality."
3	"Low-income housing is good for indigent people, but the Department's policy needs to be revisited in terms of qualifying criteria, to address each province's culture and unique needs of people. Communities need to be part of the entire process, from conceptualization, not just during implementation. Provision should be made by the Department for home owner education, and to educate people that low-income housing are starter homes, and that these low-income houses are also homes to people. Municipal officials should also be sent on courses regarding low-income housing policies, and understand that development is their responsibility and what this entails, especially in the context of low-income housing. Municipalities do not seem to understand their role in low-income housing and these needs to be addressed for low-income housing to be taken seriously. Municipalities need to adjust their policy standards to match those applicable to low-income housing in terms of service levels, etc."
4	"Comment : Low-income housing is a simple product with a complex process. There are many role players whose performance determines the efficiency of delivery. The product is low on margins and is cash flow sensitive. Any non-performance by one role player has a compounding effect on the profitability of low-income housing.
	"Policy : The policy is rigid and needs to be more flexible by recognizing the inherent differences between in-situ upgrade, green fields, People's Housing Processes, terrain, locality, size of project, etc all of which has differing influences on the viability of projects.
	"Performance : The developer/implementing agent has performance clauses in the agreement. Similarly, performance clauses need to be incorporated into the agreement to govern the department and municipalities. The Department of Housing needs to set the example in minimizing red tape and seeking solutions rather than obstacles and then to encourage municipalities to follow suite. The Department needs to go further and ensure performance within given timeframes for functions outside project agreements (e.g. the time to provide an agreement from the date of resolution).
	"Socio-political : The constant learning curve on each new project because of communal dicatates hinders experience. The Department needs policy to govern this to bring balance by requiring a percentage of skilled (outside) contractors to be employed on a project.
	"Product : As the subsidy increases (to negate inflation) there appears to be a drive to increase the unit size (which contradicts the reason for escalation increases). If anything, attention should be the quality of the product by calling for a minimum specification (e.g. thickness of doorframes, exterior doors, window frames, etc.)

Respondent No.	Comment
4	"Education : The Department and municipalities need to be more proactive in the education of communities in the rights and responsibilities of home ownership. This should be an ongoing programme and not once-off workshops."
6	"Beneficiary allocation is wrongly structured because not all role players are fully involved in this process. Both the Municipality and the Department of Housing are not hands on in this process. They leave the ward committee structures to run the show and this creates a lot of problems, for example the beneficiary mix (incorrect allocations, e.g. higher income earners receiving completed structures, and then not willing to pay in the excess)
	"The Department of Housing monitors should not monitor projects in their offices. At least twice a week they must visit the projects they monitor. They must also enforce the presence of building professionals on sites as quality controllers.
	"The Department of Housing Management should revisit the issue of inspectorate and survey component within the organization as an independent component which will only deal with building and inspections, as well as minimizing the cost of private surveys.
	"The Department of Housing should improve the communication between them and beneficiaries in order to monitor the housing occupation due to the fact that all the time most of our projects are not occupied by rightful beneficiaries that cause the crisis within the community as well as the departmental official."
7	"Even though the industry, department and local government strive to provide integrated development and have a holistic approach to development, the question needs to be asked if in the long run beneficiaries will really benefit. The beneficiaries have now been given an asset which becomes a liability in the long run as they cannot sustain the maintenance of the asset. Government should rather look at developing a sustainable economy which must create jobs in the market for all skills levels. Once this is achieved, then people can assist themselves with housing."
8	"Scope of works is often not well defined in tenders. Tender procedures in general are insufficient with regard to quality assurance.
	"Lengthy approval processes by organs of state increase costs, thus reducing value that can be achieved through construction.
	"Lack of inspection capacity within the Department and the municipality results in a reactive approach to quality control."

5.4 SUMMARY OF FINDINGS

5.4.1 Phase 1 : Defects

There are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship. The occurrence of defects is unpredictable as any one unit can have any one type of defect, or be totally free from any defect.

There were no defects in materials relating to concrete in the foundation, plastic waterproofing material of the foundation, blocks for the wall, roof sheeting and basin. Although most of the matters listed by the NHBRC (2002a: paragraph 1) were found in the sample, frequency in the sample was low in respect of materials used, poor sand, mortar or plaster mix, and/or major structural defects. Most defects were related to finishing, especially toping of slabs.

Although the defects analysis indicates that workmanship issues are the main contributing factor to quality concerns, the Pareto analysis indicates that there are a mixture of defect types and causes that need to be addressed and across categories. These relate to both workmanship and materials, as indicated in the Table 5.7 hereof.

Less than 25% of the completion inspections are done within the Department of Housing's model, which indicates inefficiencies in the system.

5.4.2 Phase 2 : Existing quality management systems

Role players are at different stages of advancement with regard to quality and supply chain management. The Developer appears to be most advanced and has a more conducive environment to implement total quality management than the organs of state. The organs of state appear to have limited resources according to responses received to implement quality management systems and are faced with the typical challenges to total quality management.

The institutions appear to have an internal focus to quality management that is not customer focussed and lacks involvement of all stakeholders. No proper market research and/or customer satisfaction surveys are undertaken.

There is no formalised policy on quality management, and strategic direction with regard to total quality management appears to be poorly formulated. Such a policy is needed to guide quality improvement and monitoring systems (Gryna, 2001:185). Performance management is required, but developers require this to be reciprocal.

None of the institutions appear to have a quality management strategy, or have an fully integrated quality perspective. The Department and the municipality would need to overcome many challenges in implementing quality management. It appears that the proper infrastructure is not in place to implement a quality management system, and there is a lack of ability to reprioritise resources to achieve quality targets.

The management environment within the municipality and the department, respectively, does not appear to be conducive to encourage a learning organisation approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality (Gryna, 2001:251).

It appears that managers mostly do not act as role models for ethical practices. The management environment and organisational culture within the department does not appear to be conducive to encourage a learning organisation approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality and needs to be led from the top (Gryna, 2001:251). It appears that managers mostly do not act as role models for ethical practices. In the case of the developer/implementing agent, quality is part of the organisation's vision, however, management approach to learning from mistakes needs improvement. Individual and team performance measurement, evaluation and feedback appear to be lacking.

The Department does not appear to measure the time taken to issue invoices, or percentage returned due to errors. It is thus, not possible for the Department to measure how many invoices are returned due to errors, or how long staff take to process these.

A lack of a proper information system exists and this is a barrier to effective quality improvement implementation programmes, and to effective project management.

Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes.

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects. Sample tests should be undertaken on critical materials to ensure the continued use of sound quality materials.

There is no common understanding regarding roles, responsibilities and inspection criteria and processes.

None of the institutions appear to have a quality assurance and audit process in place in the context of low-income housing developments. These are critical elements to a sound quality management system (Gryna, 2001:682).

Discussion and conclusions on the findings presented in this chapter are presented in the next chapter, Chapter 6.

CHAPTER 6 : DISCUSSION AND CONCLUSIONS

6.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area.

The following objectives were investigated:

(1) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(3) To identify how house construction quality issues are currently being addressed.

The municipality, department and developers have a range of different approaches to quality management. Conclusions on findings in answering the research questions are discussed in the section below.

6.2 DISCUSSION AND CONCLUSIONS

6.2.1 <u>Objective 1 : Quality concerns in government-subsidised low-income house construction in the Pietermaritzburg area</u>

6.2.1.1 Existence of quality problems

There are quality concerns in low-income housing in Pietermaritzburg related directly to housing delivery, and within support systems.

Housing delivery related findings indicate that most units are defect free, but 41,21% had some defects, of varying degrees that needed to be corrected prior to the Department releasing payment, thus confirming the existence of quality problems.

Information management is not efficient in terms of recording inspections as 479 units (26%) could not be used due to its unreliability as a result of duplicated site numbers, omission of inspection dates, and inspection recorded out of sequence, (Chapter 5, paragraph 2.1). This illustrates quality concerns within support systems. A total quality management approach results in reduced rework, thus reducing internal failure costs (Gitlow, et al, 1999:178), but needs a reliable quality information management system that informs quality improvement (Gryna, 2001: 656). A variety of software applications are available. Compatibility with organisational goals, and inclusion of key performance measurements are essential, whichever system is used (Gryna, 2001:656).

Delivery rates are slow, thus also indicating quality concerns. Less than a quarter of the completion inspections are done within 129 days, based on the Department of Housing's model in the "*Housing Project Programming Guide*" (Department of Housing, 1997:42-49). The majority of the units fall outside this model. The reasons for this are not clear, but it is noted that there were 79 re-inspections (5,81%) and this may have contributed to the delays. Whereas the Department's model is based on a medium risk approach (Department of Housing, 1997:9), it may also be possible that developers are programming construction against a lower risk programme, but this needs to be researched separately.

1030 days separate the first slab inspection and the last completion inspection in the sample, thus indicating a lengthy delivery time to completion, and lower yields than programmed in agreements. This is also the perception of officials within the municipality and the department, as confirmed in responses received (Chapter 5, paragraph 5.3.1.7). This indicates dissatisfaction with service delivery, thus supporting findings of quality concerns in the construction of low-income housing units. Whereas customer satisfaction defines quality (Kanji and Asher, 1996:1), the dissatisfaction with delivery rates indicates poor performance, thus service delivery quality and this needs to be rectified to change perceptions of public sector inefficiency (Beckford, 1998:5) In addition to this, unnecessary rework wastes human capital and talent, especially when resources are scarce, thus demoralizing individuals (Beckford, 1998:10). Unnecessary duplications in inspections must be reduced to protect human resources from these effects.

6.2.1.2 Nature of quality concerns

The occurrence of defects is unpredictable as any one unit can have any one type of defect, or be totally free from any defect. Findings were supported by descriptive statistics and supported by a Poisson probability analysis. The nature of defects is summarised in Table 6.1, below.

Table 6.1. : Nature of defects found in the Pietermaritzburg area (see *Appendix 11* for a description of defect types)

Main Category	**Sub categories**			**COUNT**
Major structural	Construction		Foundation	15
			Wall to plate	51
			Roof	9
	Materials	Foundation	Lintels (Slab)	3
			Blocks (Foundation)	1
		Wall	Mortar mix	2
			Lintels (wall)	14
		Roof	Beams, trusses, purlins	2
Incomplete work	Inadequate services		Water (connections not done)	74
			Sanitation	15
			Access	1
	Other		Incomplete	24
			Access	9
Finishes	Clearance		Site clearance	65
	Plumbing	Workmanship	Toilet	48
			Outlet Gulley	13
			Pipes	23
			Shower	9
		Material	Tap	2
			Gulley	2
			Water Tank	1
	Other finishes	Workmanship	Block work	5
			Corking	40
			Plaster	26
			Fitting frames	71
			Glazing	42
			Screed	85
		Material	Frames	25
			Plaster	37
			Door	28
Total				**742**

There were no defects in materials relating to concrete in the foundation, plastic waterproofing material of the foundation, blocks for the wall, roof sheeting and basin.

Most quality defects relate to finishing due to poor workmanship in the screeding (topping) of slabs, thus confirming the National Home Builder's (NHBRC) findings (see Chapter 3, paragraph 3.3.1 hereof). This may contribute toward delivery delays, as indicated in completion inspection timeframes that exceed the Department's guidelines. Block work was the most problematic with regard to construction activities, thus also confirming the NHBRC findings. Although most of the matters listed by the NHBRC were found in the sample, frequency in the sample was low in respect of materials used, poor sand, mortar or plaster mix, and/or major structural defects. Most defects were related to finishing, especially topping of slabs.

6.2.1.3 Extent of defects

Most units are defect free. The Poisson analysis indicates that there is an equal 100% probability of a unit having one or more defect or not. The sample mean of 0,546 is a good representation of the population as the standard error, standard deviation and sample variance are all low. In reality, the presence of a defect is absolute, thus, this may be viewed as an average of 1 defect per unit, but the data clearly illustrates that there are more defect free units. Thus some units have defects, whilst others do not.

Likewise, where defects occur, there is an equal 100% probability that any one of the defect types could occur at a point in time in low-income housing house construction in Pietermaritzburg, or for it not to occur. The average of 1 defect of any type per unit is a good representation of the population as the standard error for each type of defect is 0, or close to 0. The same is found in respect of the standard deviation, and sample variance for each type of defect, thus supporting indications that the mean represents the data well. The frequency tables and mode clearly illustrates that there are units with defects, thus some units have defects, whilst others don't. Defects thus have a random occurrence. This is supported by the Poisson analysis. It would, therefore, be difficult to establish confidently whether a defect is likely to occur or not.

6.2.1.4 Measurement against industry norms

Quality defect rates seem not to be within acceptable tolerances, based on responses received from officials within the municipality and the Department of Housing. Statistics were not obtainable, nor industry norms. This was mainly as a result of none of the projects in the Pietermaritzburg area having been enrolled with the National Home Builders Registration Council (Janse van Vuuren, 2006). The only published guide obtainable was the Departments Housing Project Programming Guide, which indicated that completion inspections exceeded expected timeframes, as discussed in paragraph 6.2.1, above. Gitlow, et al, caution that industry norms on quality in relation to costs are seldom available (1999:186), thus motivating the need for quality performance measurement from an internal perspective to monitor progress on improvement. Findings of this study, can, thus be used to set a benchmark for quality performance of low-income house construction in the Pietermaritzburg area, and to guide research in other municipal areas.

6.2.2 Objective 2 : Causes of quality concerns

6.2.2.1 Actual findings

The "actual findings" relate to those emanating from Phase 1 of the research (see Chapter 4, paragraph 4.4.1, and Chapter 5, paragraph 5.2).

(a) Payment

Quality management should not be effected by outstanding payments as the developer has been paid for most of the units inspected.

(b) Severity

Finishing related matters were the main cause of defects (61,59%), thus the concerns appear to relate to minor issues in terms of construction. Less than 8% of defects related to structural issues.

(c) Workmanship

Poor workmanship in the screeding process had the highest frequency defect count. The main cause of units failing inspection was inadequate water supply, and had the second highest number of occurrences overall. Materials quality contributed the least to all defects found, overall, and within the respective sub-categories, thus contrary to the NHBRC findings (NHBRC, 2002a: paragraph 1).

(d) Priorities

Although the defects analysis indicates that workmanship issues are the main contributing factor to quality concerns, the Pareto analysis indicates that there are a mixture of defect types and causes that need to be addressed and across categories. These relate to both workmanship and materials, as indicated in Table 6.2, below.

Table 6.2 : Pareto analysis of defects

Main Category	Sub-category	Cause	Activity	Number of Occurrences	Priority
Finishes	Other finishes	Workmanship	Screed (Finishing work)	85	1
Incomplete work	Inadequate services	-	Water (inadequate infrastructure)	74	2
Finishes	Other finishes	Workmanship	Fitting frames (workmanship)	71	3
Finishes	Clearance	-	Site clearance	65	4
Major structural	Construction	-	Wall to plate (construction)	51	5
Finishes	Plumbing	Workmanship	Toilet (plumbing work)	48	6
Finishes	Other finishes	Material	Glazing (fitting)	42	7
Finishes	Other finishes	Workmanship	Corking (workmanship)	40	8
Finishes	Other finishes	Material	Plaster (material)	37	9
Finishes	Other finishes	Material	Door(material)	28	10
Finishes	Other finishes	Workmanship	Plaster (work)	26	11
Finishes	Other finishes	Material	Frames (material)	25	12

The Pareto analysis gives more specific details of critical issues that need to be resolved than purely using the frequency distribution.

6.2.2.2 Perceived causes

The perceived causes are those obtained from respondents in Phase 2 of the research (see Chapter 4, paragraph 4.4.2 and Chapter 5, paragraph 5.3).

(a) Confirmation of Findings

Respondents confirmed the findings in Phase 1 that quality concerns exist in low-income housing and that these are caused mainly by poor workmanship, thus also confirming the

NHBRC concerns. The causes relating to poor workmanship in the sample are presented in Table 6.3, below:

Table 6.3 : Causes of poor workmanship

Statement	Agreed (%)
- Lack of inspection during production processes.	75.00
- High volume production within shortest possible timeframes.	75.00
- Lack of quality awareness.	75.00
- Lack of competently skilled resources.	62.50
- Lack of commitment to quality.	62.50
- Lack of proper quality management systems	62.50
- Lack of experience.	62.50
- Lack of supervision.	62.50
- Lack of discipline	62.50
- Inappropriate recruitment processes.	62.50
- Poor training.	62.50
- Lack of financial support for training	62.50

(b) Acceptability of delivery rates

Respondents from the municipality and the department feel that the delivery rate of forty units per month is not acceptable, and therefore needs to be improved.

(c) Materials

Issues such as availability and quality of materials were not perceived to be the main cause, and this was confirmed by the findings of the defects analysis (Chapter 5, paragraph 5.3.1.3).

(d) Other causes

Respondents listed other possible sources, individually, (Chapter 5, Paragraph 5.3.1.7), but the extent thereof had not been examined. These need to be verified in future research.

6.2.3 Objective 3: Current quality management practice

6.2.3.1 Quality management systems

The municipality appears to have a weak quality management system which does not include all its internal and external role players. Ideally, both internal and external role players should be involved to optimize quality management efforts (Gryna, 2001:15).

From the perspective of the municipal officials, quality concerns are defined primarily by the municipality and the Department of Housing.

The developer appears to have a more advanced quality management system than the public sector participants, (thus confirming the statement made by Evans and Lindsay (Evans and Lindsay, 2002:75), however, inclusiveness of all stakeholders is unclear as mixed responses were received. The project managers indicated that quality concerns are defined primarily by themselves and the Department of Housing.

The Department appears not to have a formalised quality management system, and quality management does not involve all stakeholders. Concerns appear to be defined primarily by the Department of Housing. This indicates highly internalized quality focus, which also excludes the customer from taking responsibility for quality.

The institutions, thus, appear to have an internal focus to quality management that is not customer focussed and lacks involvement of all stakeholders. The adoption of a formal quality management system based on ISO 9000 principles, and implementation of proper strategies which are led from the top and incorporate measures to include customer satisfaction is needs to be adopted, as the customer is the key to quality (Kanji and Asher, 1996:1). ISO 9000 is a good foundation for aspiring to customer satisfaction, whilst guiding the various institutions on how to structure a quality assurance plan (Burke, 2003:242).

6.2.3.2 Correlation of quality management system with ISO 9000

Neither the municipality, nor the department undertakes regular company wide assessments in relation to low-income housing projects in the Pietermaritzburg area. The department does not follow ISO 9000 principles in terms of quality management. The developer however, appears to follow these principles and appears to have a more holistic approach to quality management than the organs of state. Whereas ISO 9000 is internationally recognized as the standard for quality management systems (Beckford, 1998:238), the principles should inform quality management systems within all three institutions for optimal performance.

6.2.3.3 Quality management policy

Neither the municipality nor the department has a quality management policy. This may partly explain the "weaker" system when compared to guidelines in the literature review. A quality policy is a guide that informs quality standards, e.g., it considers the extent to which higher quality demands impact on affordability to the organization and its customers, thus also signalling the level of quality that customers can expect (Gryna, 2001:185). In the context of low-income housing, this should also include minimum quality levels of finishes and component parts used in house construction, such as doors, window frames and house size. This will enable beneficiaries to have a more realistic expectation, and guide suppliers in the minimum specifications of products required.

6.2.3.4 Strategic quality management

Quality appears not to be part of the strategic management process within the municipality, thus it is not implemented through all line functions strategic activities. Beckford (1998:13) explains that quality cannot be achieved unless it is an inherent part of strategy, thus needs to be corrected to ensure a focused and integrated approach to quality. For this to occur, inputs are required from internal and external customers, and incorporated into strategic and financial plans that should include critical success factors against which performance is be measured (Gryna, 2001:167).

The organisational culture needs to be changed to a more focused approach on quality as part of all activities to ensure that effective quality service delivery is achieved in terms of quality goals set in strategic plans (Pike and Barnes, 1996:43). This needs to be led by top management (Develin and Hand, 1995:8).

It appears that the proper infrastructure is not in place to implement a quality management system, and there is a lack of ability to reprioritise resources to achieve quality targets. Management relies on exhortation (thus principally on motivational factors once the need has been proven (Gryna, 2001:184)) to achieve targets. These are obstacles to implementing a proper quality management system (Gryna, 2001:185), thus supporting the need for a phased approach to quality improvement and inclusion in strategic plans. A phased approach provides an opportunity for learning and improvement through pilot projects (Gitlow, et al, 1999:223).

Quality is said to be part of the implementing agent's strategic management process. Information on the availability of resources to implement a quality management system is inconclusive. Quality is led and supported by top management. And exhortation is not used as the primary means to achieve goals. An incremental approach is followed in problem solving, and quality strategies are said to be implemented throughout all line function activities. Such factors are enablers for quality management improvement (Gryna, 2001: 185). There appears to be an enabling environment to implementing total quality management in this organization.

The developer is, however, faced with the challenge of scepticism in implementing new systems. This can be overcome with a sound change management approach and by ensuring some tangible results are achieved quickly (Pike and Barnes, 1996:43).

Mixed responses were received regarding the inclusion of quality in strategic management processes within the Department of Housing. It appears that it may not be the case as quality is not perceived to be led by top management alternatively, staff may not be aware of the strategic plans. This needs to be corrected to ensure a focused and integrated approach to quality, whilst the culture should be changed over time to ensure effective quality service delivery is achieved in terms of quality goals set in strategic plans.

As is the case with the municipality, the Department would need to overcome many challenges in implementing quality management. It appears that the proper infrastructure is not in place to implement a quality management system, and there is a lack of ability to reprioritise resources to achieve quality targets. A phased approach will be required, coupled with suitable change management systems, and a culture focusing on quality throughout the supply chain (Pike and Barnes, 1996:43). This should be the responsibility of all managers, across activities and support functions. Quality improvement targets should be incorporated in their performance agreements (Pike and Barnes, 1996:24). As Deming (in McLaughlin, 1995:35) points out: "People work in a system. The job of the manager is to work on the system to improve it continuously with their help".

The use of a facilitator may add value where new quality initiatives are undertaken (Gryna, et al, 2001:201. The initial crafting of quality improvement strategies within either the Department or the municipality will require such assistance, and for such facilitator to perhaps assist with the first quality management project implementation. Such appointment needs to be coupled with a clear brief requiring a mentorship programme to allow skills transfer, and adoption of the system by the organization as its own.

6.2.3.5 Quality culture

The management environment within the municipality and the department, respectively, does not appear to be conducive to encourage a learning organization approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality (Gryna, 2001:251). It appears that managers mostly do not act as role models for ethical practices.

The management environment and organisational culture within the department does not appear to be conducive to encourage a learning organization approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality and needs to be led from the top (Gryna, 2001:251). It appears that managers mostly do not act as role models for ethical practices.

In the case of the developer/implementing agent, quality is part of the organization's vision, however, management approach to learning from mistakes needs improvement. Individual and team performance measurement, evaluation and feedback appear to be lacking. Decisions are based on facts and staff are encouraged to share ideas freely. Managers also act as role models in relation to ethical issues. These aspects are enablers for quality improvement initiatives (Juran and Gryna, 1988:22.4). These findings also support perceptions that the developer's organization generally, adheres to ISO 9000 principles.

6.2.3.6 Quality management in administration and support activities

Mostly mixed responses were received indicating that staff are not equally aware of quality performance measurements for these activities. This may be as a result of the lack of application of quality management to all activities and the lack of strategic direction in the case of both the municipality and the department. Ideally all staff should be aware of key performance indicators used throughout the organization to ensure an integrated approach to achieving targets (Pike and Barnes, 1996:24 read with Kanji and Asher, 1996:2).

The developer measures finance activities on monetary value of invoices paid. The Department does not appear to measure the time taken to issue invoices, or percentage returned due to errors. It is thus, not possible for the Department to measure how many invoices are returned due to errors, or how long staff take to process these. Information technology is also not monitored on the turnaround times for reports that provide critical information to managers and monitors on project matters, and to developers on subsidy approvals. A lack of a proper information system relating to these issues poses a barrier to effective quality improvement implementation programmes (Beckford, 1998:26).

6.2.3.7 Quality management information systems

Neither the municipality nor the department appears to have a quality management information system in place for its low-income housing projects. An effective quality management information system is needed for the effective monitoring of projects and quality improvement initiatives (Gryna, 2001:656, and Beckford, 1998:26).

The developer's quality information management system appears to include typical project management information such as product design, specification and standards, material, equipment and supplier test results, work in progress and variation data. Attention needs to be given to customer data as this informs the product, monitoring of action plans, and progress to enable proper evaluation and feedback in performance reviews.

6.2.3.8 Inclusion of customer needs

There is a lack of a customer focus within the municipality. A customer orientation is critical to continuous improvement (Kanji and Asher, 1996:1). No proper market research and/or customer satisfaction surveys are undertaken.

Information on customer orientation from the perspective of the developer is inconclusive, although it appears that customer satisfaction is measured in terms of product features and freedom from deficiencies. The lack of shared views on the matter may point to a need to ensure a common understanding of quality in terms of the customer. This should be incorporated in strategic reviews, and should involve all staff (Pike and Barnes, 1996:24).

As is the case within the municipality, there is a lack of customer orientation within the department. It is noted from the literature review that there is a political element to low-income housing construction subsidised by government. The policies and procedures are prescribed by government, including norms, standards and beneficiary profiles. Market surveys and customer satisfaction surveys could, nonetheless assist government in planning future policies regarding housing, and should be explored in the interest of effective service delivery.

6.2.3.9 Tools and techniques

A variety of tools are used by the institutions, including some statistical methods. This is contrary to the statements received by officials from the department and the municipality regarding the use of statistical methods. It may be that the officials are not aware that check sheets and run charts are also means of collecting statistical information. Exposure to other tools through training could assist in improving quality management approaches, such as the use of Pareto analysis to prioritize quality concerns. Statistical tools are an important element of quality management. Total quality management requires a combination of statistical and technical techniques and management techniques (Gryna, 2001:15). A variety of tools should be used as reliance on one specific tool or technique may limit quality improvement initiative (Gitlow, et al, 1999:224).

Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes. This limits quality improvement as total quality management should incorporate both managerial and statistical tools and techniques to ensure management is based on facts, and to optimize quality improvement efforts (Gryna, 2001:185). Management training and exposure to different techniques could facilitate this process.

It appears that the developer has statistical process control systems in place to enable management by fact.

The findings on benchmarking practices were inconclusive from the perspective of the developer and the municipality. The department does not benchmark quality against competitors. It is noted, however, that the department is the main funding agent, thus is unlikely to benchmark to sustain a competitive advantage. Benchmarking in this case is still useful to measure performance against sound practice and to facilitate continuous improvement (Gryna, 2001:105).

The developer uses different problem-solving approaches to suit the situation at hand, through a diagnostic approach, thus applying total quality management techniques in identifying and solving problems for quality improvement. Project monitors from the department also use this approach. The inspectors do not use different approaches. Different approaches should be used for chronic and sporadic problems. Chronic problems have a higher frequency of occurrences, which are more problematic from a quality perspective and tend to be more significant (Gryna, 2001:96).

6.2.3.10 Supply Chain Management

The Supply chain management against world class standards was rated as transactional (Chapter 5, paragraph 5.3.2.6). Given the shortage of resources and relative inexperience in quality management systems, aspiring to world class supply chain management would be unrealistic.

Mixed responses were received regarding suppliers, and understanding of all role players of what they should be doing, and how it should be done, thus inconclusive information was obtained on this aspect. Suitable controls do not appear to be in place throughout the supply chain to ensure specifications are met. Self-regulation should be promoted in all instances as this is the ultimate form of quality control (Gryna, 2001:442).

The developer appears to be more advanced in its supply chain management according to World Class standards than the municipality and the Department of Housing. The project managers rated it between transactional and proactive. Nonetheless, given the challenges faced from other stakeholders in the supply chain, aspiring to be proactive in all cases would be more realistically achievable.

Departmental officials rated its supply chain management as transactional. Evaluation of suppliers is poor as performance of such suppliers is not rated against quality measures. Certified suppliers are not being used (although it is noted from the literature review that building contractors need to be enrolled with the National Home Builder Registration Council, and the relevant professionals need to be registered appropriately (Department of Housing, 2002b:2.1). Suppliers and the Department are perceived to understand their roles, responsibilities, and job requirements. The municipality is perceived to understand what is required but does not have the know-how. Communities are perceived to be lacking an understanding of what is required and how things need to be done in the context of low-income housing. Departmental officials were divided on the extent and suitability of controls, but disagree that these are in place within the communities. There appears to be some scope for self-control to be implemented, as most of the role players know what to do and how it is to be done. According to Gryna (2001:442), this is critical for self-control to succeed. In addition to this all role players must have a common understanding of how quality performance is measured in the context of low-income housing.

Chapter 3 (Paragraph 3.3.2) indicated a range of standards and specifications applicable to this sector. In spite of this, a range of defects still occur, thus indicating that specifications and standards on their own are not an effective means of quality assurance. Although product specifications, timeframes and costs are stipulated in the contract, these are not adhered to, thus resulting in variations to a project's scope. Variations to the contract are also not negotiated and formalised with all parties. This needs to be corrected urgently as it is critical in establishing trustworthy relationships, ensuring customer satisfaction, as well as monitoring reasons for variation to inform quality improvement, which needs to be included in organisational strategies. A formal scope change control system needs to be in place, based on sound project management principles (Burke, 2003:105). Such a system should clearly define the necessary change approval processes and documentation, and persons authorized to make changes. It must also provide for an impact analysis, the client's approval and communication to all stakeholders involved in the project (Burke, 2003:107). A proper system not only provides an audit trail, but ensures current and up to date information regarding the status of a project and its deliverables, whilst also informing future initiatives (Burke, 2003:106).

The perception is that product warranties are not in place, however, there are standard patent and latent defects warranties applicable (Department of Housing, 2005f: paragraph 4), thus illustrating the lack of knowledge of quality management systems in relation to housing. Product warranties are not typically measured. This should be initiated if chronic problems arise, as chronic cases need to be targeted for improvement (Gryna, 2001:96).

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects. Sample tests should be undertaken on critical materials (Gryna, 2001:419) such as cement mixtures, block strength and roofing material, as guided by the best practice guide for construction, SABS0400, and/or ensure Agrément certification is in place for unconventional methods, to ensure the continued use of sound quality materials (SABS, 1990:44).

6.2.3.11 Quality control and responsibility

The municipal officials view final inspections as the responsibility of the developer, municipality and Department of Housing. The inspections are said to be undertaken by the municipality and the Department of Housing.

The project managers perceived final inspections to be the responsibility of the developer, municipality, customer and Department of Housing. It is said to be undertaken primarily by the developer, customer and Department of Housing, but a quality score card is not used.

The departmental monitors indicate that a scorecard is not used. The inspectors had a mixed response to this. Final inspections are perceived to be the responsibility of all, yet are undertaken by the Department, only. Inspectors indicate that pre-inspection snag lists are not done. This may be as a result of this being done by developers, or that these are not done at all, however there is insufficient information to draw a conclusion.

A mixed response was received by all the role players, which indicates that there is no common understanding regarding roles, responsibilities and inspection criteria and processes. This needs to be corrected to improve quality in partnership with stakeholders, but also to develop self control as the ultimate form of quality control (Gryna, 2001:442).

6.2.3.12 Quality assurance and audit process

None of the institutions appear to have a quality assurance and audit process in place in the context of low-income housing developments. The municipality is, thus, not in a position to obtain independent reviews on actual quality performance, against the required standard. The aforementioned information is critical in continuous quality improvement initiatives (Gryna, 2001:682). The NAHB (American National Association of Home Builders) (2005f: paragraph 3) advises that such a system is critical in demonstrating that every reasonable effort has been made to ensure quality construction, should law suits occur. Ideally, such a system should be based on the ISO 9000 principles (NAHB: 2005a: paragraph 5).

One of the respondents eluded to the costs associated to quality control on site. Literature, however, has indicated that "quality does not cost, it pays" (NAHB, 2005d: paragraph 1, and Evans and Lindsay, 2002:107, to quote a few). The "perceived" costs could also be reduced by adopting a "100%, Zero defects" approach (NAHB, 1997a: paragraph 3). The constraints within the construction sector and use of local labour are noted (CIDB, 2002a: paragraph 2) however, members within the supply chain should strive to meet this challenge. Whereas the community may be viewed as a supplier of labour, the Department of Housing, in partnership with the municipality, developers and other stakeholders, should develop communities to enable them to provide work of a suitable standard.

6.3 OTHER CONSIDERATIONS

6.3.1 New systems

According to one of the municipal respondents, the Msunduzi Municipality has recently established a quality management committee to address processes and procedures. This could be an opportune time for the municipality to adopt a sound management system, based on ISO 9000, in order to set strategies and policies regarding quality for all municipal line function and support activities.

6.3.2 Department of Housing Policies

There is no formalised policy on quality management. Such a policy is needed to guide quality improvement and monitoring systems (Gryna, 2001:185). Such a policy should take into consideration the differences between communities, external environmental impacts and associated matters that impact on the viability of the projects.

The Department appears to rely on the existence of National Building Regulations and the activities of the National Home Builder's Association. Comments received indicate that the provisions of the National Building Regulations are not always applied. It is noted however, that these are "deemed to satisfy" standards, thus are subjected to interpretation which require a number of factors to be considered to ensure health and safety aspects (SABS, 1990:41).

6.3.3 Sustainability

A comment was received regarding sustainability in the context of housing delivery and economic development. This comment was in relation to the broader housing and development policies, and is not related directly to quality management in the construction of low-income housing. It is, however possibly an area for further research as the state of the economy and affordability to government and the private sector to deliver, would impact on determining an agreed level of quality for a housing unit.

6.3.4 Process and procedures

A comment was received that intimates that the inspectorate should be a separate component within the Department to deal only with building inspections. Beckford, (1998:26) supports the approach of having a quality assurance component separate from the production function to avoid conflicting targets between these two elements. The Department does not construct houses itself, but does this through the municipalities and the private sector. The Department has a project management component that monitors delivery against funding agreements (Department of Housing, undated*(b)* : 36). The Department may need to consider this, should inspections become a primary line function activity, in the absence of this being done through any other means. It is also noted, however, that municipalities have a role to play in terms of approving building plans, and inspections, (Department of Housing, 2002b:1.1). The National Home Builders Registration Council may also be in a position to assist (NHBRC, 2002b: paragraph 5). These provisions may further negate the need for a specialized component for inspections. Rather, consideration should be given to use experienced inspectors as a means of providing hands on training in construction processes and requirements to communities.

The Department needs to resolve its capacity issues to enable a more proactive approach to housing delivery, including regular site visits to also monitor the presence of building professionals and other quality controllers. In theory, as the supply chain management system improves, the need for this will reduce over time as all role-players should have a common interest in achieving quality goals, through partnerships based on trust and with less focus on bureaucratic processes at all levels (Burt, et al, 2003: 8). The reduction in bureaucracy is a challenge to organs of state due to legislative requirements regarding public funds, but at the very least processes should not involve unnecessary duplication or non-value adding activities (Burt, et al, 2003:28).

6.3.5 Performance management

Performance management is required, but developers require this to be reciprocal. Theoretically, a "World Class" supply chain management places less focus on performance against contract as parties trust each other to honour agreements (Burt, et al, 2003:82). The Department, however, is required to monitor contracts closely due to the implications of the Public Finance Management Act (Act 1 of 1999). Standard target time frames should be developed for all critical activities throughout line function and support units, and these should be communicated to stakeholders to enable them to plan effectively, and to integrate quality in production planning (Gryna, 2001:464).

6.3.6 The end-user

Greater consideration is needed of the end-user.

It appears that problems are experienced with allocation processes in that incorrect beneficiaries are occupying units intended for others. This could be construed as poor quality service delivery. A strategy is needed to resolve this matter and this should include representatives from the target groups.

Other training programmes should be aimed at a needs based approach within municipalities and communities, thus requiring a more targeted and customized approach, based on a proper needs analysis and understanding of customer requirements (Pike and Barnes, 1996:24). Such training should be ongoing and not take the form of once-off workshops. Community training should include home ownership and maintenance issues.

6.3.7 Learning curve effects

One respondent indicated that there are learning curve effects. The learning curve is a relationship between the number of units produced (to specification) and the time taken to produce them optimally (Burt, et al, 2003:419). The sooner a new task is mastered, the quicker and more effective the rate of production, thus learning curve effects need to be expedited (Burt, et al 2003:419). The potential of using this to improve quality is limited in the current format as the learning curve commences from first principles within every new project area due to community pressures to use local labour only. Mixing skilled labour from other areas could expedite the learning curve effects. This should be negotiated upfront with communities as the end-user, and also supplier of labour, within each project area, thus emphasizing the need for community involvement in the conceptualization stages.

6.3.8 Product quality features : size or durability

One of the respondents indicated that as the subsidy increases (to negate inflation) there appears to be a drive to increase the unit size (which contradicts the reason for escalation increases). It was suggested that the focus should shift to increasing product durability in terms of either higher specification and/or more durable material. These possibilities should be considered by the Department, but should also be based on the equivalent of a market research, but also taking cognizance of the unique needs of each community. These issues could be incorporated into a quality policy.

6.4 SUMMARY

It was confirmed that quality concerns exist in low-income housing projects in the Pietermaritzburg area. The nature and extent of defects have been quantified, and the current systems to maintain quality management within the municipality, developer and department have been explored.

This study has achieved its objectives as house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area, and the causes thereof have been identified, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal. The status of quality management systems has also been obtained.

Role players are at different stages of advancement with regard to quality and supply chain management. The Developer appears to be most advanced and has a more conducive environment to implement total quality management than the organs of state. The organs of state appear to have limited resources according to responses received to implement quality management systems and are faced with the typical challenges to total quality management. In spite of these, quality management and improvement should drive service delivery improvement as the basic principles of quality management are equally applicable to service delivery (Gryna, 2001:492). It is also relevant to the pubic sector, which is required to deliver quality services at lower costs to meet public expectations (Beckford, 1998:10).

CHAPTER 7 : RECOMMENDATIONS

7.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area.

The findings recorded in Chapter 5 illustrate that there are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship. The municipality, department and developers have a range of different approaches to quality management. This chapter presents recommendations in terms of the findings and conclusions.

7.2 RECOMMENDATIONS

7.2.1 <u>Strategic Quality Management</u>

7.2.1.1 The Department of Housing needs to take the lead in the drive for quality, through its vision, policies and strategies (Evans and Lindsay, 2002:120 and 130). It needs to work together with all stakeholders to form quality partnerships (Evans and Lindsay, 2002:182). This should be part of its strategic plans, which should include all staff so that they can take ownership and responsibility, and provide inputs to quality improvement initiatives (Kanji and Asher, 1996:2). This should be applicable to all activities as such an approach would enhance service delivery perceptions both internally and externally.

7.2.1.2 A phased approach coupled with suitable change management systems will be required. All managers should be accountable across activities, including support functions, and quality improvement targets should be incorporated in their performance agreements. In the case of new quality improvement initiatives, a facilitator may be appointed for guidance (Gryna, et al, 1999:199). The initial crafting of quality improvement strategies within the Department and municipality may require the appointment of a facilitator to guide initial implementation. Such appointment needs to be coupled with a clear brief.

7.2.1.3 The crafting of a quality policy should be prioritized by all stakeholders, as this should inform standards and measurements for all activities, and inform key aspects of product and service specifications (Evans and Lindsay, 2002:645). It is also a guide used to consider the financial impact on the organization and its customers (Gryna, 2001:185). In the context of low-income housing, such a policy should take into consideration the differences between communities, external environmental impacts and associated matters that impact on the viability of the projects, and inform the general housing subsidy policies. It should also consider the minimum levels of finishes and component parts used in house construction, (such as doors, window frames and floor area/size), and guide decisions on size versus durability type improvement. This would inform beneficiaries of what they can expect and guide suppliers in conforming to acceptable quality standards.

7.2.1.4 A proper planned change management system needs to be in place for quality improvement initiatives to succeed (Pike and Barnes, 1996:77), and should be led and supported by top management (Develin and Hand, 1995:8). It requires sound people based management (Kanji and Asher, 1996:2). A change in management culture is required within the Department to facilitate a learning organization, failing which a quality management system will not be successful. This needs to be led by top management. Progress on these aspects needs to be monitored carefully through staff satisfaction surveys incorporating specific elements such as the extent to which staff are encouraged to share ideas, learn from mistakes, etc. Such surveys would also need to address the various management levels to determine more accurately where problems are, but this would need specialist assistance and should be dealt with sensitively to avoid victimization of both workers, and managers. This would require very specific elements of improvement to be identified, with carefully identified monitoring and evaluation systems.

7.2.1.5 Some quality management initiatives need to be identified that would produce tangible results quickly to facilitate commitment and faith in quality improvement efforts (Pike and Barnes, 1996:43).

7.2.2 ISO 9000

Whereas ISO 9000 is an internationally recognized quality management system, its application would benefit all role players (Evans and Lindsay, 2002:137). Developers are likely to benefit the most as it can provide them with a competitive advantage in the market. It could also inform departmental and municipal procurement processes as ISO certification could provide quality assurance in procurement processes. Whereas it appears that the Department does not have a formalised quality management system, the ISO 9000 standards should be used to guide the development of such a system.

7.2.3 Benchmarking

7.2.3.1 Benchmarking is a means of improving quality based on best practice, and as such it is an essential tool in comparing performance in the market (Spendoli, 1992:8). It may be difficult for the Department to identify a benchmarking partner locally, but it could explore alternatives such as non-governmental organizations (NGO's), the eThekwini Municipality (Durban) and/or other government departments, or housing departments in other provinces. The department should endeavor to identify a suitable benchmarking partner to facilitate quality improvement.

7.2.3.2 In the absence of industry norms on accepted defect rates in low-income housing in the Pietermaritzburg area, the findings of this study could serve as a benchmark. This would be an interim measure, be a starting point in addressing quality concerns in this area, whilst also guiding studies in other municipal areas. Targets need to be set to improve the number of defects. A Pareto analysis indicates how a significant impact can be made by prioritizing those aspects that cause 80% of the problems (Kanji and Asher, 1996:56). The prioritization of areas needing improvement, in accordance with the findings of the Pareto analysis, as set out in Chapter 5, paragraph 5.2.2.3, will greatly reduce the defect rate. This will require a detailed quality improvement plan including actions, task allocation, resource requirements and timeframes. Whereas a project management approach is typically used to coordinate and implement quality improvement initiatives, (Gryna, 2001:199), quality improvement in the Pietermaritzburg area needs to be led by an experienced project manager, supported by an appropriate multi-disciplinary team.

7.2.3.3 Statistical methods are critical in informing improvement measures and for evaluation purposes (Oberlender, 2000:232). Whereas averages were used in this study, the differences in defect rates between project areas were not highlighted. Different projects may well have different causes of defects, thus, a project by project approach should be developed, as different sources of labour are used in each project area (as advised by Respondent 4, Chapter 5, paragraph 5.3.3, "Socio-political"). This should be informed by more quantitative measures being explored in recording the occurrence of problems through well defined, and mutually agreed check sheets, and or control charts that should be kept and maintained on site. The content, measurements and analysis techniques must be agreed between all stakeholders to facilitate a mutual understanding of uniform data recording, processing and analysis systems and to ensure effective implementation.

7.2.4 Information management

7.2.4.1 Inadequate information systems impair quality management (Beckford, 1998:26). Both the Department and the municipality need to urgently address their information management systems to include these activities to enhance quality management in terms of supplier management, project management, delivery and defect rates, and variations to contract. The system needs to include organisational goals; key performance indicators; actions plan for improvement; progress measurement; evaluation and feedback mechanisms; customer requirements and satisfaction data; product design, specification and standards; and material, equipment and supplier test results; delivery cycle timeframe projections, actual delivery timeframe and timeframe variation; and other variation data and problem solving process management data (Gryna, 2001: 656). These factors are required for effective project management.

7.2.4.2 All role players need to ensure proper records of inspections, supported by a database. These should include the project visited, site numbers, stage of the inspection, results on pre-agreed aspects and standards for inspection, as informed by the inspection guide to be developed. This will reduce duplications as well as serving as a record for statistical analysis and future research.

7.2.4.3 The developer's system should also be improved to include action plans and progress to enable proper evaluation and feedback in performance reviews.

7.2.5 Quality control

7.2.5.1 All role players should adopt a suitable audit and quality assurance system. ISO 9000 standards could be used to guide the development of an efficient system (NAHB:2005a: paragraph 1).

7.2.5.2 Inspection procedures need to be formalised. Clear guidelines need to be developed by the Department of Housing, in consultation with all stakeholders regarding inspection criteria, and quality expectations, including a description of what customers can expect in terms of level of quality. The tolerances, conditions, frequency of inspections and sample size criteria also need to be defined. Documents drafted by the Eastern Cape Provincial Government, the National Association of Home Builders (NAHB), and the Construction Industry Development Board (CIDB), as listed in the references attached to this document, could facilitate this process.

7.2.5.3 Elements identified as critical in the proposed inspection guide should be part of a well defined inspection score card. On site control charts should be available to inform decision makers on quality improvement initiatives, and this would also clarify whether pre-inspections were done, and action taken to resolve issues.

7.2.5.4 Burke (2003:105) indicates that a formal scope change control system should be in place, based on sound project management principles. The findings of this study indicate that variations to the contract are not negotiated and formalised by all parties. This needs to be corrected urgently as it is critical in establishing trustworthy relationships, as well as monitoring reasons for variation to inform quality improvement, which needs to be included in organisational strategies. The change management system should provide for variations to be informed by the implications of changes to the project scope (time, cost and quality trade-off), acceptance by the customer/client and appropriate approval processes (Burke, 2003:106). Variations need to be properly recorded and communicated to all stakeholders, including inspection staff to ensure a common understanding of revised requirements and its implications on subsequent processes (Burke, 2003:106).

7.2.5.5 Control charts and score cards should be maintained on all sites to assist in performance management and problem solving abilities, whilst also serving as a quality audit. The format of this should be agreed by all parties so as to understand the interpretation of results.

7.2.5.6 Poor materials generally increase the cost of quality (Gryna, 2001:403). Sample tests should, therefore, be undertaken regularly on critical materials (Gryna, 2001:419). Although very few defects in critical materials were found in this sample, sample tests should be undertaken on critical materials such as cement mixtures, block strength and roofing material, as guided by the best practice guide for construction, SABS0400, to ensure the continued use of sound quality materials. This should be the responsibility of staff on site, supported by a proper system for recording data (NAHB, 2005l: paragraph 4 and 2005m, paragraph 3).

7.2.5.7 The National Building Regulations need to be revisited in the context of low-income housing, and should be simplified to facilitate a common understanding, even by emerging contractors. Such revisions should be informed by sound building practice and consumer needs, and need to be incorporated into inspection sheets and guidelines of the Department of Housing.

7.2.6 Customer Focus and Market Intelligence

7.2.6.1 Leadership needs to create a customer focused vision with clear quality goals which should be incorporated in strategies (Evans and Lindsay, 2002:223). The lack of shared views on customer needs awareness may point to a need to ensure a common understanding of quality in terms of the customer. This should be incorporated in strategic reviews and involve all staff, as quality is defined by both internal and external customers (Gitlow, et al, 1999:3).

7.2.6.2 Market surveys and customer satisfaction surveys would contribute towards a sustained competitive advantage for developers, whilst improving perceptions of service delivery by organs of state (Evans and Lindsay, 2002:184, read with Beckford, 1998:10).

7.2.6.3 Market surveys and customer satisfaction surveys could assist the government in planning future policies regarding housing, and should be explored in the interest of effective service delivery. Organs of state need to ensure a proper customer orientation and recognition of a range of quality needs to be incorporated in a quality policy. This should incorporate housing allocation. It should also consider matters such as how additional funding should be applied to units (bigger size versus durability). This needs to be based on research and local needs, through customer satisfaction surveys (Evans and Lindsay, 2002:184), as it is the customer that defines the extent to which quality is achieved (McLaughlin, 1995:32).

7.2.7 Performance management plans

Performance management systems within all institutions should include measures on quality performance initiatives, as defined by the organization, and including all staff. Measures to monitor adherence to ethical standards should be explored, and this may also be an area for further research.

7.2.8 Process Management

7.2.8.1 The Department should explore the option of larger contracts, over longer periods of time, but phased appropriately through a systems and programme management approach. This could enhance economies of scale benefits; allow developers to develop their staff and subcontractors over time; thus improving proficiencies in performing on contracts; increase predictability of work flow; and supports long term jobs and skills development (CIDB, 2006:8).

7.2.8.2 Delivery rates (at each stage of the inspection) also need to be programmed and monitored, and communicated to all stakeholders to enhance supply chain management activities, including "just in time" principles (Evans and Lindsay, 2002:367). This should also apply to the Department.

7.2.8.3 A partnership approach should be adopted where possible as this provides a mechanism for sharing risks, skills and expertise and increases the predictability of outcome (CIDB, 2006:4). Joint planning and cross functional teams optimize the knowledge base for quality improvement systems and facilitate the incorporation of quality into all processes (Evans and Lindsay, 2002:365). The Department should develop and communicate the expected timeframes for its internal processes to assist stakeholders in their planning activities and ensure that such stakeholders are involved in the process. The nature of housing projects involve different professional services, thus there is a source for the development of cross-functional teams.

7.2.8.4 From this study, the municipality needs to resolve its processes relating to the processing of water connection application forms, and ensuring water connections are done prior to verification inspections being undertaken by the Department. This could be facilitated through an appropriate information and coordination by an assigned project manager.

7.2.8.5 The developer needs to correct tardiness on site to ensure site clearance has been done (SABS 1990, 63). This needs to be addressed through the site supervisor, but should also be enforced as a standard practice as the responsibility of all site staff (NAHB, 2005l, paragraph 4).

7.2.9 Training

7.2.9.1 Change management training in the context of quality management, and training on quality improvement through human resources (including performance appraisal systems) needs to be developed and implemented. This could be measured by the extent to which improvement targets are achieved by the municipality and Department of Housing.

7.2.9.2 Human resource management training is required in the context of "the learning organization and quality management approach" to encourage an environment where staff are able to learn from mistakes.

7.2.9.3 Employee and team appraisal need to be pursued to facilitate a conducive environment for quality improvement. Quality circles tend to focus on problems related to personal well being of staff and their frustrations (Gryna, 2001:202), thus this tool may assist in communicating concerns based on punitive approaches to management, where these are perceived to exist.

7.2.9.4 Exposure to a variety of statistical tools could assist in improving quality management approaches, such as the use of Pareto analysis to prioritize quality concerns.

7.2.9.5 Quality management should involve the entire organization, thus training needs to be customized to the needs of each level within the organization, and across functions (Oberlender, 2000:319). Departmental and municipal staff need to undergo quality management training at all levels which should include training on problem solving techniques in the context of low-income housing. It should include the basics of quality management philosophy, cause and effect analysis and basic statistical techniques, as well as interpersonal relations, basic supply chain management and quality management in the context of projects in general.

7.2.9.6 One of the respondents referred to the costs associated to quality control on site. Literature, however, has indicated that "quality does not cost, it pays" (NAHB, 2005d, paragraph 1, and Evans and Lindsay, 2002:107, to quote a few). The "perceived" costs could also be reduced by adopting a "100%, zero defects" approach (NAHB, 1997a: paragraph 3), as doing things right the first time will always be cheaper (Crosby in Evans and Lindsay, 2002:106). The optimum level of quality management must be determined through proper cost benefit analysis, taking cognisance of failure costs, inspection costs and prevention costs (Gitlow, et al, 1999:178).

7.2.9.7 Practical hands on training on how to undertake housing projects in all aspects, especially relating to the municipality and the community needs to be pursued by the department. This should also include modules on controls required to ensure compliance with specifications. Training on the latter should only be done once the Department has completed its guide on inspections, which ideally, should involve all stake holders.

7.2.9.8 Inspection staff and monitors within the department can facilitate hands on training by assisting with corrective action on site during inspections and/or site visits. This could be further enhanced through the use of the control charts, as recommended, as these could guide areas of concerns, and with analysis on a Pareto, could highlight where training impetus is required. Based on the findings of this study, the correct mixing of cement and application of screeding techniques (topping of the slab) should be the first priority within this particular municipal area, followed by the fitting of window and door frames and block work on walls.

7.3 SUMMARY

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. This chapter presents recommendations in terms of the findings and conclusions. The most critical items are summarized as follows:

(1) The adoption of a quality management policy that incorporates all stakeholders;

(2) The inclusion of quality management in strategic plans with a phased implementation programme;

(3) Partnership development and joint planning with all role players;

(4) Use of larger contracts, over a longer period of time through a programmatic systems approach;

(5) Identification of benchmarking partners;

(6) The adoption of an audit and assurance mechanism, based on ISO 9000;

(7) Development of a learning organisation and change management culture, led from the top;

(8) The inclusion of quality performance targets in managers' performance reviews;

(9) Clearly defined inspections procedures and documents (including roles and responsibilities), and availability of these on site;

(10) Information management systems upgrading;

(11) Revision to National Building Regulations in the context of low-income housing;

(12) Improved municipal strategies on water connection;

(13) On site training regarding topping of slabs, fitting windows and door frames and block work; and

(14) Training of all managers and staff on all aspects of quality management theory, tools and techniques, and specifically in relation to low-income housing.

Whereas limitations were applied to the study (as outlined in Chapter 4), these and other limitations and recommendations for future research are discussed in the next chapter.

CHAPTER 8 : LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

8.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. Limitations were applied to the study. These limitations and recommendations for future research are discussed in the section below.

8.2 LIMITATIONS

8.2.1 The following limitations were applied to the study (as outlined in Chapter 4):

(1) The units were inspected during 1 April 2005 to 31 December 2005 with complete datasets;
(2) The units were from low-income housing projects that have been initiated by the municipality, aimed at addressing slums clearance;
(3) The units were all from active projects (i.e. more housing unit construction is still underway);
(4) The units were inspected by the same inspection team.

8.2.2 Limitations were applied to the sample and this resulted in data being obtained from one developer only, thus reducing the ability of comparing types and efficiencies of quality management systems. Due to time constraints to the research, a Delphi technique was not feasible. The Delphi technique is useful to obtain consensus amongst all participants, and based on expertise in the field (Heizer and Render, 2004: 107).

8.2.3 The research focused on the Pietermaritzburg area only and should not be viewed as representing quality management in all low-income housing projects, as environmental factors vary between towns, areas and projects. In this regard, a sample was obtained from the Department on a population of low-income housing projects in the uMshwati municipality, and is attached as ***Appendix 16***. The findings were not discussed as the data represents a different population. This study looked specifically at quality problems, the nature and extent thereof in projects in the Pietermaritzburg area, thus an analysis of the data relevant to the uMshwati municipality would be beyond the scope of this particular study. It could be considered for future research, either as a comparative study, or to identify quality concerns in low-income housing in that municipal area.

8.2.4 The research was qualitative, thus making it difficult to accept or reject a hypothesis, which is a limitation to effective hypothesis testing (Cooper and Schindler, 2001:138). They explain nonetheless, that qualitative research with an emphasis on detail is a valuable contribution to problem solving, evaluation and strategy, and provides a source for new hypothesis.

8.2.5 A trend analysis (i.e. an analysis that looks into the frequency of an occurrence in relation to specific time intervals (Wegner, 2002:329) was not part of the scope of this research, but may be useful in future research to illustrate whether quality defects occurred mainly in the start-up phase and levels off due to learning curve effects (which may be expected) or whether these occurred consistently throughout the project life cycle.

8.3 RECOMMENDATIONS FOR FUTURE RESEARCH

The following recommendations are made for future research, taking into consideration:

8.3.1 A detailed trend analysis was not done, but could be useful to associate defects with economic trends to illustrate the impact of the macro environment on housing delivery.

8.3.2 A more detailed investigation is required to assess reasons for delivery timeframes exceeding the Department's guide. These also need to be explored to inform the Department's benchmark, and refreeze the target, if necessary, in terms of change management and performance management principles.

8.3.3 Whereas it was indicated that this research identified quality concerns in the Pietermaritzburg area only, a similar study should be undertaken in other areas to confirm trends and defect rates within the Province, especially in view of the lack of information in this regard. Also, this can be done on a project by project basis where poor performance is identified, either in terms of lengthy timeframes, or units failing inspections, or high frequency concerns raised by inspection staff. Once an inspection score card is developed, this could signal which projects need to be targeted for such a study.

8.3.4 The data obtained in respect of the uMshwati Municipality ***(Appendix 16)*** could be used to undertake a study in that area, or to compare quality concerns and systems between the two municipalities.

8.3.5 Whereas respondents were divided in some responses, a Delphi technique will improve the interpretability of data as it results in one agreed expert response from participants. This could also be applied to the following possible causes of quality defects, as provided by individual respondents in this study:

- Poor selection of contractors;
- Lack of cooperation from the implementing agent;
- Poor education of the end user (including home ownership responsibilities and house maintenance);
- Lack of proper site supervision, and absence of engineer and/or building professionals on site;
- Unskilled supervisors and lack of qualified trainers on site;
- The impact of a set subsidy and product, limited experienced and qualified skills and appropriate supervision and cost implications to the developer;
- Scope of work not being fully explained to the work force;
- Lack of proper equipment;
- Lack of inspection resources within the municipality; and
- Extent to which National Building Regulations are practiced.

8.3.6 This research did not include perceptions of quality from the perspective of beneficiaries (as the ultimate end-user). Research surveys could assist all role-players to improve their "customer" profiles. It is critical to quality management which requires a sound understanding of customer needs in terms of quality (Evans and Lindsay, 2002:184 and Gitlow, et al, 1999:3).

8.3.7 A comment was received regarding sustainability in the context of housing delivery and economic development. This comment was in relation to the broader housing and development policies, and is not related directly to quality management in the construction of low-income housing. It is, however, possibly an area for further research, as the state of the economy and affordability to government and the private sector to deliver would impact on determining an agreed level of quality for a housing unit.

8.3.8 Gryna (2001:656) indicates that there are a number of electronic information systems that could be used for quality management. An analysis of such systems and recommendation of those most suitable to provincial and local government departments involved in projects such as low-income housing would assist in improving the performance of organs of state.

8.3.9 Respondents were not clear on the extent to which managers conduct themselves ethically. Ethics in low-income housing construction could be influenced by many factors due to the political nature of housing in the country, thus may be an area for further research. This could include ethical consideration of all professions involved in housing (engineer, conveyancer, land surveyor, town planner, building professional, social facilitator), in terms of ethical standards of the profession, and in relation to ensuring quality in the interest of beneficiaries, and balancing this against the ultimate goals of business, being profit.

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. Whereas limitations were applied to the study, these were discussed in this chapter together with recommendations for future research. Final conclusions are discussed in the next chapter.

CHAPTER 9 : FINAL CONCLUSION

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. It is informed by total quality management literature. It investigates the problems statement that "ongoing quality concerns in low income housing have allegedly not been addressed adequately".

In 2005, the National Minister reiterated the need to focus on quality (Sisulu, 2005a:2). She quoted unpublished research which indicates that shoddy construction has been found in the form of poor roofing, cracks, weak doors, damp, poor foundations, and no floors (Sisulu, 2005c:4).

This study is motivated by aspects including: (1) government's accountability for public funds; (2) serving as base research for improved resource allocation; (3) and for quality improvement and sustainability strategies; (4) creating an opportunity for introspection by other members in the supply chain; and (5) a responsibility of all stakeholders to realise the ultimate goal of customer satisfaction.

The research was approached in two phases. Phase 1 was designed to identify whether quality concerns existed in the low income housing projects in the Pietermaritzburg area; and to identify the nature and the extent thereof. Phase 2 was designed to explore the perceived causes of quality concerns, and to identify the systems used by the municipality, its developing agent and the Department of Housing, to ensure sustained quality management.

The findings from Phase 1 illustrate that there are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship, especially the topping of slabs (i.e., the process in which a final layer of cement is applied to smoothen the floor surface, also referred to as "screeding"). The Pareto analysis indicates that there is a mixture of defect types and causes that need to be addressed, and in order of priority. These are : (1) screeding; (2) water connection; (3) fitting frames; (4) site clearance; (5) constructions of walls; (6) plumbing, specifically toilet fittings; (7) glazing; (8) corking/filling of gaps; (9) plaster material; (10) door quality; (11) plaster work; and (12) the quality of frames.

The findings from Phase 2 indicate that role players are at different stages of advancement with regard to quality and supply chain management. The developer is more advanced in the application of quality management systems that the public sector.

The institutions appear to have an internal focus to quality management that is not customer focussed and lacks information and involvement of all stakeholders. There is no formalised policy on quality management. The institutions do not appear to have a quality management strategy, or to have a fully integrated quality perspective. Quality assurance and audit process are also lacking. Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes. There is no common understanding of roles, responsibilities and inspection criteria and processes, and external and internal role players are excluded from quality management processes.

It appears that the proper infrastructure is not in place to implement a quality management system. Information systems are poor.

The management environment within the municipality and the department do not appear to be conducive to encourage a learning organisation approach.

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects.

The literature review indicates that proper quality management can reduce costs by lowering waste (Gitlow, 1999:172). Poor quality wastes human capital and talent, which demoralizes individuals and contributes to destructive anti-social behaviour (Beckford 1998:7). Such waste must be minimized to maximize employee satisfaction, thus enhancing productivity (Beckford, 1998:10). The literature indicates that the need for quality is equally applicable to the public sector, as observations have been made of governments and society expressing dissatisfaction with public sector cost and effectiveness (Beckford, 1998:5). The public sector is required to deliver services at the same or lower cost to meet public expectations (Beckford, 1998:10). Application of total quality management in this sector has been slow (Evans and Lindsay, 2002:75).

The evaluation of quality concerns, assists in (i) quantifying resultant and subsequent problems if quality is not addressed; (ii) identifying other problem areas; (iii) identifying the exact cause of quality problems; and (iv) creates opportunities to identify cost saving and customer dissatisfaction reduction initiatives (Gitlow, et al, 1999:182).

The findings of this study provide a basis for evaluating quality concerns and its causes in low-income housing house construction in the Pietermaritzburg area, thus identifying areas needing improvement and appropriate recommendations in respect thereof. Research limitations had been identified and recommendations have been made for future research.

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APPENDIX 1

SUMMARY OF PROCUREMENT LEGISLATION

(Adapted from the Department of Housing, *User's Guide to standardized procurement documentation, 2002.*)

Table 1: An overview of procurement legislation in South Africa

Specification	Reference to Procurement	Applicability	Comment
State Tender Board Act (Act 86 of 1968)			
	This Act provides for the regulation of the procurement of supplies and services for the disposal of moveable property of, and the hiring or letting of anything or the acquisition or granting of any right for or on behalf of, the state and to that end establishes a State Tender Board and provides for the establishment of a regional tender board.	National and provincial departments	Provincial procurement is governed by provincial legislation, which in the main, are modelled on the State Tender Board Act. The cabinet of the government of South Africa resolved in November 2000, to repeal the national and provincial tender board acts.
Local Government Transitional Act (Act 209 of 1993)			
10G	A municipality is required to award contracts for goods and services in accordance with Section 217 of Act 108 of 1996.	Local sphere of government	
(5)(a) To (c)	The Act requires that the granting of preferences be made public and permits municipalities to dispense with the calling for tenders in the case of an emergency or of a sole supplier or within such limits as may be prescribed by national law.		
10H	Sets out restrictions placed on councillors and officials with respect to any interests that they may have or benefits derived through contracts which are awarded.		
Constitution of the Republic of South Africa (Act 108 of 1996)			
217	Procurement must be conducted in accordance with a "system which is fair, equitable, transparent, competitive and cost effective." An organ of state must implement a procurement policy providing for categories of preference in the allocation of contracts and the protection or advancement of persons, or categories of persons disadvantaged by unfair discrimination in accordance with a framework contained in national legislation	All organs of state	

Public Finance Management Act (Act 1 of 1999)			
38(a) and 51(a) 76(4)	Accounting officers (head of departments / CEOs) and Accounting Authorities (boards / CEOs) are required to ensure that their organisations have in place an appropriate procurement and provisioning system which is fair, equitable, transparent, competitive and cost effective; effective, efficient and transparent systems of financial and risk management and internal control and a system for properly evaluating major capital projects prior to a final decision on a project. The National Treasury may make regulations or issue instruction concerning the determination of a framework for an appropriate procurement and provisioning system.	All organs of state, except in the local sphere of government.	A Municipal Finance Management Bill (MFMB), which mirrors the PFMA, is currently before parliament.
Preferential Procurement Policy Framework Act (Act 5 of 2000)			
All	This Act gives effect to Section 217 of the Construction by providing a framework for the implementation of the procurement policy embedded in the Constitution	All organs of state.	
*Construction Industry Development Board Act (Act 38 of 2000)			
5(1)(a) and 5(3) 5(2) 5(4) 16 and 18 18 and 22	The CIDB is empowered within the construction industry to promote and implement policies, programmes and projects aimed at procurement reform, standardisation and uniformity in procurement documentation, practices and procedures within the framework of the procurement policy of government; and best practices. The CIDB is charged with the establishment and maintenance of a national register of contractors which facilitates public sector procurement and a register of projects. It may also establish a register of suppliers, manufactures or service providers in the construction industry. The CIDB must publish a code of conduct for all construction-related procurement and all participants in the procurement process and may implement programmes aimed at standardisation of procurement documentation, practices and procedures. The Minister of Public Works must prescribe the manner in which public sector contracts may be invited, awarded or managed within the framework of the register and policy on procurement. Only contractors who are registered with the CIDB are permitted to undertake, carry out or complete construction works or a portion thereof. All construction contracts above a prescribed value must be recorded in the register and be subjected to a best practice project assessment.	All organs of state which engage in construction industry related procurement.	The Construction Industry Development Board (CIDB) has only recently been established and must within three years of their establishment establish the registers of contractors and projects and, within a reasonable period thereafter, establish a best practice contractor recognition scheme.

*(*Note : The Construction Industry Development Board Regulations have not been included in the Department's Documents. The Regulations are published under Notice 63 of 2004, government Gazette 26427. These are aimed at ensuring uniformity, transparency and predictability of procurement in construction processes, as discussed in paragraph 4.1.2 of this report.)*

APPENDIX 2

LIST OF STANDARDIZED PROCUREMENT DOCUMENTS : DEPARTMENT OF HOUSING

1. SUMMARY OF MINIMUM STANDARDS FOR PROCUREMENT LOW-INCOME HOUSING (Adapted from Department of Housing *User's Guide to Standardised Procurement Documents*)

These include the minimum standards for:

(1) issuing, receiving and evaluating tenders, including preferencing requirements;

(2) provides standard conditions of tender that are suitable for all methods of evaluation and preferencing in relation to housing;

(3) identifies professional services, engineering and construction works and standards of key outputs, and desired minimum performance standards in respect of each output;

(4) returnable documents and format of submission;

(5) drafting contracts;

(6) performance requirements and measurement;

(7) pricing instructions and schedules

2. SPECIFICATION AND TENDER DOCUMENTATION

Table 1: Documents that relate to the Tender

Number	Document
Part 1:Tendering procedures:	
T1.1	Tender Notice and Invitation to Tender
T1.2	Tender Data
Part 2: Returnable documents:	
T2.1	List of Returnable Documents
T2.2	Tender Schedules

Table 2: Documents that relate to the Contract

Number	Document
Part 1: Agreement / Contract Data	
C1.1	Form of Offer and Acceptance
C1.2	Contract Data
C1.3	Forms for Adjudicators Appointment
C1.4	Forms of Securities
Part 2: Pricing data	
C2.1	Pricing Instructions
C2.2	Activity Schedule / Bill of Quantities
Part 3: Scope of Work	
C3	Scope of Work
Part 4: Site information	
C4	Site Information

Table 3: Standard Headings and Sequencing of Documents when calling for tenders

Volumes		Contents	
Number	**Description**	**Number**	**Heading**
Volume 1	Tendering procedures	**Part 1: Tendering procedures**	
		T1.1	Tender Notice and Invitation to Tender
		T1.2	Tender Data
Volume 2	Tender Returnables	**Part 2: Returnable documents**	
		T2.1	List of Returnable Documents
		C1.1	Form of Offer and Acceptance
		C1.2	Contract Data (if relevant)
		C2.1	Pricing Instructions
		C2.2	Activity Schedule / Bill of Quantities
		T2.2	Tender Schedules
Volume 3	Contract	**Part 1: Agreement and Contract Data**	
		C1.2	Contract Data (if not included in the above)
		C1.3	Forms of Securities
		C1.4	Forms for Adjudicators Appointment
		Part 2: Pricing data	
		Part 3: Scope of Work	
		C3	Scope of Work
		Part 4: Site information	
		C4	Site Information

Table 4: Descriptions of component documents

Contents Number	Contents Heading	Function and broad outline of contents
	TENDER	
Part1: Tendering procedures		
T1.1	Tender Notice and Invitation to Tender	Alerts prospective contractors to the nature of the supplies, services or engineering and construction works required by the employer and should contain sufficient information to enable them to respond appropriately.
T1.2	Tender Data	Provides information to tenderers about the procedures that are to be observed during the tendering stage and what documentation they need to submit with their tenders, failing which their tenders may be rejected.
Part 2: Returnable documents		
T2.1	List of Returnable Documents	Ensures that everything the employer requires a tenderer to submit with his tender is included in, or returned with, his tender submission.
T2.2	Tender Schedules	Contains documents that are required for the purpose of evaluating tenders, some of which will be included in the subsequent contract.
	CONTRACT	
Part 1: Agreements and contract data		
C1.1	Agreement, Tender and Acceptance	Establishes the offer and acceptance
C1.2	Contract Data	Establishes the terms that collectively describe the risks, liabilities and obligations of the contracting parties and the agreed procedures for the administration of the contract.
C1.3	Forms for Adjudicators Appointment	Establishes the appointment and terms of reference for adjudicators.
C1.4	Forms of Securities	Provides the securities required by the employer
Part 2: Pricing data		
C2.1	Pricing Instructions	Sets out the way in which items are to be measured and priced.
C2.2	Activity Schedule / Bill of Quantities	Records the contractor's prices for providing supplies / services / engineering and construction works in terms of the contract.
Part 3: Scope of Work		
C3	Scope of Work	Identifies the supplies, services, or engineering and construction works which are to be provided during the execution of the contract and establishes any requirements and constraints relating to the manner in which the contract is to be executed. (Management, resource, construction and material specifications are included under the Scope of Work)
Part 4: Site information (engineering and construction works contracts only)		
C4	Site Information	Describes the site as at the time of tender to enable the tenderer to price his tender and to decide upon his method of working and programming

Table 5: Standardised procurement documents associated with the Project Linked Subsidy Housing Developments

Contents		Engineering and Construction Works Contract						Land acquisition contract	
Number	**Heading**		**Traditional Preplanned Contract**						
		Turnkey Contract	**Short contract**	**ECC2**	**Development**	Services contract	Project agreement	**Land purchase**	**Land availability**
STANDARD HEADINGS OF DOCUMENTS THAT RELATE TO THE TENDER									
Part 1: Tendering procedures									
T1.1	Tender Notice and Invitation to tender	√	√	√	√	√	X	√	√
T1.2	Tender Data	√	√	√	√	√	X	√	√
T1.3	Standardised conditions of tender	√	√	√	√	√	X	√	√
Part 2: Returnable documents									
T2.1	List of Returnable Documents	√	√	√	√	√	X	√	√
T2.2	Tender Schedules								
	Certificate for authority of signatory	√	√	√	√	√	X	X	X
	Certificate of attendance at clarification meeting		X	X	X	√	X	X	X
	Record of addenda to tender documents	√			X	X	X	X	X
	Form of intent to provide a performance bond	√	?	√	X	X	X	X	X
	Proposed subcontractors	√	X	√	X	X	X	X	X
	Quality plan	√	X	X	X	X	X	X	X
	Provision of samples	?	?	?	X	X	X	X	X
	Certificate of attendance at site meeting	√	√	√	√	X	X	X	X
	Basis of Design (Design / build and turnkey contracts)	√	X	X	X	X	X	X	X
	First programme method ands method statement	√	?	√	X	X	X	X	X
	Management plan	√	?	√	X	X	X	X	X
	Health and safety plan	√	?	?	X	X	X	X	X
	Record of addenda to tender documents	√	√	√	√	X	X	X	X
	Preference schedule (direct preference)	?	?	?	√	X	X	X	X
	Preference schedule (direct preference (generic)	X	x	X	X	√	X	X	X
	Preference schedule (direct participation) (generic)	X	x	x	X	√	X	X	X
	Preference schedule (direct participation using the SABS 1914-4 specification)	?	?	?	X	X	X	X	X
	Preference schedule (direct participation using the SABS 1914-5 specification)	?	?	?	X	X	X	X	X
	Targeted Enterprise Declaration Affidavit (S&ME)	?	?	?	X	X	X	X	X
	Targeted Enterprise Declaration Affidavit (SBE/ WBE/ EE)	?	?	?	√	X	X	X	X

Notes:
√ Standardised document in suite to be used
X No document required
? Standardised document in suite may be used if appropriate / necessary

Contents		Engineering and Construction Works Contract						Land acquisition contract	
Number	**Heading**		**Traditional Preplanned Contract**						
		Turnkey Contract	**Short contract**	**ECC2**	**Development**	Services contract	Project agreement	**Land purchase**	**Land availability**
STANDARD HEADINGS OF DOCUMENTS THAT RELATE TO THE CONTRACT									
Part 1: Agreement and Contract Data									
C1.1	Form of offer and acceptance	√	√	√	√	√	√	√	√
C1.2	Contract Data	ECC2	ECSC1	ECC2	ECSC1	PSC2	ECC2	**Purpose written**	**Purpose written**
C1.3	Forms for Adjudicators Appointment	√	√	√	√	√	√	X	X
C1.4	Form of securities	√	?	√	X	X	X	X	X
Part 2: Pricing Data									
C2.1	Pricing instructions	√	√	√	√	√	√	√	√
C3.2	Pricing schedules	√	√	√	√	√	√	√	√
Part 3: Scope of work									
C3	Scope of work	√	√	√	√	√	√	X	X
	Specification for Beneficiary and Housing Subsidy Administration	X	X	X	X	X	√	X	X
	Specification for Construction and management requirements pertaining to the NHBRC Warranty Scheme	?	?	?	X	X	√	X	X
	Schedule of Actual Cost	X	X	X	X	X	√	X	X
	Programme for Housing Development	X	X	X	X	X	√	X	X
	Draw Down Forecast	X	X	X	X	X	√	X	X
Part 4: Site Information									
C4	Site Information	√	√	√	√	√	√	X	X
	Annexure for Land acquisition agreement	?	X	X	X	X	√	X	X
	Annexure for Municipality's undertakings to supply and install bulk connector services and take over installed services.	?	X	X	X	X	√	X	X
	Annexure for NHBRC Project Enrolment Certificate	?	X	X	X	X	√	X	X
	Annexure for Phase I geotechnical investigation report.	?	X	X	X	X	√	X	X
	Annexure for Environmental impact assessment report	?	X	X	X	X	√	X	X
	Annexure for Social Compact Agreement	?	X	X	X	X	√	X	X

Notes: **√** Standardised document in suite to be used
X no document required
? Standardised document in suite may be used if appropriate / necessary
ECC2 = NEC Engineering and Construction Contract 2nd Edn 1995
ECSC1= NEC Engineering and Construction Short Contract 1st Edn 1999
PSC2= NEC Professional Services Contract 2nd Edition June 1998

APPENDIX 3

SUMMARY OF STANDARDS SOUTH AFRICA (SANS) PROCUREMENT SPECIFICATIONS

Table 1 : SANS Procurement Specifications

SANS Number	Description
*294	*Construction procurement processes, methods and systems*
*10403	*Formatting and compiling of construction procurement documents*
*10306	*Implementing preferential procurement policies using targeting procurement procedures*
*1914	Family of standards for targeted procurement
*10120	*Code of practice for use with standard specifications for civil engineering construction and contract documents*

*__Note :__ The National Housing documents have not been updated to reflect this standard.

APPENDIX 4

SUMMARY OF GEOTECHNICAL REQUIREMENTS INVESTIGATION

Adapted from the Department of Housing Standard Procurement Specifications, also obtainable from the NHBRC website at http://nhbrc.org.za/SubsidySector/TechnicalDocuments.htm, as accessed on 20 September 2005 and 28 August 2006).

1. GEOTECHNICAL INVESTIGATION ACTIVITIES FOR GOVERNMENT FUNDED LOW-INCOME HOUSING PROJECTS

The specifications outline the following activities:

(1) Evaluation of the geology and hydrogeology of the site.
(2) Examination of existing geotechnical information pertaining to the site.
(3) Excavating or boring in soil or rock.
(4) In-situ assessment of geotechnical properties of materials.
(5) Recovery of samples of soil or rock for examination, identification, recording, testing or display.
(6) Testing of soil or rock samples to quantify properties relevant to the purpose of the investigation.
(7) Evaluation of geotechnical properties of tested soils
(8) Reporting of the results

2. SUMMARY OF CONTENT OF GEOTECHNICAL SPECIFICATION FOR GOVERNMENT FUNDED LOW-INCOME HOUSING PROJECTS

(Adopted from the Department of Housing's Standard Procurement Documents)

The specifications contain:

(1) minimum qualification and experience of the professional conducting the reports in the various types of geotechnical investigations
(2) objectives and key outputs for each stage of the investigations;
(3) classification of risks of doline and specified size sink hole forming
(4) classification of risk characterization and anticipated number of ground-movement;
(5) minimum requirements for the entire process (objectives, inputs, processes and outputs) of the geotechnical investigations, including the following:
(6) consultation with relevant organizations
(7) data input, collection and analysis requirements
(8) geotechnical classification and scale of favourability of the site;
(9) field work and testing; and
(10) very detailed reporting requirements, including standard headings, content, presentation, special precautionary measures, and attachments (such as maps), specifically aimed at obtaining risks and precautionary measures for excavation, sanitation and founding conditions and soil suitability.

APPENDIX 5

SUMMARY ENVIRONMENTAL ASSESSMENT SPECIFICATIONS
(Adapted from the Department of Housing Standard Procurement Specifications, also obtainable from the NHBRC website at http://nhbrc.org.za/SubsidySector/TechnicalDocuments.htm, as accessed on 20 September 2005 and 28 August 2006).

The specification contains :

(1) objectives for each stage of the environmental impact assessment;
(2) key outputs;
(3) qualification criteria of professionals engaging in the process;
(4) Minimum requirements for each stage of the process (pre feasibility scan, scoping, impact report and management plan phases);
(5) Reporting requirements in respect of inputs, processes and outputs; and
(6) Application requirements, including investigations, motivation, consultation, recommendation and feedback.

APPENDIX 6

SUMMARY OF STANDARDS AND SPECIFICATION FOR ENGINEERING SERVICES

1. Department of Housing norms and standards

Table 1 : Department of Housing minimum norms and standards for engineering services

Type of service	**Minimum Level**
Water	Single standpipe per erf (metered)
Sanitation	Ventilated Pit Latrine per erf
Roads	Access to each erf with graded or gravel paved roads
Strom Water	Lined open channels
Street lighting	High mast security lighting for residential purposes where this is feasible and practicable, on condition that such lighting is not funded by CMIP or funding available form other sources

2. SANS specifications

Table 2 : SANS Civil Engineering Design and Construction Specifications

SANS Number	Description
1200	*Civil engineering construction standards*
......	*Design of buried pipelines*
*0102[1]	*Pipe materials*
*010252[2]	*Water supply and drainage for buildings*
*10299[3]	*Development, maintenance and management of ground water resources*

Note :
1 These standards have not been updated in the Department of Housing Documents.
2 SANS 010252 - *Water supply and drainage for buildings*, has legal status as it was proclaimed in the Government Gazette No. 22355, 8 June 2001 – Regulation Notice R509. (www.stansa.co.za/watersuply.aspx)
3 SANS 10299 – *Development , maintenance and management of ground water resources,* was developed specifically to address South African needs to establish a framework in which ground water should be managed, specifically with regard to the location, siting, design, construction, drilling, rehabilitation and decommissioning of boreholes and associated pumps. (www.stansa.co.za/TOWARDSBETTERGRONDWATERUSE.aspx

3. CSIR

CSIR "Guidelines for human settlement planning and design – The Red Book"
These are not standards in the true sense as it is not designed to be enforceable absolute limits, but have informed the Department of Housing's specification for engineering design and construction. The guidelines are performance based suggestions for professionals involved in human settlement planning and design. It is aimed at ensuring quality town planning layouts and engineering designs, taking cognizance of planning and transport nodes, land use planning, minimum property sizes, distances, open space types, quantities, transport matters (including access), sanitation and water designs, etc.(CSIR, 2000:2-5).

APPENDIX 7

HOUSE CONSTRUCTON SPECIFICATION : DEPARTMENT OF HOUSING

(Adapted from the Department of Housing Standard Procurement Specifications, also obtainable from the NHBRC website at http://nhbrc.org.za/SubsidySector/TechnicalDocuments.htm, as accessed on 20 September 2005 and 28 August 2006).

(1) Acoustics (privacy, reduce noise penetration and annoying emission);
(2) Condensation (applicable to the Southern Cape Condensation Area);
(3) Construction accuracy (dimensions and limits);
(4) Energy efficiency;
(5) Fire safety (ease of escape, mitigation of spread, suppression and rescue elements);
(6) Functionality (in terms of spaces, uses, ease of access, indoor visual environment, natural ventilation and accident safety);
(7) Internal wall finishing;
(8) Minimum measurements/dimensions/distances;
(9) Permissible deviations (concrete work; masonry and reinforcement in masonry; drainage; structural timber members; pre-cast concrete elements before and after erection);
(10) Sanitation;
(11) Solar radiation;
(12) Storm water disposal;
(13) Structural durability;
(14) Structural safety;
(15) Structural serviceability performance (e.g. design life minimum of 50 years for structural system and non-accessible components, 25 years for repairable/replaceable components such as roofing material);
(16) Tests (general; performance; structural safety; serviceability and durability; and rain penetration test for roofs and walls respectively;
(17) Thermal Performance;
(18) Water penetration (rain and other moisture elements); and
(19) Water saving measures.

APPENDIX 8

SUMMARY OF CONTENT : CODE OF APPLICATION OF THE NATIONAL BUILDING REGULATIONS (SABS 0400:1990)

(a) Administration
(b) Structural Design
(c) Dimensions (Plans, room heights, floor area)Public Safety
(d) Demolition work
(e) Site operations
(f) Excavations
(g) Foundations
(h) Floors
(i) Walls
(j) Roofs
(k) Stairways
(l) Glazing
(m) Lighting and ventilation
(n) Drainage
(o) Non-water borne means of sanitary disposal
(p) Storm water disposal
(q) Facilities for disable persons
(r) Fire protection
(s) Refuse disposal
(t) Space heating
(u) Fire installation

APPENDIX 9

SUMMARY OF SANS BUILDING CONSTRUCTION SPECIFICATIONS APPLICABLE TO LOW-INCOME HOUSING

Table 1 : SANS Building Construction Related Specifications

SANS Number	Description
0400	*Code of Practice for the application of the National Building Regulations*
542	*Specification for concrete roofing tiles*
0155	*Code of practice for accuracy in buildings* (Method of measurement and accuracy of dimensions for setting out and completing structures with permissible deviations, as prescribed)
0160	*Code of Practice for general procedures and loadings to be adopted in the design of buildings* (stability of structures when exposed to wind)
0177	*Fire proofing*
1263	*Glazing* (including areas requiring safety glazing, but this is less likely in low-income housing projects)
*11600:1993/ ISO11600:1993	*Building construction – sealants – classification and requirements*
10409:2000	*Design, selection and installation of geomembranes* facilitates the correct use and installation of plastics to act as a barrier for waterproofing (e.g. foundation slabs and roofs) www.stansa.co.za/SANS10409.aspx
*10145:2000	*Concrete masonry construction* (Covers construction of walls with precast concrete masonry units)
*1783-2:2005	*Sawn softwood timber Part 2:Stress graded structural timber and timber for frame wall construction*

*__Note__ : *These standards have not been updated in the National Department of Housing Documents.*

APPENDIX 10

UNIVERSITY OF
KWAZULU-NATAL

RESEARCH OFFICE (GOVAN MBEKI CENTRE)
WESTVILLE CAMPUS
TELEPHONE NO.: 031 – 2603587
EMAIL : ximbap@ukzn.ac.za

23 AUGUST 2006

MRS. MM MILNE (9020479470)
MANAGEMENT STUDIES

Dear Mrs. Milne

ETHICAL CLEARANCE APPROVAL NUMBER: HSS/06212A

I wish to confirm that ethical clearance has been granted for the following project:

> **"An investigation into quality concerns in house construction in government subsidized low income housing projects in the Pietermaritzburg Area"**

Yours faithfully

Ximba

MS. PHUMELELE XIMBA
RESEARCH OFFICE

PS: The following general condition is applicable to all projects that have been granted ethical clearance:

THE RELEVANT AUTHORITIES SHOULD BE CONTACTED IN ORDER TO OBTAIN THE NECESSARY APPROVAL SHOULD THE RESEARCH INVOLVE UTILIZATION OF SPACE AND/OR FACILITIES AT OTHER INSTITUTIONS/ORGANISATIONS. WHERE QUESTIONNAIRES ARE USED IN THE PROJECT, THE RESEARCHER SHOULD ENSURE THAT THE QUESTIONNAIRE INCLUDES A SECTION AT THE END WHICH SHOULD BE COMPLETED BY THE PARTICIPANT (PRIOR TO THE COMPLETION OF THE QUESTIONNAIRE) INDICATING THAT HE/SHE WAS INFORMED OF THE NATURE AND PURPOSE OF THE PROJECT AND THAT THE INFORMATION GIVEN WILL BE KEPT CONFIDENTIAL.

cc. Faculty Office (Post-Graduate Studies)
cc. Supervisor (Mr. M Poulter)

APPENDIX 11

EXTRACT OF SPREAD SHEET FOR DATA COLLECTION : PHASE 1

Key: NO DEFECT TYPE DETECTED=0; DEFECT TYPE DETECTED=1

PROJECT DETAILS		INSPECTION DATES			TIMEFRAMES (Calendar days)			STAGE (Completed during 1April 200 5 to 31 December 2005)		
PROJECT NAME	SITE NUMBER	SLAB	WALL PLATE	COMPLETION	Slab to wall	Wall to completion	Total	SLAB	WALL PLATE	COMPLETION
	8473	4/26/05	7/19/05	8/30/05	84	42	126	1	1	1
	8474	4/26/05	7/12/05	7/26/05	77	14	91	1	1	1
	8475	4/26/05	5/31/05	7/19/05	35	49	84	1	1	1
	8476	4/26/05	5/17/05	7/26/05	21	70	91	1	1	1
	8477	4/26/05	5/17/05	7/19/05	21	63	84	1	1	1
	8478	4/26/05	7/26/05	8/30/05	91	35	126	1	1	1
	8534	5/31/05	6/14/05	8/16/05	14	63	77	1	1	1
	8542	5/10/05	6/14/05	8/16/05	35	63	98	1	1	1
	8543	5/31/05	6/14/05	8/16/05	14	63	77	1	1	1
	8544	5/10/05	6/14/05	8/16/05	35	63	98	1	1	1
	8545	5/10/05	6/14/05	8/16/05	35	63	98	1	1	1

TIME FRAME ANALYSIS			Slab to wall	Wall to completion	Total
UNITS V TIMEFRAME STATISTICS					
AVERAGE	3/30/05	8/11/05	172	135	307
MODE	7/12/05	7/19/05	0	0	84
Frequency	1086	4/28/01	98	69	137
MEDIAN	04/19/05	8/11/05	146	101	316
MIN	2/11/04	2/2/05	0	0	0
MAX	12/20/05	12/20/05	655	510	779
DIFFERENCE	678	321.00	655	510	779
Units/day	2.00	2.00			
Units/month (30 days)	60.13	60.13			
DIFFRENCE between first slab and last subsequent stage				1030.00 days	
Units/day				1.32	
Units/month (30 days)				39.58	

Completion time frames							
90 day period (3 months)							
Days	**91-180**	**181-270**	**271-360**	**361-450**	**451-540**	**541-630**	**>630**
Units	293	154	175	294.00	165	106	16
Units/day (90 days)	3.26	1.71	1.94	3.27	1.83	1.18	0.18
Units/month (30 days)	7.67	51.33	58.33	98.00	55.00	35.33	5.33
180 day period (6 months)							
Days	**0-180**		**181-360**		**>361**		
Units	432		329		475		

PROJECT NAME	POTENTIAL FAILURE																
	MAJOR STRUCTURAL												OTHER		INADEQUATE SERVICES		
	Construction			Material/s													
				Foundation				Wall			Roof						
Site number	Foundation and Slab	Wall to plate	Roof)	Lintels	Concrete	Blocks	DPC	Blocks	Mortar mix	Lintels (window , door, partitions	Sheeting	Beams and Purlins	Incomplete/not ready	Access/Keys	Water	Sanitation	Access
															1		
															1		
															1		
															1		
															1		
															1		
	1														1		
															1		

PROJECT DETAILS PROJECT NAME	CLEARANCE	FINISHING																	REINSPECTIONS	Duplications	Errors per unit
		PLUMBING								OTHER FINISHES											
		Workmanship					Material			Workmanship						Material					
Site Number	Site clearance	Toilet (Incl. Pipes and Rodding eyes)	Outlet and Gully	Pipes (Water, incl. taps)	Basin	Shower	Tap	Gully	Water tank	Block work (	Cork/Fill/Grout	Plaster	Fitting windows, glass and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	Door			
												1			1						3
												1			1						2
																					1
													1					1			3
						1					1	1									3
											1	1									3
																					1
																					1
																					2
															1						1

APPENDIX 12

SUMMARY OF DEFAULT CATEGORIES AND DESCRIPTIONS

MAIN CATEGORY	SUBCATEGORY	INSPECTION STAGE/ DEFECTIVE UNIT	COMMENTS
A : MAJOR STRUCTURAL ISSUES These will cause the stage to be failed by the inspector	(1) Workmanship (Construction)	Foundation and Slab	Includes leveling, waterproofing, major cracks, pad and lintels, etc.
		Wall Plate	Includes: block work; mortar mix; lintels; plumpness of building, windows and door; brick force, brick courses (building height), etc.
		Completion	Structural design, pitch, ties, beam spacing, and fixture (screw spacing, etc), overhang and overlap, etc)
	(2) Materials (quality)	Foundation and Slab	Lintels, concrete, blocks and DPC (Plastic membrane for waterproofing)
		Wall Plate	Blocks, mortar mix, lintels (windows, doors and partitions, where applicable).
		Completion	Sheeting type, thickness and rust free, beams and purlins to specification and SABS/SANS compliant
B : INCOMPLETE WORK These will cause the inspector to fail the unit as it is not habitable, or cannot be accessed for inspection.	(1) Inadequate services	Water, Sanitation, Access	These should be completed before the house is occupied, but needs to be available to ensure that the plumbing and water supply is in working order, and that the property is accessible.
	(2) Other	Incomplete/ not ready	Includes outstanding pre-certification by engineer/building professional.
		Access/Keys	Where keys are not available, or the unit could not be accessed for final inspections,
C : FINISHING	(1) Clearance		Used in records to describe both site preparation, and clearing materials after construction.
	(2) Plumbing		
	(a) Workmanship	Toilet	Entire system, including pipes and rodding eyes
		Outlet and gulley	Fitting, leaks, gradient of fall, and positioning over the gulley and condition of gulley
		Pipes	For water, and including taps
		Basin	Fitting
		Shower	System and all fittings
	(b) Materials (quality)	Tap	
		Gully	
		Water tank	
	(3) Other finishes		
	(a) Workmanship	Block work	
		Fillings	
		Plaster	(and/or bag washing, where applicable)
		Fitting windows, glass and door frames	
		Glazing	
		Screed	(Topping of slab)
	(b) Materials (quality)	Window and/or door frames	
		Plaster/Cement/Bag wash material	
		Door	
		Glazing	

Figure 1 : Poor mortar mix, inadequate cement.

Figure 2 : Poor block work resulting in re-work.

Figure 3 : Poor founding conditions resulting in cracks.

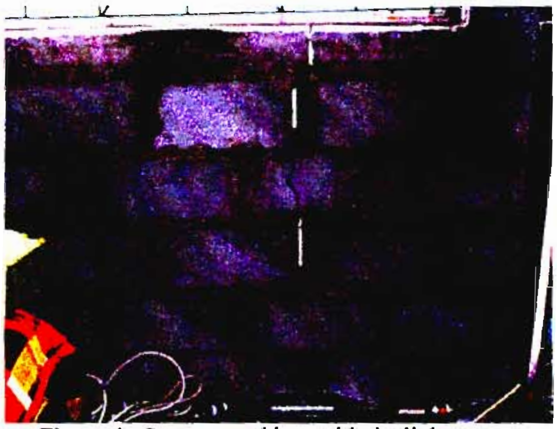


Figure 4 : Severe cracking, with daylight shining through.

Figure 5 : Structural cracks from window to roof.

Figure 6 : Structural cracks from roof beam to window.


Figure 7 : Structural crack starting from roof.


Figure 8 : Foundations being underpinned as a result of poor founding. Also note block-work had to be redone.


Figure 9: Roof screw not done properly.


Figure 10: Poor sealing of holes, as is evident from reflection of light on the beam.

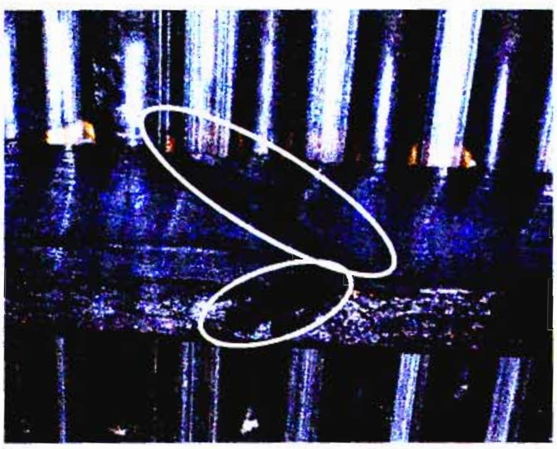


Figure 11 : Poor quality timber used.


Figure 12: Poor material (knotty timber), nailing roof screws, poor and holes not sealed.

Figure 13 : Roof ties fitted retrospectively

Figure 14 : Poor beam filling, roof ties fitted retrospectively, and holes not sealed.

Figure 15 : Poor service maintenance.

Figure 16 : Poor service maintenance.

Figure 17 : Poor service maintenance.

Figure 18 : Poor service maintenance.

Figure 1: An informal wattle and daub structure.

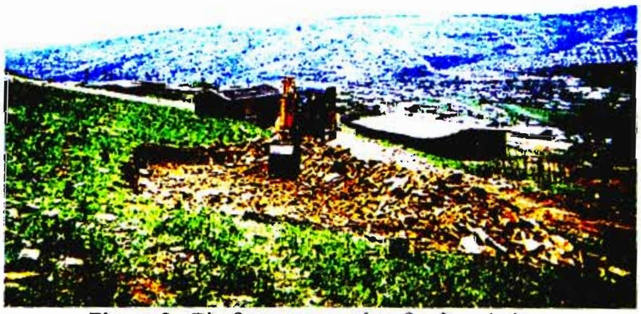


Figure 2 : Platform excavation for foundation.

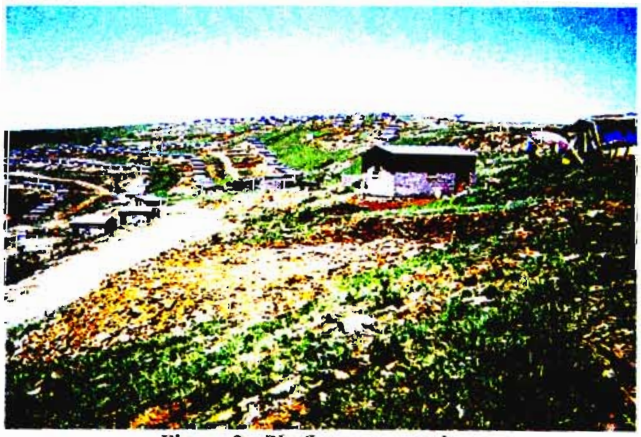


Figure 3 : Platform preparation.

Figure 4 : Preparation for constructing foundation.

Figure 5 : Preparation for foundation continued.

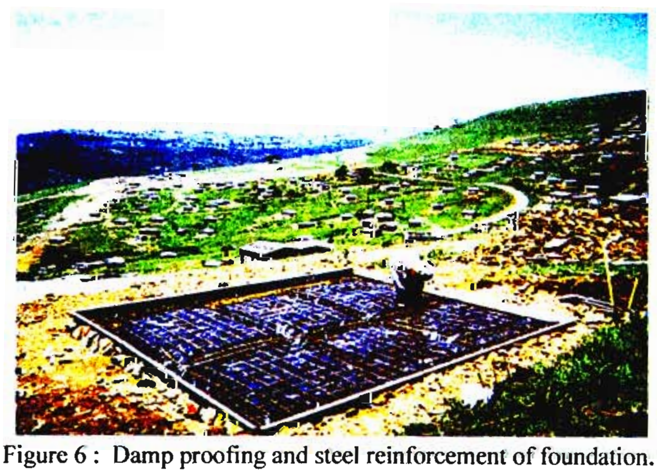


Figure 6 : Damp proofing and steel reinforcement of foundation.

Figure 7 : Pouring cement for foundation and slab.

Figure 8 : Slab completed, ant poison applied and clearance commencing.

Figure 9 : Setting profiles to construct walls.

Figure 10 : Mixing mortar for wall construction.

Figure 11 : Joints being filled and internal wall construction.

Figure 12 : Unit completed to plate level.

Figure 13 : Roofing of structure commencing.

Figure 14 : Completed unit ready for occupation.

Figure 15 : Unit handed over to occupant.

APPENDIX 15

Dear Potential Participant

PARTICIPATION IN RESEARCH : AN INVESTIGATION INTO QUALITY CONCERNS IN HOUSE CONSTRUCTION IN GOVERNMENT-SUBSIDISED LOW-INCOME HOUSING PROJECTS IN THE PIETERMARITZBURG AREA

This attached questionnaire aims at informing a MBA study through the University of KwaZulu-Natal. The study is an investigation into issues that affect quality in Government-subsidised low-income housing house construction in the Pietermaritzburg area. The study is informed by the theoretical framework of total quality management (TQM).

The purpose of this study is to identify issues that affect quality in the construction of houses through the South African Government's low-income housing subsidy scheme in the Pietermaritzburg area, and to determine how quality management can assist in improving house construction in an environment limited by budget constraints.

Research Objectives

The research is aimed at the following objectives:

(8) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(9) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(10) To identify how house construction quality issues are currently being addressed.

Identification for the need of the research

The need for this research was identified through numerous references regarding quality concerns in low-income housing. This matter has been raised in numerous political speeches at National and Provincial level. These concerns were also raised at the KwaZulu-Natal Housing Summit held on 23 and 24 March 2005. The report on the summit highlights the Department of Housing's role in ensuring quality that is acceptable to the beneficiaries. In discussion at the summit the need for the quality of housing to be reviewed, the need for improved value of this type of asset, review of the house design, and quantity vis-à-vis quality aspects, were recorded. A resolution was taken to "beef up the inspectorate component" of the Department of Housing, to assist in addressing the quality. Resolutions were also taken that required the Department to develop performance indicators, standardize reporting and monitoring templates, and quality specifications for various housing options. This research would assist in informing these efforts.

Benefits of participation

- Assist in identifying common trends in housing quality issues which you are involved in.
- Quantify the extent of quality defaults.
- Inform quality management strategies of your organization/component.
- Provide information on gaps in quality management in the context of low-income housing.

What is required from participants?

Participants are required to complete the attached questionnaire, which will take approximately 30 minutes to 1 hour to complete. All responses should be done in the contexts of low-income housing.

There are no financial, legal or personnel implications to your or your organization. Thee names of all respondents will remain anonymous. The research report will refer to respondents in the context of the category (Department of Housing, Municipality, Private Developer/ Implementing Agent, etc.), and each respondent will be referred to in numerical terms (e.g. Municipality/Local Government: Respondent 1).

The questionnaire is structured in three sections:

> **Section 1 :** The objective of this section is to establish possible causes of quality concerns in the Pietermaritzburg area, from the perspectives of the Department of Housing (DoH) officials, developers, and the municipality, respectively.
>
> **Section 2 :** The objective of this section is to establish which systems are in place and to review the efficiency of these.
>
> **Section 3 :** Provision is made here to list any additional concerns, comments and/or suggestions regarding quality management in the contexts of Government subsidised low-income housing.

Kindly provide contact details (your name, organization, contact number, and/or e-mail) at the bottom of the questionnaire. These details will be used for purposes of obtaining clarity, should the need arise. Please note that the names of all respondents will remain anonymous.

Kindly submit your responses to Mrs. Martie Milne at 199 Pietermaritz Street, Room 1/07 or via e-mail at milnem@hse.kzntl.gov.za, before 10 June 2006.

Participants may be contacted for purposes of obtaining clarity. The research summary should be completed by 14 July 2006.

Information management

Questionnaires will be filed in a secure filing facility, until final acceptance of the dissertation, and then destroyed thereafter.

Data findings will be stored electronically, until final acceptance of the dissertation, and then destroyed thereafter.

Confidentiality and anonymity
Please note that information will be dealt with discretely and anonymity will be ensured as explained above. Kindly indicate where information is sensitive in nature and how you wish this to be included/excluded from the research report by providing a brief explanation on the questionnaire, or by contacting the research investigator (see contact details below).

Non-participation
Please note that a decision not to participate will not result in any form of disadvantage or prejudice. Participation is voluntary and that subjects are free to withdraw from the study at any stage and for any reason.

Declaration
Kindly complete the declaration section below and return to the research investigator at 199 Pietermaritz Street, Room 1/07 or via fax (033-8452086), before 7 June, 2006

Contact details

The **research investigator** is Mrs M Milne, a MBA student, registered with the University of KwaZulu-Natal. Should you have any queries regarding this questionnaire, kindly contact Mrs. Martie Milne on 0827715217, or via e-mail : milnem@hse.kzntl.gov.za.

The **research supervisor** is Mr Mike Poulter, University of KwaZulu-Natal, Pietermaritzburg. He may be contacted at 033-2605736 or e-mail at Poulter@ukzn.ac.za.

Should you require further information, kindly contact the research investigator or research supervisor, alternatively, the Programme Director, Prof. D. Vigar- Ellis, at the University of KwaZulu-Natal, Pietermaritzburg Campus, School of Business.

Your inputs into this research are greatly appreciated.

Yours faithfully

Martie Milne
MBA Student (902479470)

DECLARATION

PARTICIPATION IN RESEARCH : AN INVESTIGATION INTO QUALITY CONCERNS IN HOUSE CONSTRUCTION IN GOVERNMENT-SUBSIDISED LOW-INCOME HOUSING PROJECTS IN THE PIETERMARITZBURG AREA

I...(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT DATE

....

Note : Enquiries may be directed to the research supervisor, Mr. Mike Poulter at the University of KwaZulu-Natal (Pietermaritzburg) at 033-2605736 or e-mail at Poulter@ukzn.ac.za.

QUESTIONNAIRE

SECTION 1 : POSSIBLE CAUSES OF QUALITY CONCERNS							
Kindly indicate the extent to which you agree with the following statements:		0 = Strongly disagree 1 = Disagree 2 = Slightly agree 3 = Agree 4 = Strongly agree					
		Not sure	0	1	2	3	4
1.	Quality concerns exist in low-income housing in Pietermaritzburg						
2.	Most defects in the area relate to structural issues.						
3.	Most defects relate to finishing.						
4.	Defects are caused mainly through the availability of resources, in terms of						
(a)	- Finance						
(b)	- Skilled labour						
(c)	- The following major materials:						
	Cement						
	Sand						
	Stone						
	Steel						
	Timber						
	Water						
5.	Defects are caused mainly by poor quality material.						
6.	Materials are SABS or Agrément compliant. *(Agrément is a South African Organization responsible for the certification of non-standardized building methods)*						
7.	Material and product samples are regularly tested against SABS or Agrément requirements.						
8.	Defects are caused mainly through poor workmanship						
9.	Poor workmanship is caused by (please mark those you feel are relevant):						
(a)	- Inappropriate recruitment processes.						
(b)	- Poor training.						
(c)	- Lack of financial support for training						
(d)	- High work speed requirement						
(e)	- Pressure relating to high volume and short time frames.						
(f)	- Lack of supervision.						
(g)	- Lack of performance management.						
(h)	- Lack of reward systems.						
(i)	- Lack of proper quality management systems						
(j)	- Lack of staff involvement in problem solving.						
(k)	- Lack of inspection during production processes.						
(l)	- Lack of team work.						
(m)	- Lack of leadership.						
(n)	- Lack of competently skilled resources.						
(o)	- Lack of commitment to quality.						

		Not sure	0	1	2	3	4
(p)	- Lack of quality awareness.						
(q)	- Lack of experience.						
(r)	- Lack of quality responsibility ownership.						
(s)	- High volume production within shortest possible timeframes.						
(t)	- Lack of discipline						
10.	Quality defect rates are within acceptable tolerances.						
11.	Quality defects result in major rework and/or re-inspections.						
12.	Quality defects impact on cashflow.						
13.	Product warranties are in place.						
14.	Claims against warranties are measured.						
15.	The average yield of 40 units per month (completed and passed for payment) is acceptable.						
16.	Construction stages (foundation and slab : wall plate : completion) are programmed and monitored.						
17.	Delivery rates between timeframes are acceptable.						
18.	Product specifications and timeframes are stipulated in the contract.						
19.	Timeframes, costs and product specifications are adhered to at all times.						
20.	Variations to the contract are negotiated with all stakeholders and are formalised.						
21.	Quality concerns are addressed at site meetings						
22.	Repetitive quality problems are included in organisational strategies.						
23	Other possible quality causes (please list some here and rate the impact on quality, based on the assumption that the impact would be significant, as per the example in italics, below)						
	<u>Example :Possible cause</u> *:Poor maintenance of equipment (score on the extent to which you agree that this would have a significant impact)*					X	

SECTION 2 : QUALITY MANAGEMENT SYSTEMS AND EFFICIENCIES							
1.1	Your organization has a quality management system	Not sure	0	1	2	3	4
1.2	In your organization, quality management involves **all** internal components.						
1.3	In your organization, quality management involves **all** external role players						
1.4	Quality concerns are defined by:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f)	- None of the above.						
(g)	- Some of the above (Please indicate which ones by marking these with [*].)						
1.5	The responsibility for quality lies with:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality.						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f)	- None of the above.						
(g)	- Some of the above. (Please indicate which ones by marking these with [*].)						
2.1	Your organization undertakes regular company wide quality assessments (at least once a year).						
2.2	Your organization follows ISO 9000 quality standards.						
2.3 (a)	Quality management in your organization is customer focused.						
(b)	Quality management is practiced with effective leadership.						
(c)	Quality management follows a process approach. (*A process approach includes planning, controlling and improving primary process*)						
(d)	Quality management supports a systems approach to management.						
(e)	Quality management focuses on continuous improvement.						
(f)	Quality management includes a factual approach to decision making.						
(g)	Quality management is aimed at mutual beneficial supplier relationships.						
(h)	Quality management is practiced with effective leadership.						

		Not sure	0	1	2	3	4
3.1	Different approaches are followed for quality problems that occur less often and/or are less severe, than those that happen often and/ or have a major impact on delivery.						
3.2	A diagnostic approach is followed in solving quality management problems. *(A diagnostic approach allows for decisions to be made on facts)*						
4.1	Quality is benchmarked against competitors. *(Benchmarking is the comparison of your product or service to best practices in the field or industry).*						
4.2	Quality management in your organization recognizes a range of different customers with different needs.						
4.3	A quality management policy is in place.						
5.1	Quality control includes a quality score card						
5.2	Final inspections are the responsibility of:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality.						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f)	- None of the above.						
(g)	- Some of the above. (Please indicate which ones by marking these with [*]).						
5.3	Inspections are carried out by:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality.						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f)	- None of the above.						
(g)	- Some of the above. (Please indicate which ones by marking these with [*].)						
5.4	All stakeholders are aware of the criteria used in inspection processes.						
5.5	Inspection processes are based on prior knowledge of product quality, similarity within the lot and allowable risk.						
5.6	The following is typical of inspections :						
(a)	- No inspection.						
(b)	- Small samples.						
(c)	- Large samples.						

		Not sure	0	1	2	3	4
(d)	- 100% inspection.						
(e)	- Snags are done prior to final inspections.						
(f)	- Snags are addressed properly and within the given time.						
6.1	Quality is part of the strategic management process to ensure long term customer satisfaction goals.						
6.2	In your organization:						
(a)	Quality management is lead and supported by top management.						
(b)	Proper infrastructure (including plans, goals, organisational mechanisms and resources, performance measurement and rewards) exist at all levels to implement a quality management system.						
(c)	Role players are not skeptic about the need for new quality management programmes.						
(d)	Management relies ***principally on strong motivational technique to encourage improvement,*** once statistical strong evidence has been used to convince all of the seriousness of the problem.						
(e)	An incremental approach is followed is solving quality problems *(i.e. prioritization of quality problems to address, as opposed to trying to resolve all problems simultaneously).*						
(f)	Different techniques are used to achieve quality goals (Please refer to Appendix 1 for typical tools and kindly indicate the 5 most frequently used in your organization).						
(g)	Sufficient time and resources are available to address quality, and the need to change priorities as a result thereof is supported by management).						
6.3	Quality strategies are implemented throughout all line function activities.						
7.1	Quality is part of the organization's vision.						
7.2	Decision making styles (command, consultative and consensus/agreement) are adapted to suit the situation at hand).						
7.3	Management creates an environment that encourages learning from mistakes to encourage improvement.						
7.4	Employees participate in quality related decision and take ownership of work related thereto.						
7.5	Individual and team performance is measured regularly and are provided with feedback on progress.						
7.6	Management base decisions on facts and scientific instruments.						

		Not sure	0	1	2	3	4
7.7	Staff are encouraged to share ideas, feelings and needs freely, in an open and trusting manner without fear of punishment.						
7.8	Managers act as role models for ethical practices.						
8.1	Customer needs are well understood.						
8.2	Customer needs defined based on proper market research.						
8.3	Customer satisfaction is measured in terms of product features and freedom from deficiencies.						
8.4	Customer satisfaction surveys inform product development.						
9.1	Suppliers are evaluated regularly against quality defaults.						
9.2	Supplier quality problems are resolved through partnerships.						
9.3	Certified suppliers are used.						
9.4	Suppliers understand all specification and standards clearly, and these are stated in quantitative terms.						
9.5	All role players understand **what** they should be doing. *(Please rate each of the role players listed in (a) to (e) below).*						
(a)	- Implementing agent, project manager or developer						
(b)	- Suppliers						
(c)	- Department of Housing						
(d)	- Municipality						
(e)	- Community						
9.6	All role players know **how to** undertake their functions.*(Please rate each of the role players listed in (a) to (e) below).*						
(a)	- Implementing agent, project manager or developer.						
(b)	- Suppliers.						
(c)	- Department of Housing.						
(d)	- Municipality.						
(e)	- Community.						
9.7	All stakeholders have suitable, controllable processes to meet specifications. *(Please rate each of the role players listed in (a) to (e) below).*						
(a)	- Implementing agent, project manager or developer.						
(b)	- Suppliers .						
(c)	- Department of Housing.						
(d)	- Municipality.						
(e)	- Community.						
10.	Statistical process control systems are used to measure and analyse all processes .						

		Not sure	0	1	2	3	4
11.	Rate the extent to which the administration and support activities in 11.1 to 11.3 are measured in terms of quality.						
11.1	Finance *(Rate the extent to which items (a) to (d) are measured by your organization).*						
(a)	- monetary value of invoices paid late.						
(b)	- average number of days to issuing of invoices.						
(c)	-% of invoices returned due to errors.						
(d)	-monetary value of unrecoverable accounts receivable.						
11.2	Personnel *(rate the extent to which items (a) to (d) are measured by your organization).*						
(a)	-% resumes (cv's) received that result in interviews						
(b)	-number of candidates interviewed before an offer is made and accepted.						
(c)	-average number of days from request for personnel to initial employment date.						
(d)	-% certified/qualified workers in critical activities.						
11.3	Information technology *(rate the extent to which items (a) to (e) are measured by your organization)..*						
(a)	-% system uptime *(i.e. when systems can be used).*						
(b)	- Mean (average) time between failures.						
(c)	- Mean (average) time to restore services.						
(d)	- Turnaround time for reports *(how long it takes to get reports out of the system).*						
(e)	- Software/programming errors.						
12.	A quality information system is in place and includes the following items listed in (a) to (l) below:						
(a)	- Key Performance Indicators.						
(b)	- Action Plan for Improvement						
(c)	- Progress on action plan						
(d)	- Evaluation and feedback mechanism.						
(e)	- Customer satisfaction data.						
(f)	- Product design, specification and standards information.						
(g)	- Material, equipment and supplier test results .						
(h)	- Work in progress.						
(i)	- Complaints.						
(j)	- Management control.						
(k)	- Delivery cycle timeframe projections, actual and variation.						
(l)	- Variation data and problem solving process management data.						
13.	A quality audit and assurance programme is in place. *(A Quality audit is an independent review conducted to compare some **actual** aspects of quality performance with the **required** standard of performance.. Quality assurance is a process of providing evidence to establish whether quality requirements will be met.*						

SECTION 3 : COMMENTS, CONCERNS AND SUGGESTIONS
Kindly submit any concerns, suggestions and comments with regard to low-income housing in the space below. (A separate sheet may be attached if necessary)

CONTACT DETAILS

Name:	
Organization:	
Component:	
Position:	
Contact Number:	
E-mail	

Thank you for your time and participation.

RESEARCH QUESTIONNAIRE Appendix 1

The questionnaire is structured two sections:

> **Section A :** The objective of this section is to establish broad quality management tools and techniques used in your organization.
>
> **Section B :** The objective of this section is to collect data on participants' perception of the supply chain management status of their organizations.

Detailed explanations of each tool have been provided at the back of the questionnaire, together with an example to illustrate how items should be selected.

Kindly provide contact details (your name, organization, contact number, and/or e-mail) at the bottom of the questionnaire. These details will be used for purposes of obtaining clarity, should the need arise. Please note that the names of all respondents will remain anonymous.

Kindly submit your responses to Mrs. Martie Milne at 199 Pietermaritz Street, Room 1/07 or via e-mail at milnem@hse.kzntl.gov.za, before 10 July 2006.

SECTION A

QUALITY MANAGEMENT TOOLS

Various authors discuss a range of different tools and techniques, those most commonly referred to in the literature are briefly outlined in the section below. Kindly mark the 5 most commonly used by your organization. Please note that detailed explanationsare attached at the back of the questionnaire.

(Note, the quota of 5 includes selections from subcategories. Where sub-subcategories are provided, please make your selection from these, should it be applicable). An example is attached, in which the "respondent's" selection is highlighted)

1. **Process analysis**

2. **Quality management systems(e.g. ISO 9000)**

3. **Statistical method**

    3.1 Run charts
    3.2 Control charts
    3.3 Pareto analysis
    3.4 Histograms
    3.5 Cause and effect diagrams
    3.6 Stratification data
    3.7 Check sheets
    3.8 Scatter diagrams

4. **Qualitative methods**

    5.1 Quality circles
    5.2 Job design
    5.3 Organisational structure
    5.4 Supplier relationships and -development
    5.5 Specifications and Standardisation

5. **Other Management Methods**

    5.1 Six sigma
    5.2 Deming wheel
    5.3 Bench marking
    5.4 Gantt charts

SECTION B : SUPPLY CHAIN MANAGEMENT STATUS

Organizations achieve different levels of mastering world class supply chain management as summarised in Figure 9 below. Kindly peruse Figure 9 and rate the placement of your organization in terms of World class status, by encircling the "World Class Supply Chain Scale" at the bottom.

Figure 9. The Progression to World Class Supply Chain Management

Clerical	Mechanical	Proactive	World Class
			▪ Strategic sourcing
			▪ Monitoring supply environment
			▪ Understand key supply industries
		▪ Coordinate procurement system	▪ Develop and implement commodity strategies
			▪ Commodity teams
		▪ Involved in development of requirements	▪ Supply base by design
		▪ Fulfil social responsibilities	▪ Time-based competition
	▪ Transactional focus	▪ Plan for recurring requirements	▪ Manage risk
		▪ Develop Suppliers	▪ Leverage supplier technology
▪ Process paperwork		▪ Near defect free materials and services	▪ Virtually defect free materials and services
	▪ Not involved in key source selections	▪ Active in source selection	▪ Integrated supply strategy
▪ Confirm actions of others	▪ React to requisitions	▪ Long term contracts	▪ Develop and manage alliances and networks
▪ Emphasis : Convenience	▪ Emphasis : Purchase price	▪ Emphasis : cost, quality, timeliness	▪ Emphasis : total cost
▪ Relationships : Personal	▪ Relationships : Transactional/adversarial	▪ Relationships : Transactional and collaborative	▪ Relationships: Transactional, collaborative, and alliance
▪ Bottom-line impact : Overhead	▪ Bottom-line impact: Revenue neutral	▪ Bottom-line impact : Profit	▪ Bottom-line impact : Increase shareholder value
▪ Reporting : very low level	▪ Reporting low level	▪ Reporting : Upper management	▪ Reporting: Member executive group
▪ Data: Not available	▪ Data: Used to expedite	▪ Data Facilitates sourcing and pricing	▪ Data: Facilitates strategic planning
	▪ Computers process paperwork	▪ e-Commerce	▪ e-Commerce II

1 2 3 4 5 6 7 8 9 10

World Class Supply Chain Scale

CONTACT DETAILS

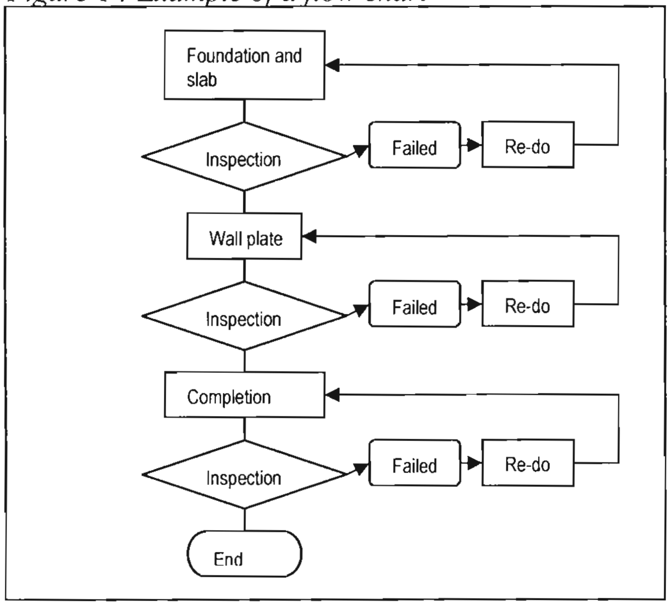
Name:	
Organization:	
Component:	
Position:	
Contact Number:	

EXPLANATIONS OF QUALITY MANAGEMENT TOOLS AND RELATING TO SECTION A

6. Process analysis

Process analysis outlines systems and helps to identify process and quality problems Flow charts (Figure 1, below) provide a visual representation of all the steps in a process, links between them, source of inputs and resultant outputs.

Figure 1 : Example of a flow chart



7. Quality management systems

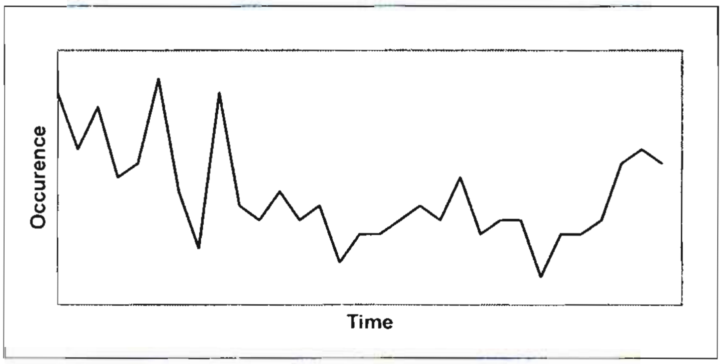
A quality management system is a systematic approach that yields a formal record of an organization's quality management method and provides a basis for measuring and monitoring quality performance. The system is certified by a third party as conforming to an acceptable standard, such as the International Standards Organization, e.g. ISO 9000 and 14000.

8. Statistical method

Various tools are available to collect and analyse data. A number of computerized software programmes are available

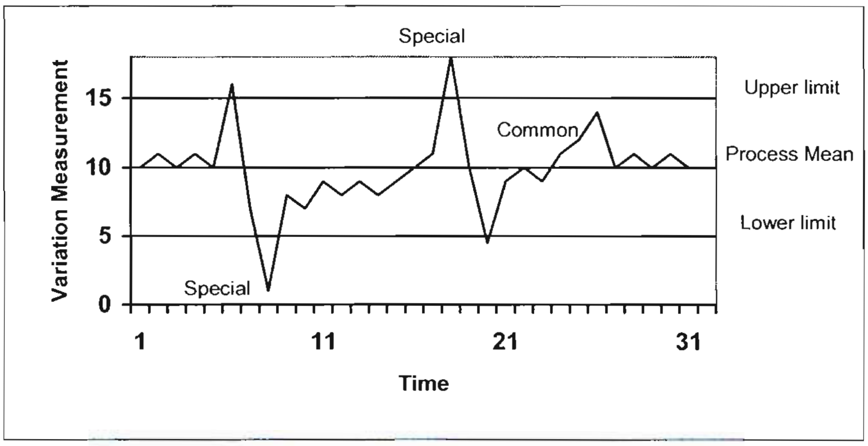
3.1 Run charts (Figure 2 below) provide graphic representation of occurrences over time to indicate trends, cycles and other changes over time.

Figure 2 Run chart



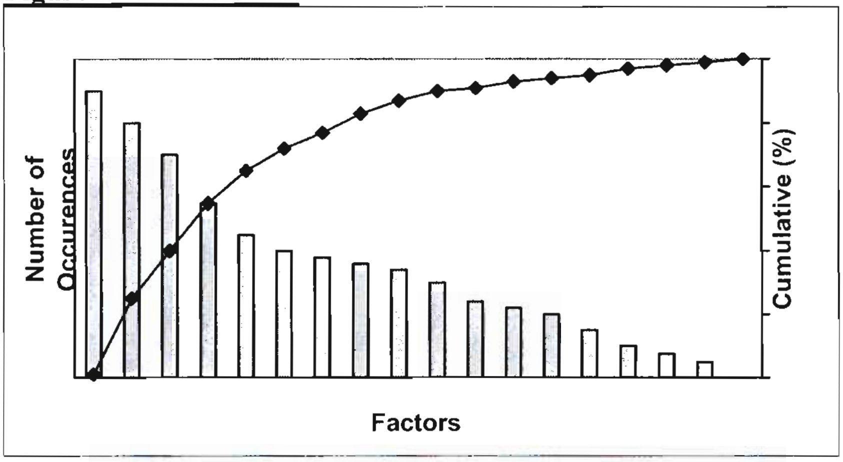
3.2 Control charts (Figure 3, below) are used to indicate variation that exceed set limits to identify "special causes" needing intervention to reduce variation.

Figure 3 : Sample control chart



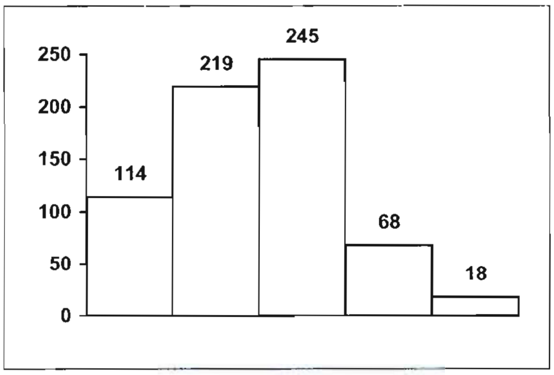
3.3 A Pareto analysis is used to identify the most critical problems to be addressed for maximum impact. The resultant charts (Figure 4, below), provide a graphic representation of factors in descending order of the frequency of occurrences to identify the starting point for problem solving, monitor progress and identifying basic causes.

Figure 4 : Pareto chart



3.4 Histograms (bar charts) are used to display the frequency distribution of an occurrence through the use of bar charts. It highlights the centre and amount of variation in a sample.

Figure 5 : The histogram



3.5 Cause and effect diagrams (Figure 6.1) are used to identify root causes of problems and indicate resultant effects. With adaptation the model can be used to indicate the potential consequences of proposed actions, see Figure 6.2.

Figure 6.1 : Ishikawa or fishbone diagram

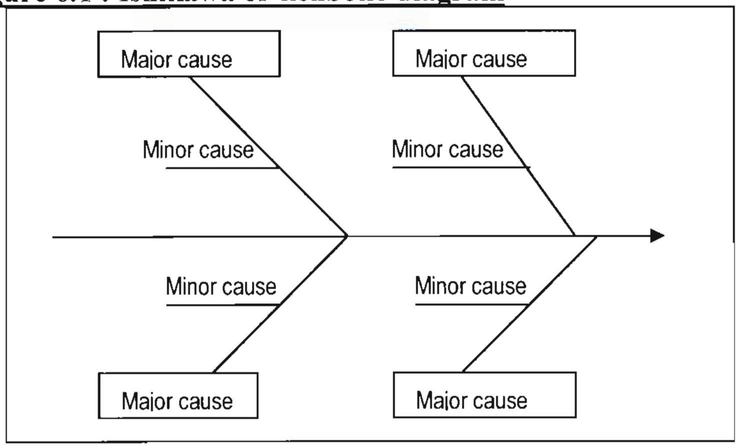
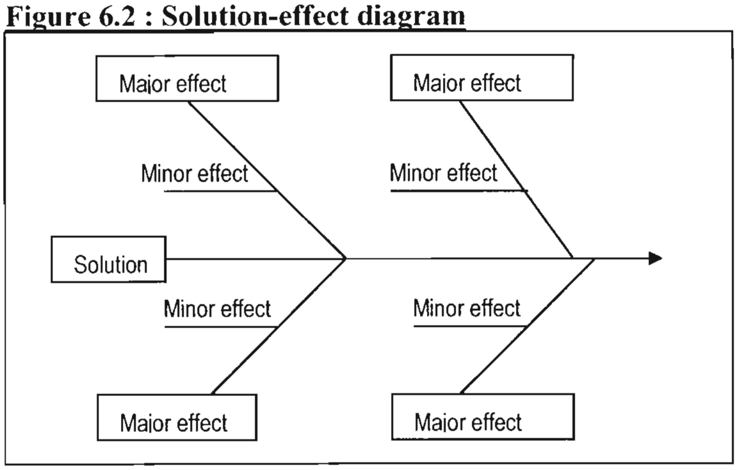
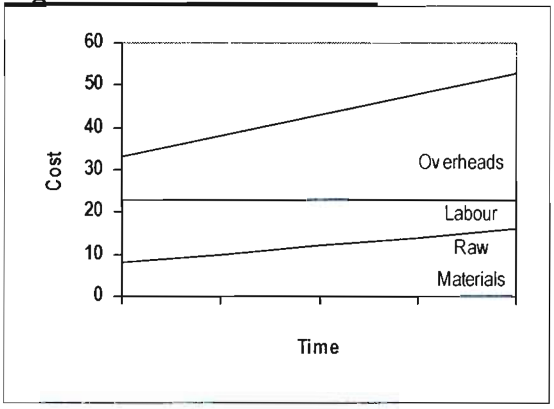


Figure 6.2 : Solution-effect diagram



3.6 Stratification data is presented in stratification charts (Figure 7). Bands of information are presented as cumulative totals of each type of occurrence to indicate which element is incurring the greatest costs or greatest number of faults. These can be used to indicate the relative importance of contributing factors to a process or problem and are typically easier to construct than Pareto's.

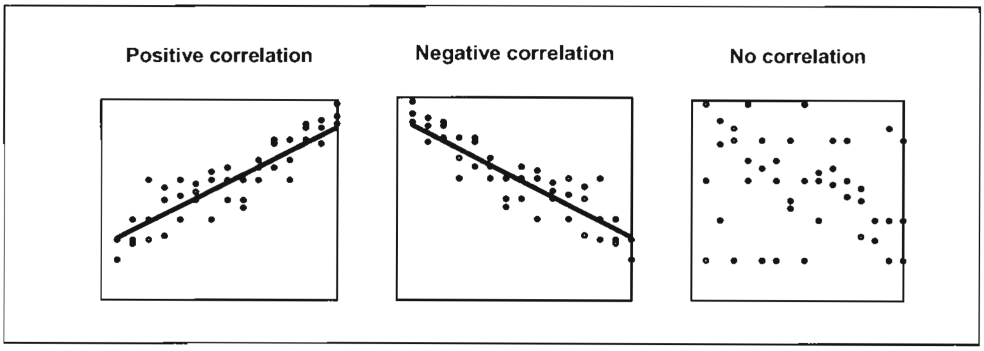
Figure 7: Stratification chart



3.7 Check sheets provide a simple method for collecting data on the occurrence of defects or values, in a wide range of areas. It is used to collect numerical values of nonconforming aspects for Pareto analysis and/or histograms.

3.8 Scatter diagrams are used in combination with statistical methods to determine whether there is a relationship between two variables. Points are plotted on a graph to ascertain whether there is a pattern in the distribution that would allow a line of best fit to be drawn with the same number of points on each side.

Figure 8 : Scatter diagrams



9. Qualitative methods

4.1 Quality circles

Quality circles (workforce teams) comprise of groups of people within each department who meet regularly to address quality problems within their particular components.

4.2 Job design

People need to know the job requirements and how it should be executed, they should be suitable to the job, be trained and skilled (thus also indicating the importance of proper selection and recruitment, and should be authorized to make decisions. Delegation empowers people and is a motivational tool that could stimulate innovation (which is critical to continuous improvement), and illustrates management's trust in its employees Continuous feedback on performance through effective appraisal and rewards is a key element in improving work quality.

4.3 Organisational structure

Recent trends indicate a shift from function based to processed based organization where quality management is assigned to all functional departments, focusing on internal and external customers. Decisions are delegated to lower levels and suppliers and customers are partners in quality improvement. Upper management leads quality and is responsible for quality strategy development and implementation support. Middle management is responsible strategy execution; and the workforce for implementation and providing knowledge and experience type inputs.

4.4 Supplier relationships and -development

The use of partnerships is a growing trend in attending to quality. These partnerships can be facilitated through joint economic and technological planning (and cooperation in execution of contracts.

4.5 Specifications and Standardisation

"Specifications and standardisations are related topics in supply chain management".

"*Specifications* are targets and tolerances determined by designers of products and services. Targets are ideal values for which production is to strive; tolerances are specified because designers recognize the impossibility of meeting meet targets all of the time in manufacturing. The degree of conformance to specifications, within the prescribed tolerance of deviation, is a means of defining quality.

Standardisation is defined by the International Standards Organization defines it as "documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products and services are fit for their purposes".

10. Other Management Methods

5.5 Six sigma

Six sigma combines managerial and statistical techniques process variation reduction. Six sigma status means that a small amount of variation (denoted by a sigma) exceeds specification limits. Six standard deviations are recorded between the process mean and upper and lower limits. The closer the number of variations to six, the better. The approach aims to identify, remedy and prevent future defects, as does total quality management discussed earlier, thus from this perspective is a means through which total quality can be achieved.

It comprises five phases, summarised as follows:

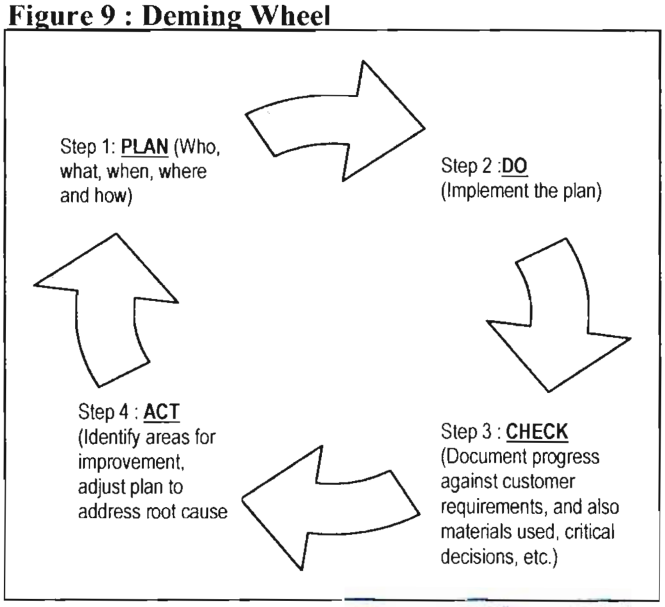
Phase 1- Definition phase: Identify and define projects and –teams
Phase 2- Measurement phase: Identify key parameters and process characteristics; data collection needs; and measures current process capabilities.
Phase 3- Analysis phase: Collect and analyse past and current performance data to identify causes for variation, including the development and testing of theories (hypothesis) on cause and effect relationships of variations identified.
Phase 4- Improvement phase: Design a remedy to address causes of variation; test and prove effectiveness; develop and implement change management plan.
Phase 5- Control phase: Ensure design and implementation of activities for maintenance and improvement of processes

5.6 Deming wheel

This is a management concept advocated by Deming (a quality management theorist) to satisfy customer requirements by using a continuous cycle of **plan, do, check** and **action** (see Figure 9, below).

Plan –	Identify causes of a problem and obtain data to detect the causes of error.
Do –	Quality team to address problem.
Check –	Investigate whether improvement was successful.
Action –	Accept new quality level if improvement was successful, or repeat the cycle.

Figure 9 : Deming Wheel



5.7 Bench marking

Benchmarking is a continuous, systematic process for evaluating the products, services and work processes of organizations that are recognized as representing best practices for the purpose of organisational improvement. It is the measurement of an organization's performance against best practices, determining how these are achieved and using this information for superior performance.

5.8 Gantt charts

Commonly used in project management or to illustrate steps and timeframes for activities, as illustrated in Figure 10, below.

Figure 10 : Example of a Gantt Chart

Task		**Timeframe**				
No.	**Description**	**1**	**2**	**3**	**4**	**5**
1	Activity 1					
2	Activity 2					
3	Activity 3					
4	Activity 4					
5	Activity 5					

APPENDIX 16

DATA FOR UMSHWATI LOW-INCOME UNITS USING THE SAME LIMITATIONS APPLIED IN THIS STUDY

Table 1 : Defective Units v Defect Free Units

DEFECTS ANALYSIS	Frequency	% of Sample		Slab	Wall	Completion
Total number of sites	411	100.00	Total (per defect type)	236	283	403.00
			% Number Defects	31.81	38	54.31
Totally Defect free	126	30.66	% of Sample	57	69	98.05
Total number defects	218	53.04				
Total Re-inspections	73	17.76				
Total no. Inspections (Apr-Dec 2005)	922					

Table 2 : Defect types : Issues leading to potential failure of the inspection

	MAJOR STRUCTURAL												OTHER		INADEQUATE SERVICES		
	Construction			Material/s													
				Foundation				Wall			Roof						
	Foundation and Slab	Wall to plate	Roof	Lintels	Concrete	Blocks	DPC	Blocks	Mortar mix	Lintels (window , door, partitions	Sheeting (thickness and rust free	Beams and Purlins	Incomplete/not ready	Access/Keys	Water	Sanitation	Access
Total (per defect type)	15.00	-	-	16.00	-	-	12.00	-	-	2.00	-	1.00	-	6.00	1.00	8.00	1.00
% Number Defects	2.02	-	-	2.16	-	-	1.62	-	-	0.27	-	0.13	-	0.81	0.13	1.08	0.13
% of Sample	3.65	-	-	3.89	-	-	2.92	-	-	0.49	-	0.24	-	1.46	0.24	1.95	0.24

DESCRIPTIVE STATISTICS																	
Mean	1	-	-	1	-	-	1	-	-	1	-	1	-	1	1	1	1
Standard Error	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Median	1	-	-	1	-	-	1	-	-	1	-	1	-	1	1	1	1
Mode	1	-	-	1	-	-	1	-	-	1	-	0	-	1	0	1	0
Standard Deviation	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Sample Variance	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Kurtosis	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Skewness	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Range	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Minimum	1	-	-	1	-	-	1	-	-	1	-	1	-	1	1	1	1
Maximum	1	-	-	1	-	-	1	-	-	1	-	1	-	1	1	1	1
Sum	15	-	-	16	-	-	12	-	-	2	-	1	-	6	1	8	1
Count	15	-	-	16	-	-	12	-	-	2	-	1	-	6	1	8	1
Largest(1)	1	-	-	1	-	-	1	-	-	1	-	1	-	1	1	1	1
Smallest(1)	1	-	-	1	-	-	1	-	-	1	-	1	-	1	1	1	1
Confidence Level(95.0%)	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0

Table 3 : Defects relating to finishing : Plumbing

	CLEARANCE	FINISHING : PLUMBING										
		Workmanship					Material					
	Site clearance	Toilet (Incl. Pipes and Rodding eyes)	Outlet and Gully	Pipes (Water, incl. taps)	Basin	Shower	**Tap**	**Gully**	**Water tank**	REINSPECTIONS	Duplications	Errors per unit
Total (per defect type)	0	5.00	1.00	25.00	38.00	0	27.00	1.00	24.00			
% Number Defects	0	0.67	0.13	3.37	5.12	0	3.64	0.13	3.23	9.84	3.23	59.30
% of Sample	0	1.22	0.24	6.08	9.25	0	6.57	0.24	5.84	17.76	5.84	107.06
DESCRIPTIVE STATISTICS												
Mean	-	1	1	1	1	-	1	1	1	1	1	1.0706
Standard Error	-	0	8E-15	0	0	-	0	8E-15	0	0	0	0.0501
Median	-	1	1	1	1	-	1	1	1	1	1	1
Mode	-	1	0	1	1	-	1	0	1	1	1	0
Standard Deviation	-	0	0	0	0	-	0	0	0	0	0	1.0157
Sample Variance	-	0	0	0	0	-	0	0	0	0	0	1.0316
Kurtosis	-	0	0	0	0	-	0	0	0	0	0	-0.139
Skewness	-	0	0	0	0	-	0	0	0	0	0	0.7002
Range	-	0	0	0	0	-	0	0	0	0	0	4
Minimum	-	1	1	1	1	-	1	1	1	1	1	0
Maximum	-	1	1	1	1	-	1	1	1	1	1	4
Sum	-	5	1	25	38	-	27	1	24	73	24	440
Count	-	5	1	25	38	-	27	1	24	73	24	411
Largest(1)	-	1	1	1	1	-	1	1	1	1	1	4
Smallest(1)	-	1	1	1	1	-	1	1	1	1	1	0
Confidence Level(95.0%)	-	0	0	0	0	-	0	0	0	0	0	0.0985

Table 4 : Defects relating to finishing : Other

	FINISHING : OTHER FINISHES										
	Workmanship						Material				
	Block work	Cork/Fill/Grout	Plaster	Fitting windows, glass and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	REINSPECTIONS	Duplications	Errors per unit
Total (per defect type)	0	0	1.00	0	0	34.00	19.00	17.00	73.00	24.00	
% Number Defects	0	0	0.13	0	0	4.58	2.56	2.29	9.84	3.23	59.30
% of Sample	0	0	0.24	0	0	8.27	4.62	4.14	17.76	5.84	107.06
DESCRIPTIVE STATISTICS											
Mean	-	-	1	-	-	1	1	1	1	1	1.0706
Standard Error	-	-	8E-15	-	-	0	0	0	0	0	0.0501
Median	-	-	1	-	-	1	1	1	1	1	1
Mode	-	-	0	-	-	1	1	1	1	1	0
Standard Deviation	-	-	0	-	-	0	0	0	0	0	1.0157
Sample Variance	-	-	0	-	-	0	0	0	0	0	1.0316
Kurtosis	-	-	0	-	-	0	0	0	0	0	-0.139
Skewness	-	-	0	-	-	0	0	0	0	0	0.7002
Range	-	-	0	-	-	0	0	0	0	0	4
Minimum	-	-	1	-	-	1	1	1	1	1	0
Maximum	-	-	1	-	-	1	1	1	1	1	4
Sum	-	-	1	-	-	34	19	17	73	24	440
Count	-	-	1	-	-	34	19	17	73	24	411
Largest(1)	-	-	1	-	-	1	1	1	1	1	4
Smallest(1)	-	-	1	-	-	1	1	1	1	1	0
Confidence Level(95.0%)	-	-	0	-	-	0	0	0	0	0	0.0985

Table 5 : Time Frames

UMSHWATI SLUMS CLEARANCE	INSPECTION DATES			TIMEFRAMES (Calendar days)			INSPECTION STAGE (Completed during 1 April 2005 to 31 December 2005)		
	SLAB	WALL PLATE	COMPLETION	Slab to wall	Wall to completion	Total	SLAB	WALL PLATE	COMPLETION
UNITS V TIMEFRAME STATISTICS									
AVERAGE	4/27/05	5/15/05	9/27/05	17	135	153	-	-	-
MODE	2/3/05	6/22/05	9/22/05	0	112	112	-	-	-
Frequency	63	318	7/16/00	98	166	115	-	-	-
MEDIAN	04/28/05	05/19/05	9/29/05	8	126	143	-	-	-
MIN	1/10/05	1/10/05	5/26/05	0	0	0	-	-	-
MAX	11/24/05	11/24/05	10/21/06	182	464	625	-	-	-
DIFFERENCE	318.00	318.00	513.00	182	464	625	-	-	-
Units/day	1.29	1.29	1.25	-	-	-	-	-	-
Units/month (30 days)	38.77	38.77	37.45	-	-	-	-	-	-
DIFFERENCE between first slab and last subsequent stage	318	-	649.00	days	-	-	-	-	-
Units/day	1.29	-	0.63		-	-	-	-	-
Units/month (30 days)	38.77	-	19.00	-	-	-	-	-	-

Overall completion date analysis

90 day period (3 months)

Days	0-90	91-180	181-270	271-360	361-450	451-540	541-630	>630	-	-	-
Units	139	293	154	175	294.00	165	106	16	-	-	-
Units/day (90 days)	1.54	3.26	1.71	1.94	3.27	1.83	1.18	0.18	-	-	-
Units/month (30 days)	46.33	97.67	51.33	58.33	98.00	55.00	35.33	5.33	-	-	-

180 day period (6 months)

Days	0-180	181-360	>361
Units	432	329	475

	Slab	Wall	Roof
Total (per defect type)	236	283	403.00
% Number Defects	31.81	38.14	54.31
% of Sample	57	69	98.05

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UNIVERSITY OF KWAZULU-NATAL

MASTERS IN BUSINESS ADMINISTRATION

DISSERTATION

An Investigation into Quality Concerns in House Construction in Government-subsidised Low-income Housing Projects in the Pietermaritzburg Area

By M M Milne

Supervisor : Mr M Poulter

A dissertation submitted in partial fulfilment of the requirements of Masters of Business Administration in the Faculty of Management Sciences
In the School of Management
University of KwaZulu-Natal
September 2006

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EXECUTIVE SUMMARY

Ongoing quality concerns in low income housing have allegedly not been addressed adequately, as has been expressed in numerous speeches and at the Provincial Housing Summit of 2005.

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. It is informed by total quality management literature.

It is motivated by aspects including: (1) government's accountability for public funds; (2) serving as base research for improved resource allocation; (3) and for quality improvement and sustainability strategies; (4) creating an opportunity for introspection by other members in the supply chain; and (5) a responsibility of all stakeholders to realise the ultimate goal of customer satisfaction.

Research Design

The following research objectives were set:

(1) To identify house construction quality concerns in government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) ^A^ To identify the causes of house construction quality problems in the low income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal. In the context of this research, "developer" is defined as the entity used by the Department or the municipality as an agent for implementing projects.

(3) v To identify how house construction quality issues are currently being addressed.

The research was approached in two phases. Phase 1 was designed to identify whether quality concerns existed in the low income housing projects in the Pietermaritzburg area; and to identify the nature and the extent thereof. Phase 2 was designed to explore the perceived causes of quality concerns, and to identify the systems used by the municipality, its developing agent and the Department of Housing, to ensure sustained quality management.

Findings

Defects : The findings recorded in Chapter 5 illustrate that there are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship, especially the topping of slabs (i.e., the process in which a final layer of cement is applied to smoothen the floor surface, also referred to as "screeding"). The Pareto analysis-indicates that there is a mixture of defect types and causes that need to be addressed, and in order of priority. These are : (1) screeding; (2) water connection; (3) fitting frames; (4) site clearance; (5) constructions of walls; (6) plumbing, specifically toilet fittings; (7) glazing; (8) corking/filling of gaps; (9) plaster material; (10) door quality; (11) plaster work; and (12) the quality of frames.

Existing systems, norms and standards *:* Role players are at different stages of advancement with regard to quality and supply chain management. The institutions appear to have an internal focus to quality management that is not customer focussed and lacks information and involvement of all stakeholders. There is no formalised policy on quality management. Such a policy is needed to guide quality improvement and monitoring systems (Gryna, 2001:185). The institutions do not appear to have a quality management strategy, or to have a fully integrated quality perspective. Quality assurance and audit process are also lacking. Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes.

It appears that the proper infrastructure is not in place to implement a quality management system. Information systems are poor and this is a barrier to effective quality improvement implementation programmes, and to effective project management. There is no common understanding of roles, responsibilities and inspection criteria and processes and internal and external role players are excluded from quality management processes.

The management environment and organisational culture within the municipality and the department do not appear to be conducive to encourage a learning organisation approach.

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects.

Recommendations : These have been summarised as follows:

1. The adoption of a quality management policy that incorporates all stakeholders;
2. The inclusion of quality management in strategic plans with a phased implementation programme;
3. Partnership development and joint planning with all role players;
4. Use of larger contracts, over a longer period of time through a programmatic systems approach;
5. Identification of benchmarking partners;
6. The adoption of an audit and assurance mechanism, based on ISO 9000;
7. Development of a learning organisation and change management culture, led from the top;
8. The inclusion of quality performance targets in managers' performance reviews;
9. Clearly defined inspections procedures and documents (including roles and responsibilities), and availability of these on site;
10. Information management systems upgrading;
11. Revision to National Building Regulations in the context of low-income housing;
12. Improved municipal strategies on water connection;
13. On site training regarding topping of slabs, fitting windows and door frames and block work; and
14. Training of all managers and staff on all aspects of quality management theory, tools and techniques, and specifically in relation to low-income housing.

DECLARATION

I, Martha Maria Milne, hereby declare that the contents of this dissertation are my own work, and that all sources utilised, have been accurately reported and acknowledged. This dissertation has not been, nor is submitted for any degree or examination at any other university.

Signed: Date: 22.14^

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CHAPTER 1 : INTRODUCTION

1.1 INTRODUCTION

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. It is informed by total quality management literature (discussed more fully in Chapter 2). Chapter 1 aims to explain the background of, and motivation for the study, and to identify the research questions and objectives of the study. Chapter 2 looks at the theoretical framework of quality management, focussing mainly on total quality management philosophy. Chapter 3 places total quality management in the context of low-income housing. Chapter 4 provides an explanation of the research methodology. Findings are then presented in Chapter 5, whilst conclusions are formulated in Chapter 6. Chapter 7 makes recommendations based on findings and conclusions, and also presents areas for future research.

1.2 BACKGROUND AND MOTIVATION

1.2.1 Statement of the problem

Ongoing quality concerns in low-income housing have allegedly not been addressed adequately.

1.2.2 Background

Quality concerns in housing have been ongoing. This matter has been raised in numerous political speeches at National and Provincial level (Makhaye, 2000: 4, and Mabandla, 2003: 4). These concerns were also raised at the KwaZulu-Natal Housing Summit held on 23 and 24 March 2005. The report on the summit highlights the Department of Housing's role in ensuring quality that is acceptable to the beneficiaries (Department of Housing, 2005a:9). Commissions at the summit recorded the need for the quality of housing to be reviewed, the need for improved value of this type of asset, review of the house design, and quantity *vis-a-vis* quality aspects (Department of Housing, 2005a:32). A resolution was taken to "beef up the inspectorate component" of the Department of Housing (herein referred to as the Department), to assist in addressing the quality concerns (Department of Housing, 2005b:4 and 2005a:38). Resolutions were also made that required the Department to develop performance indicators, standardise reporting and monitoring templates, and quality specifications for various housing options (Department of Housing, 2005a:37).

The South African Government's policy on housing for the poor (1994) was originally based on maximising the volume of delivery. Many stakeholders have raised concerns on the resultant quality of units that were delivered. (Department of Housing, undated(oj:l, and Sisulu, 2005b:5). In 1999 the National Department of Housing introduced norms and standards aimed at ensuring a minimum top structure size ($30m^2$) and service levels (Department of Housing, 2000:181). In 2002 the National Minister of Housing responsible for housing (herein referred to as "National Minister") announced that the involvement of the National Home Builder's Registration Council (NHBRC) would be extended to low-income housing green field projects from 1 April 2002 (Department of Housing, 2002:4). A further agreement had been reached that extended the NHBRC involvement to in-situ developments and units built by people themselves (Department of Housing, 2005c:6).

In 2005, the National Minister reiterated the need to focus on quality. She announced that houses built between 1994 and 2002 would be audited and action would be taken regarding poorly built houses (Sisulu, 2005a:2). She quoted unpublished research which indicates that shoddy construction has been found in the form of poor roofing, cracks, weak doors, damp, poor foundations, and no floors (Sisulu, 2005c:4). A media article quoted her stating the need not to push for quantity only, but to look at quality and correct past errors. This would result in spending funds on corrective work, thus reducing the budget available for new houses (Anonymous, 2005: paragraph 6).

In addition to this, the construction industry has been reported to have experienced several capacity problems in delivery resulting in poor quality construction throughout the sector (CIDB, 2002a: paragraph 2). Demand for delivery is increasing due to additional needs such as infrastructure requirements for the 2010 Soccer World Cup and which will increase the strain on resources and skills within the construction- and public(CIDB, 2006:2).

1.2.3 Motivation for research

Quality problems in housing construction have been an ongoing concern in all spheres of government. In spite of this, little has been done to quantify the extent of the problem. No research has been done by the Department of Housing in KwaZulu-Natal in this area. The following five reasons also motivate the research:

Reason One : Accountability for public funds

The Department is answerable to the public for its expenditure on housing initiatives. South African legislation compels all spheres of government to ensure proper spending of public funds, in a cost effective, transparent and equitable manner (Republic of South Africa, 1999: sections 2 and 38, and Republic of South Africa, 2004a: section 2).

The Provincial Budget allocation details for low-income housing projects are summarised in Table 1.1 below:

Table 1.1 : Summary of Budget: 2005/2006 Financial Year

		Medium-term estimates (R million)		
2004/2005 Allocated	2004/2005 Estimated **Actual**	2005/2006	2006/2007	2007/2008
538,616	609,287	563,601	664,164	644,144

(Mabuyaldiulu, 2005:7 anc 16)

The Msunduzi Municipality (Pietermaritzburg) has the second highest allocation for the Medium Term Expenditure Framework (after Durban Metropolitan Council) (Provincial Treasury, 2005:300). In terms of municipal categorisation, it has the highest allocation of all the municipalities in its category (Category B) (Provincial Treasury, 2005:300). The three "Category B" Municipalities with the highest allocations are summarised in Table 1.2 below.

Table 1.2 : Summary of "Category B" Municipalities with the highest subsidy allocations

Municipality	Medium-term estimates(R million)		
	2005/2006	2006/2007	2007/2008
Msunduzi (Pietermaritzburg)	29,581	34,861	33,854
Usinga	17,415	20,513	19,920
Ntambanana	14,864	17,495	16,989

(Provincial Treasury, 2005:300)

Reason 2 : Base research for improved resource allocation

The housing backlog is still very large and resources are extremely limited. Proper planning and efficient use of resources is, thus, critical if housing goals are to be achieved (Department of Housing, 2005d:2). Rework on poor quality construction depletes scarce resources even further. This research could facilitate more efficient resource utilisation.

Reason 3 : Base research for quality improvement and sustainability strategies

Quality concerns in housing still persist (Department of Housing, undated^ : 1). At the Provincial Housing Summit, the Minister indicated that the Department would be engaging in a rigorous process that will ensure a decent quality of housing (Department of Housing, 2005a:8). The Department has limited resources at the moment, and research in regard to quality has not progressed. No internal research has been done to identify and/or quantify housing construction quality defaults. The scope of the problem is unknown at this stage.

This research will assist in identifying quality default and management trends that could assist the Department in developing suitable strategies.

Reason 4 : Introspection by other members in the supply chain

Developers and municipalities could benefit by looking into their supply chain and quality management issues to enhance delivery.

Reason 5 : Customer satisfaction, the ultimate goal

Beneficiaries of the subsidy will also benefit as the identification of quality problems could inform strategies and policies to improve house construction in this sector of the market.

1.2.4 **Theoretical framework**

The research is based on quality management theory as a framework to analyse issues regarding quality in low-income housing projects, with a view to suggesting recommendations that may enhance house construction in the market. The relationship between world class supply chain management, total quality management (TQM) and the role of norms, standards and specifications is also explored in Chapter 2, and contextualised to low-income housing projects in Chapter 3.

1.2.5 **Context**

The study was done in the context of low-income housing projects, subsidised by government's conditional grant. It focussed on the activities relating to the actual construction of houses in the Pietermaritzburg area.

The context chapter (Chapter 3) includes findings of international research on quality issues in housing. It highlights prominent standards and specifications applicable to low-income housing, supply chain management, and quality control, in South Africa.

1.3 RESEARCH QUESTIONS AND OBJECTIVES

1.3.1 The purpose of this study

The purpose of this study was to identify issues that affect quality in the construction of houses through the South African Government's low-income housing subsidy scheme in the Pietermaritzburg area, and to determine how quality management can assist in improving house construction in an environment limited by budget constraints.

1.3.2 Research questions

The following questions were investigated:

(1) Are there quality problems in projects in the Pietermaritzburg area?

(2) What is the nature and extent thereof and how does it measure against acceptable industry norms?

(3) What are the perceived causes of quality concerns?

(4) What systems, norms and standards are in place to ensure sustained quality management?

1.3.3 Research objectives

The following research objectives were set:

(1) To identify house construction quality concerns in government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal. In the context of this research, "developer" is defined as the entity used by the Department or the municipality as an agent for implementing projects.

(3) To identify how house construction quality issues are currently being addressed.

1.4 CHAPTER PLAN

Table 1.3, below provides a summary of the structure of the document.

Table 1.3 : Structure of the research report

Chapter	Content	Purpose
1	Introduction	Overview of the chapter, what is covered and motivation for research.
		Brief overview of low-income housing policy and quality improvement initiatives in government low-income housing.
		Research questions and objectives.
		Outline of this document.
2	Quality management theory	Defines and describes quality management.
		Role of quality management.
		Summary of quality management theories (history and current trends).
		Total quality management (TQM), its nature, benefits and challenges.
		Supply chain management (in the context of quality management).
		Norms, standards and specifications.
		Relationship between TQM, supply chain management, norms, standards and specifications.
3	Quality Management in the context of low-income housing	International findings on quality in low-income housing as a description of quality concerns in low-income housing at international level, and how these are addressed.
		Quality concerns in South African low-income housing.
		National and Provincial initiatives and institutions involved in quality management and assurance in the context of low-income housing.
		Overview of norms, standards and specifications in low-income housing, as defined in terms of legislation and government policies.
4	Research methodology	Describes phasing of the research, population, sample, and data types, -tools, and -analysis.
5	Findings	
6	Conclusions	
7	Recommendations	

1.5 SUMMARY

This chapter provides a brief overview of the content of the report. It presents the problem statement, background and motivation for the research. It also identifies the research questions and objectives and provides a summary of the structure of the report.

The next chapter provides insight to relevant aspects relating to quality management.

CHAPTER 2 : QUALITY MANAGEMENT THEORY

2.1 INTRODUCTION

Quality has emerged as a dominant theme in management since 1940 (Beckford, 1998: 3). It affects all levels of the organization, i.e. operational, administrative and strategic (Beckford, 1998:11). The need for quality is equally applicable to the public sector as it is required to deliver services at the same or lower cost to meet public expectations (Beckford, 1998:10).

In investigating issues affecting quality in low-income housing, this chapter explores literature to identify how quality is defined, and to obtain a brief overview of the historic evolution of quality philosophies in total quality management (TQM). The importance of quality management is explored from both an internal and external perspective. The quality control process and the tools and techniques commonly referred to in literature is briefly outlined. This includes an overview of process analysis, statistical methods, "six-sigma" and benchmarking. The qualitative methods of quality circles, job design, organisational structure and supply chain management will be discussed briefly. An overview is also given of standards, specifications, and supply chain management, as quality is often defined as "conformance to requirements" (Crosby in Evans and Lindsay, 2002:106), and an integrative approach (Gitlow, et al, 1999:3, and Feigenbaum in Evans and Lindsay, 2002:108).

2.2 DEFINITION OF QUALITY

Quality has been defined as the degree of conformance to standards or fitness of use (McLaughlin, 1995:32). Deming defined it as "a predictable degree of uniformity and dependability, at low cost and suited to the market" (Deming in Gitlow, et al, 1999:1).

Juran and Gryna (1988:2.2) defined it as "fitness of use"... and "those product features which meet the needs of customers and thereby provide product satisfaction, (and also) freedom of deficiencies". Fitness of use is achieved through a collection of activities that make up the quality function, and these are critical in achieving some degree of predictability (Gitlow, et al, 1999:168). A product or service is less fit for use when:

(1) Product features (quality of design) do not match customer needs; (2) there is a lack of consistency and reliability due to high process variability which reduces customer confidence; and (3) there are high degrees of variation (Gitlow, et al, 1999:9). Quality of conformance is lost with variations to the specification (quality of design), where these variations are above or below the specification limits (Gitlow, et al, 1999:6). Variation may occur in processes related to things such as poor lighting, training, poor design. This is known as common process variation (Gitlow, et al, 1999:9). Special variation may also occur when elements such as material, employees or equipment are introduced (Gitlow, et al., 1999:9).

Crosby defines it as "conformance to requirements, not elegance" (Evans and Lindsay, 2002:106).

Gitlow, et al (1999:3) explores the definition: "Quality is customer satisfaction". They define customers as external (purchasers, intermediaries and all those who come into contact with the product, including governments and regulators), and internal customers which cover the entire organization (Gitlow, et al, 1999:3). They explore customer satisfaction in terms of "product features" (i.e. quality of design) and "freedom from deficiencies" (i.e. quality of conformance), (Gitlow, et al, 1999:5).

Quality of design defines the quality characteristics of a product or service required to meet the needs of the market (Gitlow, et al, 1999:5). This requires a strong customer focus, consumer research and involvement of all stakeholders in the design (Gitlow, et al, 1999:5).

Quality of conformance is the extent to which the specification (quality of design) can be achieved within cost (Gitlow, et al, 1999:6). Quality of performance relates to how quality of design and conformance perform in the market (Gitlow, et al, 1999:8). This includes after sales, maintenance, logistical support, reliability and purchase rates (Gitlow, etal, 1999:8).

The description that quality comprises customer satisfaction and fitness of use correlates with Juran and Feigenbaum's description of "total quality". *Total Quality* has been defined by Juran (1988:2.5) as a function comprising "an entire collection of activities through which we achieve fitness for use, no matter where these activities are performed". It covers every process, job and person (McLaughlin, 1995:31) and can be applied to any organization (Pike and Barnes 1996:24). It is "a system of behaviour which embraces everyone within an organization and determines their relationship with the outside world - customers, suppliers, competitors, society and the environment" (Develin and Hand, 1995:3). Feigenbaum, who in literature is best known for coining the phrase "total quality control", defined it as "an effective system for integrating the quality development, quality maintenance and quality improvement efforts of various groups in an organization to enable production and service at the most economical levels which allow full customer satisfaction" (Evans and Lindsay, 2002:108).

It is driven by the principle of continuous improvement (Develin and Hand, 1995:3), in every activity, including decision making and employee behaviour (Develin and Hand, 1995:5). This requires the optimization of systems with all stakeholders, including suppliers, subcontractors, employees, markets, communities, regulators and investors (Gitlow, et al, 1999:3), thus the entire supply chain:

The common thread in most definitions is that quality means to meet customer requirements (Develin and Hand, 1995:3), thus achieving "customer satisfaction... and fitness for use" (Gitlow, et al, 1999:165). The customer, therefore, determines the extent to which quality is achieved in its totality (McLaughlin, 1995:32).

2.3 HISTORIC OVERVIEW AND CONTRIBUTIONS TOWARDS MODERN PHILOSOPHIES AND TECHNIQUES

2.3.1 Early approaches

Quality issues have existed for centuries (Gitlow, et al, 1999:15). Quality management evolved from basic inspection to ensure the well being of others, progressing to corrective action, through to more integrative preventative modern approaches involving the entire system from customers to suppliers (Gitlow, et al, 1999:3).

In 2000BC the Code of Hammurabi referred to quality in the context of poor house construction that causes death of occupants as punishable by death (Gitlow, et al, 1999:15). Phoenician civilizations ensured compliance to government enforced quality standards and specifications by amputating the hand of the maker of defective products (Gitlow, et al, 1999:15).

From the thirteenth century quality became an inherent part of craftsmanship pride and training through apprenticeships to ensure quality skilled craftsmen in the interest of the trade. Government imposed quality standards (weights and measures) also applied (Gitlow, et al, 1999:15).

In the nineteenth century Frederick W. Taylor introduced the scientific management system to find ways of increasing production quantities (Gryna, 2001:228). This was based on assigning planning activities to educated and professional people, and execution to workers and supervisors (Gryna, 2001:228). The assignment of planning activities based on higher education has been diluted due to increased levels of education, cross functional teams and skills development in the workplace (Gryna, 2001:229).

The increased production focus was accelerated by industrialization. Attention to volume compromised quality but resulted in renewed quality efforts, including the creation of specialized chief inspection positions (Gitlow, et al, 1999: 15). This evolved into an explosion of quality philosophies and techniques throughout the twentieth century (Gitlow, et al, 1999:15). The most commonly quoted examples in the literature are briefly discussed in the section below:

2.3.2 Twentieth century trends

Early in the twentieth century **George Edwards** coined the term "quality assurance" as an approach that results from planned and interrelated activities of all the organisational units in the production chain (Gitlow, et al, 1999:16), thus introducing a more holistic and integrative approach to production.

In 1924 **Walter Shewart** introduced statistical quality control to manage variations and these tools are still in use (Gitlow, et al, 1999:16).

After World War II, quality initiatives were used to rebuild business and economies in America, and Japan (Gitlow, et al, 1999:17). From 1950, **Dr Edwards Deming** worked closely with Japanese industrialists to improve perceptions of poor quality products, by practicing continuous improvement processes (Gitlow, et al, 1999:17). His philosophy focuses on improvements by reducing uncertainty and variability in product design and manufacturing processes by applying statistical tools (Evans and Lindsay, 2002:91). Variability is viewed as the main cause of poor quality which could be reduced through a continuous cycle of design, manufacturing, testing, sales, survey and redesign (Evans and Lindsay, 2002:91). This is articulated also in the "Deming wheel", a continuous cycle of plan; do; check; action (Gryna, 2001:127). He advocates quality improvement as a catalyst for sustainability of a business, as follows: Quality improvement results in cost reduction. This increases productivity, thus performance in the market place, which ensures a viable organization, thus enabling increased job creation (Evans and Lindsay, 2002:91).

Joseph Juran also worked extensively with the Japanese and has contributed largely to the *Quality Control Handbook*, published in 1951 (Evans and Lindsay, 2002:104). His philosophy motivates quality management through cost accounting and analysis (Juran and Gryna, 1988:4.4), and focuses on increasing conformance to specifications by eliminating defects through statistical analysis (Juran and Gryna, 1998:23.2). He viewed quality management as a process comprising three generic processes: quality planning, quality control and quality improvement (Juran and Gryna, 1988:2.6).

Quality planning involves establishing quality goals, identifying customers and their needs, developing product- and process features, and establishing process controls (Juran and Gryna, 1988:2.6).

Quality control is the regulatory process which measures actual quality performance against quality goals, and acts on the difference (Juran and Gryna, 1988:6.31). This entails choosing control subjects and units of measure, setting goals, creating sensors to assist with monitoring, performance measurements, interpretation of variations, and taking action on causes of variation (Gitlow, et al, 1999:171).

Quality improvement includes confirming the need for quality improvement, identifying quality projects, organizing project teams, problem solving, and change management (Gitlow, et al, 1999:171). These should include detailed improvement programmes for effective implementation (Evans and Lindsay, 2002:105).

Phillip B Crosby offers a behavioural approach to quality management that focuses on managerial thinking (Evans and Lindsay, 2002:107). He emphasizes conformance to clearly defined and understood requirements and getting things right first time to save costs, through a "Zero Defects" performance standard (Evans and Lindsay, 2002:106). He explained that variation was caused by a lack of attention from psychological preconditioning in which defects are perceived to be inevitable, thus mindsets need to be reconditioned to getting it right first time (Evans and Lindsay, 2002:106).

In 1951 **Armand Feigenbaum** expanded on the application of continuous quality improvement from production to all aspects in business, shifting efforts to preventative measures (Gitlow, et al, 1999:17). He emphasizes the role of leadership by management and planning to prevent quality loss (Evans and Lindsay, 2003:108). This requires the integration of quality management into business planning across all disciplines, and involvement of all (Evans and Lindsay, 2002:108). Success of implementation depends on organisational commitment, continuous training and motivation of the entire workforce, and involvement of all role players (Evans and Lindsay, 2002:108).

Kaoru Ishikawa was a pioneer in the Japanese quality revolution. He promoted the bottom up and participative approaches to quality management, through team work and the application of statistical tools in all business analyses (Evans and Lindsay, 2002:109). His philosophy expands on Feigenbaum's integrative approach, as quality should be practiced by all, thus reducing reliance on quality professionals and departments (Evans and Lindsay, 2002:109). He advocates that customer requirements and ongoing education are paramount to quality processes. Quality must be the first priority and should address the root cause, not the symptoms, and the difference between goals and actions to achieve them must be understood (Evans and Lindsay, 2002:109). This can be analysed through fishbone diagrams, named after him as "Ishikawa Diagrams" and flow charts (Develin and Hand, 1995:137).

Genichi Taguchi also contributed and influenced Deming's work (Evans and Lindsay, 2002:109). He grades quality as the extent to which variation occurs about the nominal specification: smaller variation resembles better quality (Evans and Lindsay, 2002:110). He promoted test designs to identify variables, aimed at minimizing the adverse affects of uncontrollable issues on production (Evans and Lindsay, 2002:111 and Gryna, 2001:301).

2.4 IMPORTANCE OF QUALITY MANAGEMENT

Quality is important to the organization itself (i.e. an internal perspective) and to the broader external environment in which it operates (Gitlow, et al, 1999:173).

2.4.1 The internal perspective

Quality improvement can reduce costs by lowering waste (Gitlow, et al, 1999:172). Inappropriate or misguided quality improvement initiatives such as inappropriate design adjustments can, on the other hand, increase cost to an organization (Gitlow, et al, 1999:172). Quality may prolong completion, or reduced time frames may detract from the intended quality, thus quality, costs and schedules must be compatible (Gitlow, et al, 1999:172). Assessments must be undertaken regularly to ensure optimum quality management systems (Gitlow, et al, 1999:178).

A hundred percent confidence level in quality rates requires a hundred percent inspection rate, but this is rarely successful, is expensive and impractical in many industries (Beckford, 1998:33). The optimum cost of quality must be determined (Juran and Gryna, 1988:4.20). Where failure costs are high, relative to total costs, and prevention costs are low, quality improvement projects should be undertaken. Where appraisal costs exceed failure costs, the appropriateness of standards may be reviewed, inspections may be reduced and sample audits can be introduced (Gitlow, et al, 1999:188), where quality is inherent to the process and the product (Beckford, 1998:33).

Industry norms on quality costs are seldom available. Quality costs should be assessed against the nature of the industry, client and the company's policy on cost reduction to consumers (Gitlow, et al, 1999: 186, 189 and 190). Some industries (e.g. pharmaceutical) may require quality at all costs. Affluent clients may be willing to pay a premium for outstanding quality, whilst some companies strive to optimize the user's cost (Gitlow, et al, 1999:190). The company's culture (opinions beliefs, traditions and practices), also play a role in addressing quality costs (Gitlow, et al, 1999:192).

Quality management increases productivity, price flexibility, competitive position, demand, profit, customer satisfaction, healthy supply chain relationships, jobs and job security (Gitlow, et al, 1999:14). It reduces rework and customer dissatisfaction and associated costs in losing customers, thus the total cost per unit (Gitlow, et al, 1999:4 and 182).

Poor quality adds costs to firms, their suppliers and customers which result from internal failure-, external failure-, appraisal- and prevention costs. (Gitlow, et al, 1999:178). Some of these costs may be more obvious than others (such as over-time, inventory costs, space, inappropriate buffers to accommodate standard variations and potential loss of sales) (Gitlow, et al, 1999:184).

Internal failure costs are those found prior to delivery to the customer (e.g. scrap; rework; analysis costs; inspections, re-inspections and retesting; negligence and price reductions resulting from poor quality) (Gitlow, et al, 1999:178). It includes costs related to defective inputs such as having to stop production and unfulfilled orders, resulting in dissatisfied customers (Beckford 1998:32).

External failure costs occur after delivery to the customer and include warranty charges upon replacing or repairing products under warranty; complaints handling processes and discounts for accepting a substandard product (Gitlow, et al, 1999:179).

Appraisal costs result from activities to assess the degree of conformance to quality requirements (e.g. inspections; quality audits; testing equipment maintenance; and testing quality of stock) (Gitlow, et al, 1999:179). These cannot be completely eradicated as inspections are necessary to provide information for decision making and strategic direction (Beckford, 1998:3).

Prevention costs relate to attempts to minimize failure and appraisal costs, including quality planning; product reviews; quality audits; supplier quality evaluation and training (Gitlow, et al, 1999:180).

The evaluation of quality concerns, assists in (i) quantifying resultant and subsequent problems if quality is not addressed; (ii) identifying other problem areas; (iii) identifying the exact cause of quality problems; and (iv) creates opportunities to identify cost saving and customer dissatisfaction reduction initiatives (Gitlow, et al, 1999:182).

2.4.2 The external perspective

Quality management is important for economic, social and environmental reasons (Beckford, 1998:3).

2.4.2.1 Economic reasons

Enablers of global trade such as improved information and transport systems have increased markets, competition and customers' choices, making quality a necessity (Beckford, 1998:5).

Increased competition through global trade has increased low cost strategies, encouraging greater emphasis on differentiation on the basis of quality service (Beckford, 1998:7). Addressing quality problems reduces lost opportunities from an inability to meet requirements, or from imports with perceived better quality (Beckford, 1998:6). Increased quality facilitates international trade investment, which benefits the greater economy (Beckford, 1998:8).

2.4.2.2 Social reasons

Poor quality wastes human capital and talent, which demoralizes individuals and contributes to destructive anti-social behaviour (Beckford 1998:7). Such waste must be minimized to maximize employee satisfaction, thus enhancing productivity (Beckford, 1998:10).

The need for quality is equally applicable to the public sector, as observations have been made of governments and society expressing dissatisfaction with public sector cost and effectiveness (Beckford, 1998:5). The public sector is required to deliver services at the same or lower cost to meet public expectations (Beckford, 1998:10). Application of total quality management in this sector has been slow (Evans and Lindsay, 2002:75).

2.4.2.3 Environmental reasons

Increased global awareness of the finite availability of natural resources has resulted in greater awareness of environmental considerations, requiring the minimization of waste and damage to protect limited natural resources (Beckford, 1998:8). Environmental management requirements are standardized through the International Standards Organization (ISO 14000) (Burt, et al, 2003:254).

2.5 TOTAL QUALITY MANAGEMENT

2.5.1 <u>The philosophy</u>

The quality function has grown from basic manufacturing, to the entire supply chain (Gitlow, et al. 1999:168). Customers, processors and suppliers form an integrated system in which each of these are responsible for quality and commit to engage with each other to ensure continuous improvement (Gitlow, et al, 1999:170). This requires an internal and external perspective on quality (Gitlow, et al, 1999:173), with contributions from all disciplines within an organization (finance operations, marketing, and strategic planning) (Gitlow, et al, 1999:173).

Quality affects all levels of the organization (Beckford, 1998:11). Although quality targets are achieved at operational level, this needs to be done against limits imposed by the organization's strategies, which define the scope of the organization's activities. (Beckford, 1998:12 and 14). Quality cannot be achieved unless it is an inherent part of strategy (Beckford, 1998:13).

Total Quality Management (TQM) philosophy has evolved from the involvement of all stakeholders and processes (Gitlow, et al, 1999:174). TQM is a system of activities to achieve customer satisfaction, empower employees and increase revenue, all at lower costs (Gitlow, et al, 1999:174). It is based on the following principles:

(1) Customer satisfaction determines quality, thus requiring proper needs identification from the perspective of the customer (Kanji, and Asher, 1996:1), and a proper understanding of these requirements (Pike and Barnes, 1996:24). All business aspects are aligned to meet customer needs as business goals and customer needs are inseparable (Pike and Barnes, 1996:24).

(2) It is based on a sound understanding of current and required performance measurement, and decisions, problem solving and strategies based on factual information (Kanji and Asher, 1996:2).

(3) The focus is on prevention to reduce costs (Develin and Hand, 1995:6) and facilitate continuous improvement (Kanji and Asher, 1996:5).

(4) Continuous improvement is inherent. Employees must have a behavioural orientation that there is always room for improvement (Develin and Hand, 1995:8). Work processes contain elements of variation that must be reduced through continuous improvement, to achieve quality (Kanji and Asher, 1996:3).

(5) Change is inherent to continuous improvement, thus requiring strong leadership and change management (Pike and Barnes, 1996:77).

(6) People are inherent to continuous improvement processes (Kanji and Asher, 1996:3). People based management is essential to ensure they understand what is required, what needs to be done, how to do it, and be provided with feedback and encouragement to take responsibility (Kanji and Asher, 1996:2). "People work in a system. The job of the manager is to work on the system to improve it continuously with their help" (Deming, in McLaughlin, 1995:35).

(7) The process is managed by interdependent relationships of cross-functional teams (Develin and Hand, 1995:8), with members who are committed to quality,

and involves every person, process, function and department (Pike and Barnes, 1996:24).

(8) There is a common view and commitment from top management to make quality the ultimate goal (Develin and Hand, 1995:8). This is promoted in all human activities through measurement and rewards (Pike and Barnes, 1996:24).

(9) Leadership by example requires the removal of employees' fear of management in general by actively removing barriers to cooperation and trust and to encourage teamwork and reward (Develin, and Hand, 1995:10).

(10) Getting it right first time, every time, but taking cognisance of human nature where errors result due to: inadequate time to do things properly; training and incompetence; inappropriate tools; inadequate information and material; human error; and poor motivation (Develin and Hand 1995:10 and 11).

(11) A realization that the benefits of quality management, outweigh the costs (Develin and Hand,1995:12 and Juran, 1988:4.4), thus, from this perspective "quality is free … as doing things right the first time is always cheaper" (Crosby in Evans and Lindsay, 2002:106).

2.5.2 Enablers

Total Quality Management requires an environment, in which:

(1) There is commitment and continued active involvement by top management and their continued active involvement is critical (Juran and Gryna, 1988:22.4).

(2) There is a desire to: Exceed customer requirements; improve the organization's image, employee morale, communication, and documentation; improve the design and manufacturing of products, services and the physical environment; create a common mission, adopt best practice and standardized processes; and produce uniform products at low cost, suited to the needs of the market (Gitlow, 1994:32).

(3) Mission and purpose statements, responsibilities and accountability, and policies on customer-, supplier- and employee involvement are clear (Pike and Barnes, 1996:43).

(4) An appropriate culture with sound change management systems (Pike and Barnes, 1996:43).

(5) Quality management processes are carefully planned and involve middle managers from the outset (Pike and Barnes, 1996:43). Quality improvement programmes require a comprehensive and organized approach (Juran and Gryna, 1988:22.5).

(6) Proper coordination of quality functions (Juran and Gryna, 1988:7.21). In large and unique projects this would be done by a project manager (Juran and Gryna, 1988:7.23).

(7) Producing tangible results are fast tracked (Pike and Barnes 1996:43).

2.5.3 Barriers

In spite of the benefits of quality management, many challenges need to be overcome. These include:

(1) Fixation on existing systems and procedures increase resistance to change from current systems (Beckford, 1998:22), and/or reliance on specific techniques that focus only on specific aspects (Gitlow, et al, 1999:224). Values and beliefs are reflected in performance systems and procedures that signal performance priorities to staff. It is difficult to change such entrenched beliefs (Beckford, 1998:22). Set mindsets and inability to change the organisational culture impede change management (Gitlow, 1994:33). Resistance to change limits innovation, thus is a threat to continuous improvement (Beckford, 1998:23).

(2) Organisational politics and influential subgroups within an organization impact on the successes of change management. Factions and/or followers may pursue negative views expressed by such groups (Beckford, 1998:22).

(3) Management perceptions that productivity related measurements indicate superior performance cause them to focus on production rather than quality (Beckford, 1998:22), thus focusing on conformance only and neglecting customer needs (Juran and Gryna, 1988:7.21). Performance and selection criteria need to be redesigned to take customer expectations into account (Beckford, 1998:22).

(4) Penal attitudes towards errors detected, as opposed to learning and improvement opportunity recognition, result in employees not owning up to errors and not wanting to take responsibility (Beckford, 1998:25) which result in fear of being scrutinized (Gitlow, 1994:33).

(5) Lack of commitment and discipline to change, result in an inability to maintain and sustain momentum (Gitlow, 1994:33).

(6) Resistance to standardisation and fear of rigidity result in non-adoption of quality management initiatives (Gitlow, 1994:33).

(7) Resistance to concerns of increased workload (Juran and Gryna, 1988:22.5).

(8) Lack of organization and preparation for change (Juran and Gryna, 1988:22.5) including infrastructure, goals, plans, organization implementation mechanisms, time resources and budgets (Gitlow, et al, 1999:223).

(9) Conflicting targets between quality assurance and production, where these are within the same business unit, may result in quality assurance being sacrificed for the sake of production. Quality assurance components should be independent from production units (Beckford, 1998:26).

(10) Inadequate information systems (from report generation through to executive reporting, and general communications) inhibit effective quality management (Beckford, 1998:26). Systems need to generate the right information, in the right format, at the right time and to the correct users (Beckford, 1998:26).

(11) Understanding and articulation of roles may result in inefficiencies (e.g. decision making too far removed from operations and inability of senior management to focus on higher level strategies) (Beckford, 1998:28).

(12) Lack of required resources results in implementation difficulties (Gitlow, 1994:33).

(13) Sceptic views on new programs within the organization due to previously failed and/or abandoned attempts (Juran and Gryna, 1988:22.4).

(14) Different management styles create confusion. (Gitlow, 1994:33). Management must set the example and create a culture that quality is a cause for concern (Beckford, 1998:29).

(15) Focusing on short term results, results in the use of existing performance parameters, thus losing sight of the need for continuous improvement (Beckford, 1998:29).

(16) Failure to start small and learn from pilot projects (Gitlow, et al, 1999:223).

2.6 QUALITY CONTROL PROCESSES

Quality control is a process comprising of a universal sequence of steps used to meet quality standards (Gryna, 2001:141). Deming and Juran (in Evans and Lindsay, 2002:105) define the process as follows: Define what to control; establish measurement units to evaluate data objectively; establish performance standards; conduct a gap analysis and target specific actions to address the gap. Juran also advocates the use of a detailed programme for improvement, which identifies the need and specific quality improvement projects; ensures support activities and resources are planned; diagnoses causes and remedies to address them; tests effectiveness of solutions; and includes a proper control and maintenance system (Evans and Lindsay, 2002:105).

Self-control is the ultimate form of quality control and requires people to know the job content and technique, know their performance and have a system to regulate this (Gryna, 2001:141). Measurement and establishment of standards are central to this process (Gryna, 2001:133). These should be based on the organization's mission and be informed by the results of benchmarking, balanced scorecards and quality assessments. This information is obtained through employee participation, performance planning and evaluation systems (Gryna, 2001:124). This enables a holistic approach resulting in best practice standards that informs business processes, (including operational quality planning and improvement) and the broader strategic planning within the organization (Gryna, 2001:124).

2.7 QUALITY MANAGEMENT TOOLS AND TECHNIQUES

Quality management should be informed by statistical methods, as it provides a quantitative means for analysing problems, rather than depending on opinions and subjective preferences of individuals (Oberlender, 2000:323). Various authors discuss a range of different tools and techniques, those most commonly referred to in the literature are briefly outlined in the section below.

2.7.1 Process analysis

Process analysis outlines systems and helps to identify process and quality problems (Beckford, 1998:227). It can be used to identify standards and measures for critical parts of the process, identify gaps, and unnecessary activities and duplications in processes (Pike and Barnes, 1996:204). Flow charts provide a visual representation of all the steps in a process, links between them, source of inputs and resultant outputs (Develin and Hand, 1995:141). Such a system should factually record and cover the entire process and related activities, and allow for these to be questioned and verified. New processes should not be adopted until all quality problems and causes have been exposed (Beckford, 1998:232).

2.7.2 Quality management systems

A quality management system is a systematic approach that yields a formal record of an organization's quality management method and provides a basis for measuring and monitoring quality performance (Beckford, 1998:243). The system is certified by a third party as conforming to an acceptable standard, such as the International Standards Organization (Beckford, 1998:243). The system should be accurate, robust and generate meaningful data, thus employees at the "coal face" should be involved in its development, and be committed to the system for success (Beckford, 1998:238). It should contain the organization's quality policy, procedures for implementation and procedures, described in terms of the process, rather than broad functions (Beckford, 1998:240). A record system should be included to monitor adherence to the system (Beckford, 1998 :240).

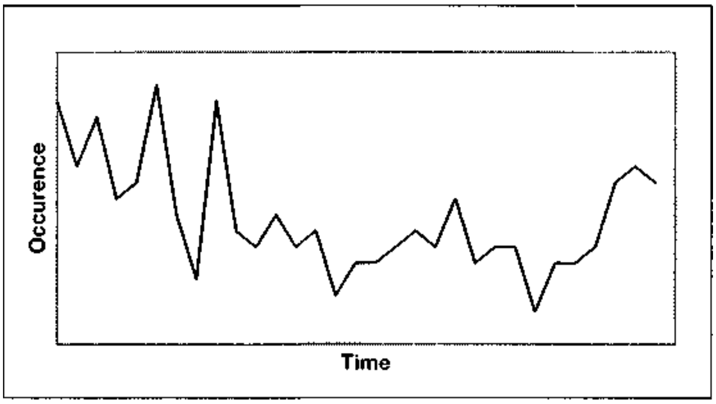
2.7.3 Statistical method

Data collection and analysis form the basis of quality assurance initiatives (Gitlow, et al, 1999:685). The collection of data may be done on a continuous measurement scale (variable data) or as a result of counting the occurrences of variations to attributes (attribute data). Various tools are available to collect and analyse data (Gitlow, et al, 1999:685). A number of computerized software programmes are available and are able to generate run charts, control charts, histograms, Pareto charts, scatter diagrams and other statistical analyses (Evans and Lindsay, 2002:729).

Statistical process control methods record and monitor the outputs of a system to identify aspects needing improvement (Beckford, 1998:255). It requires a predefined process; established measurement system and predetermined quality characteristics definitions that are understood and agreed to by all (Beckford, 1998:244). The system must indicate what is to be measured, where, recording and reporting method and timeframes (Beckford, 1998:245). It is based on performance limits against which performance is measured, taking cognizance of any input specifications (Beckford, 1998:245). Performance between limits indicates common (normal) variation where the process is deemed to be under control. Points outside the upper and lower limit indicate areas that may need intervention (Beckford, 1998:245). Causes may be common (random/chance types inherent in the process), or special (chronic cases) that need special intervention through quality improvement (Gryna, 2001:499). Gryna (2001:96) advocates that only chronic cases should be addressed through quality improvement projects.

2.7.3.1 **Run charts** (Figure 2.1 below) provide graphic representation of occurrences over time to indicate trends, cycles and other changes over time (Develin and Hand, 1995).

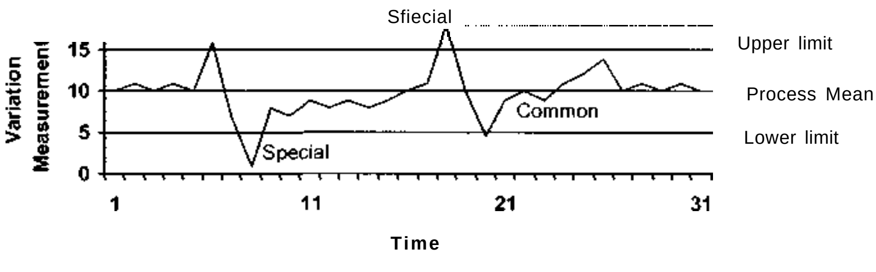
Figure 2.1 Run chart



(Adapted from Gryna,2001:248)

2.7.3.2 **Control charts** (Figure 2.2, below) are used to indicate variation that exceed set limits (Beckford, 1998:247), and to identify "special causes" needing intervention to reduce variation (Gryna, 2001:499). Upper and lower limits are normally set within 3 standard deviations from the mean (Beckford, 1998:247).

Figure 2.2 : Sample control chart



(Adapted from Evans and Lindsay, 2002:607)

Different types of charts and calculations should be used to indicate defective items or failures of components with reference to attributes, and whether constant samples or varied sample sizes can be taken (Beckford, 1998:247, Gryna, 2001:503). These charts indicate when the number of defective items or components is changing over time and differentiate between common/random variation from real variation caused by changes in a process (Kanji and Asher, 1996:194), as indicated in Table 2.1 below.

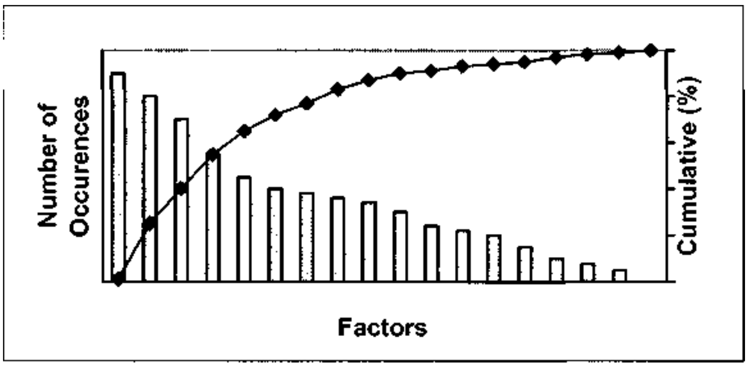
Table 2.1 : Attribute Control Chart types

	Sample Size	**Chart type**
Defective units	Varied	P chart
	Constant	NP chart
Component Failure	Varied (by more than 25% of the average sample size) (Kanji and Asher, 1996: 225)	U chart
	Constant (or does not vary more than 25% of the average sample size (Kanji and Asher, 1996:161).	C chart

(Adapted from Kanji and Asher, 1996:225)

2.7.3.3 **A Pareto** analysis is used to identify the most critical problems to be addressed for maximum impact (Kanji and Asher, 1996:56). The resultant charts (Figure 2.3, below), provide a graphic representation of factors in descending order of the frequency of occurrences (Develin and Hand, 1995:137), identify the starting point for problem solving, monitor progress and identify basic causes (Gitlow, et al, 1999:686). It is useful in six sigma approaches to identify critical processes (Gryna, 2001: 57, see also 7.4 below) and in supplier analysis during supplier selection (Gryna, 2001:426).

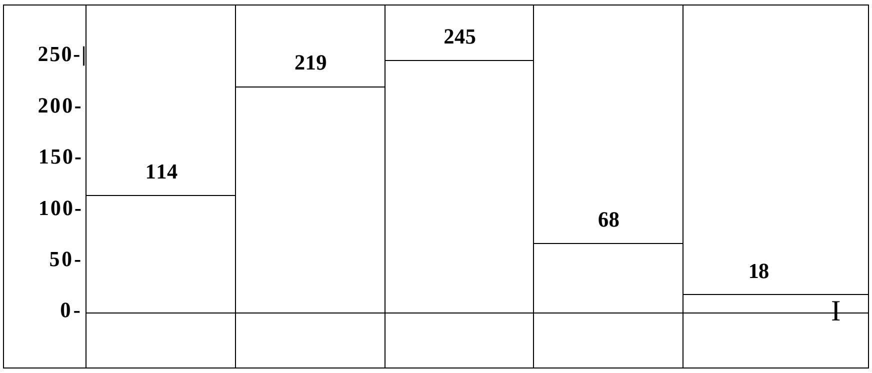
Figure 2.3 : Pareto chart



(Adapted from Develin and Hand, 1995:137)

2.7.3.4 **Histograms** (bar charts) are used to display the frequency distribution of an occurrence through the use of bar charts. It highlights the centre and amount of variation in a sample. It is simple to construct, thus effective in elementary data analysis (Beckford, 1998:251, and Gryna, 2001:244)

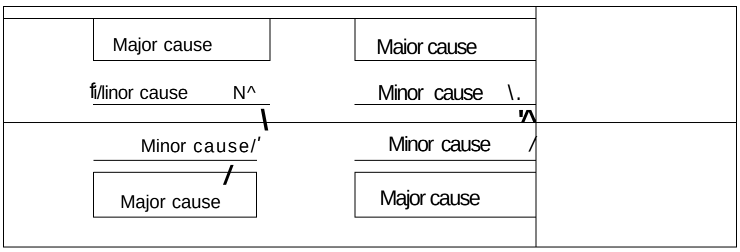
Figure 2.4 : The histogram



(Adapted from Beckford, 1998:252)

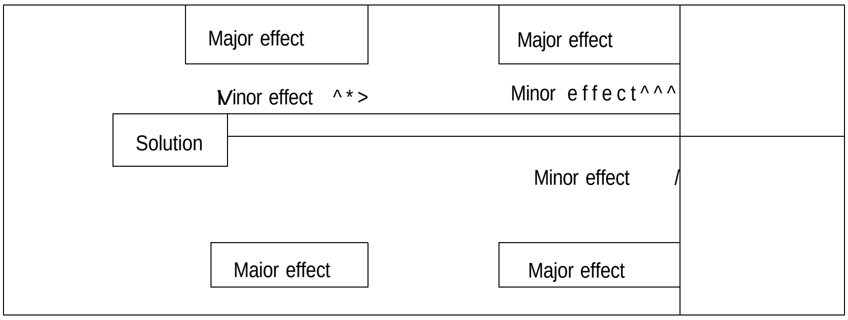
2.7.3.5 **Cause and effect diagrams** (Figure 2.5.1) are used to identify root causes of problems and indicate resultant effects. It allows for a holistic approach to problem identification and points to possible areas for investigation and data collection (Kanji and Asher, 1996:79).With adaptation the model can be used to indicate the potential consequences of proposed actions (Beckford, 1998:248), see Figure 2.5.2.

Figure 2.5.1 : Ishikawa or fishbone diagram



(Adapted from Beckford, 1998:250)

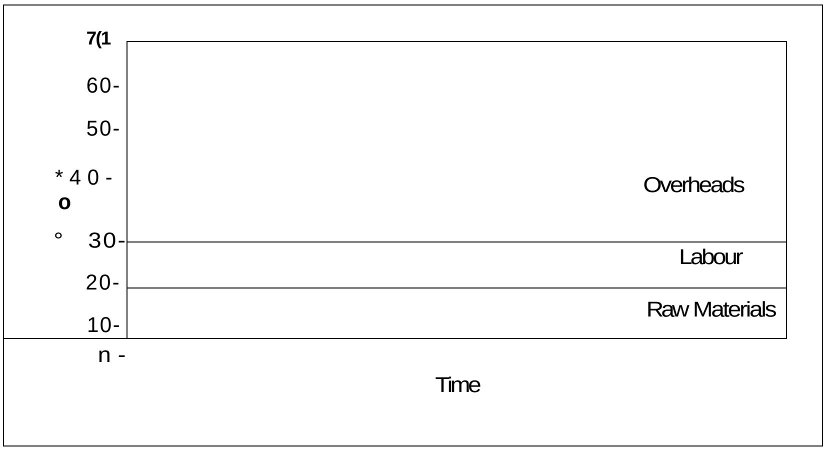
Figure 2.5.2 : Solution-effect diagram



(Adapted from Beckford, 1998:250)

2.7.3.6 **Stratification data** is presented in stratification charts (Figure 2.6). Bands of information are presented as cumulative totals of each type of occurrence to indicate which element is incurring the greatest costs, or greatest number of faults (Beckford, 1998:250). These can be used to indicate the relative importance of contributing factors to a process or problem and are typically easier to construct than Pareto charts (Beckford, 1998:250).

Figure 2.6: Stratification chart

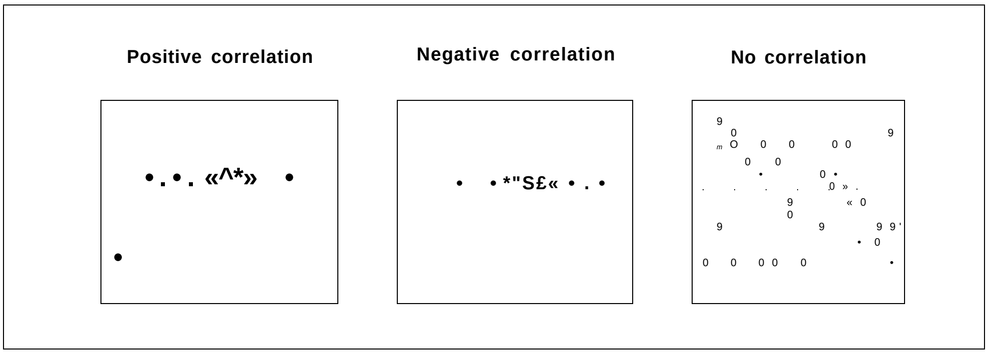


(Beckford, 1998:251)

2.7.3.7 **Check sheets** provide a simple method for collecting data on the occurrence of defects or values, in a wide range of areas (Kami and Asher, 1996:164). It is used to collect numerical values of non-conforming aspects for Pareto analysis and/or histograms (Gitlow, et al, 1999:685).

2.7.3.8 **Scatter diagrams** are used in combination with statistical methods to determine whether there is a relationship between two variables (Develin and Hand, 1995:139). Points are plotted on a graph to ascertain whether there is a pattern in the distribution that would allow a line of best fit to be drawn with the same number of points on each side (Beckford, 1998:252).

Figure 2.7 : Scatter diagrams



(Adapted from Develin and Hand, 1995:139)

2.7.4 Six Sigma, a combined approach

Six sigma combines managerial and statistical techniques to reduce process variation (Gryna, 2001:57). Six sigma status means that a small amount of variation (denoted by a sigma) exceeds specification limits. Six standard deviations are recorded between the process mean and upper and lower limits. The closer the number of variations to six, the better (Gryna, 2001:57). The approach aims to identify, remedy and prevent future defects (Gryna, 2001:58), as does total quality management discussed earlier, thus from this perspective it is a means through which total quality can be achieved.

It comprises five phases which with reference to Gryna (2001:57-96) can be summarised as follows:

Phase 1- Definition phase: Identify and define projects and -teams (Gryna, 2001:58).

Phase 2- Measurement phase: Identify key parameters and process characteristics; data collection needs and measures current process capabilities (Gryna, 2001:63).

Phase 3- Analysis phase: Collect and analyse past and current performance data to identify causes for variation, including the development and testing of theories (hypothesis) on cause and effect relationships of variations identified (Gryna, 2001:70).

Phase 4- Improvement phase: Design a remedy to address causes of variation; test and prove effectiveness; develop and implement change management plan (Gryna, 2001:86).

Phase 5- Control phase: Ensure design and implementation of activities for maintenance and improvement of processes (Gryna, 2001:94).

Six sigma requires intensive coordination across organisational units and project improvement teams (Gryna, 2001:200).

2.7.5 Benchmarking

A benchmark is a reference point against which performance is measured. Such points may include the specification, customer desires, competition, best in the industry, and best in *any* industry (Gryna, 2001:105). Benchmarking is "a continuous, systematic process for evaluating the products, services and work processes of organizations that are recognized as representing best practices for the purpose of organisational improvement" (Spendoli, 1992:8 and Finnigan, 1996:5). It is the measurement of an organization's performance against best practices, determining how these are achieved and using this information for superior performance (Evans and Lindsay, 2002:413). It involves identifying characteristics to be benchmarked, choosing organizations or components against which to benchmark, collecting and analyzing data, determining who is considered to be the best in class, and then identifying the organization's own performance gap, relative to the benchmark partner (Gryna, 2001:105).

It is a total quality management tool for continuous improvement throughout an organization to achieve higher levels of customer satisfaction and productivity. It provides information for improving almost any business activity (Spendoli, 1992:33), and the key processes involved for competitive advantage (Finnigan, 1996:4). It forces organizations to look outside themselves and compare their business thinking, ideas and inspiration with their external environment, thus learning from the business-, industrial- and competitive environments for self-improvement (Spendoli, 1992:16).

2.7.6 <u>Qualitative methods</u>

2.7.6.1 Quality circles

Quality circles (workforce teams) comprise groups of people within each department who meet regularly to address quality problems within their particular components (Gryna, 2001:202). Such teams tend to focus on problems related to the personal well being of workers and their frustrations (Gryna, 2001:202). They have potential behavioural and motivational benefits that can contribute toward increased performance (Gryna, 2001:203).

2.7.6.2 Job design

People need to know the job requirements and how they should be executed, they should be suitable to the job, be trained and skilled thus also indicating the importance of proper selection and recruitment, and should be authorized to make decisions (Gryna, 2001:230). Delegation empowers people and is a motivational tool that could stimulate innovation (which is critical to continuous improvement), and illustrates management's trust in its employees (Gryna, 2001:230).

Continuous feedback on performance through effective appraisal and reward is a key element in improving work quality (Gryna, 2001:232).

2.7.6.3 Organisational structure

Recent trends indicate a shift from function based to processed based organization (Gryna, 2001:405), where quality management is assigned to all functional departments, focusing on internal and external customers. Decisions are delegated to lower levels and suppliers and customers are partners in quality improvement (Gryna, 2001:188). Upper management leads quality and is responsible for quality strategy development and implementation support (Gryna, 2001:190-192). Middle management is responsible for strategy execution; and the workforce for implementation and providing knowledge and experience type inputs (Gryna, 2001:196-7).

These trends increase coordination of quality activities (Gryna, 2001:189). Project teams could facilitate coordination and implementation of quality improvement projects (Gryna, 2001:199). Teams should comprise a project champion from upper management; team leader responsible for execution; project recorder for administrative functions; and cross functional team members (Gryna, 2001:199-200). Expertise may supplement the team to guide initial processes (Gryna:2001:201).

2.7.6.4 Supplier development and supply chain management

Poor quality component goods and services impact on the cost of quality (Gryna, 2001:403). Cost- and quality improvement in supply chain inventory management, (such as just-in-time), increase the need for quality inputs, as goods and services are provided only in the quantity and at the time they are required for production (Gryna, 2001:403). This also applies to the service sector (Gryna, 2001:403).

Gryna (2001:404) describes traditional and strategic approaches to purchasing process relationship. **Traditionally** supplier relationships are adversarial, short term, competitive and distrusting. Quality assurance is achieved through inspection on receipt. Many suppliers are used and managed, based on the norm. Purchasing plans are developed in isolation from end-users, and purchasing decisions are based on price. **Strategic** approaches use purchasing to build partnerships based on mutual trust to achieve long term symbiotic relationships that negates the need for incoming inspection. There are few, carefully selected suppliers who are managed individually. Purchasing plans are integrated with end-user requirements. The focus on purchasing decisions is on the total cost of ownership.

Burt, et al (2003:80-87) describe a continuum of three different types of supplier relationships, i.e. transactional, collaborative, and strategic alliances. The characteristics of each are briefly summarised in Figure 2.8, below.

Figure 2.8 Characteristics of Three types of Relationships

Continuum of Buyer-Seller

Type of Relationship	Transactional	Collaborative	Alliance
	< ^ >		< ^ >
Characteristic	Little or no concern about the other party's well-being, Win-lose orientation (Burt, etal, 2003:81)	An awareness of interdependence and necessity of cooperation and recognition of the benefits that this provides (Burt, et al, 2003:83).	Institutional trust (shared information on strategic plans, relevant cost information and forecasts; risks and rewards addressed openly and informal agreements are viewed as good as formal ones (Burt, et al 2003:84))
Communication	High potential for problems		Systematic approach to enhance communication
Competitive Advantage	Low		High
Connectedness	Independence		Interdependence
Continuous Improvement	Little		A focus
Contributions to New Product Development	Few		Many early supplier involvement
Difficulty of Exit	Low		Difficult, high impact
Duration	Short		Long
Expediting	Reactive		Proactive
Focus	Price		Total cost
Level of Integration	Little or none		High or total
Level of Trust	Low		High
Number of Suppliers	Many		One or few
Open Books	No, secrecy		Yes, mutual visits, disclosures and assistance
Quality	Incoming inspection, conformance to specification		Designed into system, fitness for use, continuous improvement.
Relations	Inward looking, arms length		Concern with each other's well being
Resources	Few, low skill level		Professional
Service	Minimal		Greatly improved
Shared Forecasts (Plans)	No		Yes
Supply Disruptions	Possible		Unlikely
Technology Inflows	No		Yes
Type of Interaction	Tactical		Strategic synergy

(Adapted from Burt, et al, 2003:80, and Evans and Lindsay, 2002:405)

None of these relationships are good or bad (Burt, et al, 2003:81), and few are true to the type (2003:87) (hence a continuum). Collaboration and alliance relationships complement continuous improvement (Gryna, 2001:418). The CIDB (2006:4) indicates that a range of strategies should be available that would accelerate project completion times; provide shared incentives and shared risk; and allow phasing of work over longer periods of time. Burt, et al (2003:86-87) indicate several factors to be considered in determining the appropriate type of relationship, summarised in Table 2.2, below:

Table 2.2 Criteria in Selecting an Appropriate Relationship

Characteristic	Relationship
Many relatively undifferentiated suppliers providing interchangeable commodities	Transactional.
Supplier has economic power and is willing to exert this over its customers.	Transactional or very carefully developed and managed collaborative.
Both parties recognize potential benefit of alliance but lack human resources.	Collaborative.
Desire to progress to strategic alliance.	Collaborative is the appropriate first step.
Supplier is superior in providing value (including price, innovation, adaptability, capacity, etc.).	Alliance.
Supplier is strategic to the organization's performance as it has a major impact on, and is a critical element in performance.	Alliance may be vital.
There are potentially great benefits to integrating supplier with the organization (e.g. shared ideas, resources, and product development initiatives).	Alliance.
Require high degrees of flexibility and speed of performance, due to customer requirements.	Alliance.

(Adapted from Burt, et al, 2003:86)

This indicates that there are areas where strategic alliances may be less appropriate, hence some companies segment their suppliers into categories based on their importance to the business, and manage them accordingly (Evans and Lindsay, 2002: 405).

Supply and purchasing management also involves specification of requirements; selection of suppliers; and management of the supply chain (Gryna, 2001:406). These are discussed briefly in the section below. The relevant specifications in the context of low-income housing in South Africa are discussed in the next chapter.

(a) Specifications and standardisation

"Specifications and standardisations are related topics in supply chain management" (Burt, etal, 2003:237).

"*Specifications* are targets and tolerances determined by designers of products and services. Targets are ideal values for which production is to strive; tolerances are specified because designers recognize the impossibility of continuously meeting targets in manufacturing (Evans and Lindsay, 2002:13). The degree of conformance to specifications, within the prescribed tolerance of deviation, is a means of defining quality (Evans and Lindsay, 2002:13).

Specifications are broadly categorised as simple or complex. Most firms use a combination. Specifications must be clear for the correct procurement of goods and services. They should concentrate on minimum requirements for cost effectiveness, as unnecessary precision adds risk and costs to suppliers, which in turn increases costs to the purchasing firm. This can be countered through standardized products (Burt, et al, 2003:251).

Standardisation is related to specification and can reduce cost and enhance quality. (Burt, et al, 2003:253). It can significantly improve efficiencies in time and cost of delivery of projects and improve quality and end user satisfaction (CIDB, 2006:8). Standardisation is performance goals for product and process features that are legitimate, customer focused, measurable, understandable, aligned and equitable (Gryna, 2001:132). ISO defines it as "documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products and services are fit for their purposes (Evans, et al, 2002:132). It is "a uniform identification that is agreed on" (Burt, et al. 2003:252).

Two broad types are found : (i) Industrial standardisation establishes agreed uniform specifications for "define characteristics of quality, design, performance, quantity, service and so on", and (ii) Managerial standardisation focuses on operating practices, procedures and systems" (Burt, et al, 2003:152). It is a means of reducing the number of variations in materials and components to reduce costs (Heizer, et al, 2004:424). Three sources exist: international; national and industry; and company standards (Burt, et al, 2003:253).

(1) International standards

The International Standards Organization (ISO) develops standards through its technical committees that are usually accepted world wide. These are developed through consultation with other national standards authorities such as the American National Standards institute (ANSI), German Institute for Standards; and British Standards Institute (Burt, et al, 2003:253). These standards have facilitated international trade as it provides a benchmark for acceptable quality process (ISO 9000) and environmental (ISO 14000) standards world wide (Burt, et al, 2003:254). The content of the ISO 9000 series is summarised in Table 2.3, below.

Table 2.3 : ISO: 9000 Standards

ISO Reference Code	Content
9000	Quality Management Systems - Fundamentals and Vocabulary.
9001	Quality Management Systems - Requirements.
9004	Quality Management Systems - Guidance for Performance Improvement.
19011	Environmental Management.

(Adapted from Evans and Lindsay, 2002:133 read with Burt et al, 2003:254)

(2) National and industry standards

Many countries develop their own standards with industry stake holders, and taking cognizance of international standards (Burt, et al, 2003:254). In the South African context, this includes the South African National Standards, as is more fully discussed in Chapter 3.

(3) Company standards

Companies may develop their own standards (Burt, et al, 2003:254). The National *"Norms and Standards for Low-income Housing"* of the National Department of Housing is such a standard.

(b) Selection of suppliers

The selection of suppliers involves "make or buy", and "in-source or outsource" decisions (Gryna, 2001:409). Outsourcing could facilitate superior quality and lower costs where an organization cannot easily develop or maintain elements. Core competencies should not be outsourced as this could expose the organization to exploitation (Gryna, 2001:410). Supplier selection (in addition the relationships issues outlined in Figure 2.8 and Table 2.2, above), should be based on: reputation of the supplier; qualification testing/screening (e.g. samples) facilities survey and supplier databases (Gryna, 2001:411).

Selection processes should consider the supplier's quality survey and evaluation processes (e.g. quality certification, warranties and inspection results of the product) (Gryna, 2001:412). Assessment criteria will depend on the product or service to be procured (Gryna, 2001:412). It may include management philosophy, commitment to quality, design aspects, manufacturing facilities and management, purchasing policies, quality management and coordination, inspection and tests, data and information management, and personnel performance results (Gryna, 2001:413). ISO9000 could assist such surveys (Gryna, 2001:414).

(c) Management of the supply chain

Management of the supply chain is affected by the quality of the relationship with suppliers and selection criteria (Gryna, 2001:428). Trends are moving towards partnerships in supply chain management and quality (Gryna, 2001:415). These partnerships can be facilitated through joint economic and technological planning (Gryna, 2001:416) and cooperation in execution of contracts (Gryna, 2001:418).

Joint economic planning should identify value adding activities rather than focusing on conformance to specification, to improve or maintain quality at lower costs. It should reduce ownership costs by identifying costs over the life cycle of the product to identify opportunities in order to reduce these in the interest of both partners (Gryna, 2001:416).

Joint technological planning should strive for a shared understanding of all requirements, (specifications and interpretations, processes, quality control and inspection requirements) and systems that are required to provide continuous and timely feedback, and responses (Gryna, 2001:417).

Effective supply chain management requires proper supply, demand and logistics management (Burt, et al, 2003:622). *Supply management* includes the effective management of suppliers, supplier networks and relationships with them (Burt, et al, 2003:623). *Demand management* seeks to ensure effective planning and management of information for procurement, deliveries and processes, between buyers and suppliers, to ensure a continuous flow of goods and services at the time, place and quantities in which they are needed (Burt, et al, 2003: 627). *Logistics management* focuses on the effective flow of goods from the point of origin, through the supply chain, to consumption (Burt, et al, 2003:634). Organizations achieve different levels of mastering world class supply chain management (Burt, et al, 2003:7), as summarised in Figure 2.9, below:

Figure 2.9: The Progression to World Class Supply Chain Management

Clerical	Mechanical	Proactive	World Class
			• Strategic sourcing
			• Monitoring supply environment
			• Understand key supply industries
		• Coordinate procurement system	• Develop and implement commodity strategies
			• Commodity teams
		• Involved in development of requirements	• Supply base by design
		• Fulfil social responsibilities	• Time-based competition
	• Transactional focus	• Plan for recurring requirements	• Manage risk
		• Develop Suppliers	• Leverage supplier technology
• Process paperwork		• Near defect free materials and services	• Virtually defect free materials and services
	• Not involved in key source selections	• Active in source selection	• Integrated supply strategy
• Confirm actions of others	• React to requisitions	• Long term contracts	• Develop and manage alliances and networks
• Emphasis: Convenience	• Emphasis: Purchase price	• Emphasis: cost, quality, timeliness	• Emphasis: total cost
• Relationships: Personal	• Relationships: Transactional/adversarial	• Relationships: Transactional and collaborative	• Relationships: Transactional, collaborative, and alliance
• Bottom-line impact: Overhead	• Bottom-line impact: Revenue neutral	• Bottom-line impact: Profit	• Bottom-line impact: Increase shareholder value
• Reporting: very low level	• Reporting low level	• Reporting: Upper management	• Reporting: Member executive group
• Data: Not available	• Data: Used to expedite	• Data Facilitates sourcing and pricing	• Data: Facilitates strategic planning
	• Computers process paperwork	• e-Commerce	• e-Commerce II
1 2	3 4 5	6 7	8 9 10

World Class Supply Chain Scale

(Adapted from Burt, et al, 2003:8)

Supply chain quality control is an integral part of the process and focuses on ensuring cooperation in the execution of contracts, supplier certification and rating, and quality measurement for supplier relationships (Gryna, 2001):418. Supplier product delivery is typically evaluated through different levels of inspection, as summarised in Table 2.4, below:

Table 2.4 Methods of evaluating supplier product

Method	Approach	Application
100% inspection	Every item is evaluated against some or all elements in the specification.	(1) Critical items where costs is justified by cost of risk of defects. (2) To establish quality level of new suppliers.
Sampling	Sample selection based on predefined sampling plan, and decision made to accept or reject, based on sample.	Important items where supplier has good quality track record.
Identifying inspection	Product examination to ensure correct delivery, only.	Less important item where quality record and supplier laboratory reliability has been established.
No inspection	Self explanatory.	Standard, non-critical items, not used in the product.
Supplier data (certification)	Supplier data or certification is used, thus no inspection based on certification from supplier.	Items where supplier has strong quality control record.

(Adapted from Gryna, 2001:419)

The choice of evaluation method will depend on factors such as (Gryna, 2001:420):

(1) Supplier's track record;

(2) Importance of the component part in overall performance and/or later operations;

(3) Warranty or use history;

(4) Supplier process capability and overall capacity;

(5) Nature of the process;

(6) Product homogeneity (e.g. greater homogeny requires smaller sample sizes); and

(7) Availability of required inspection skills, equipment and resources.

Proper measurement of the supplier, coupled with communication, feedback and awards, is critical (Evans and Lindsay, 2002:405). This requires ongoing surveillance and rating of supplier quality with appropriate measures (Gryna, 2001:419). These measures may include percentage of product not conforming; overall product quality; delivery against schedule; cost of defective products (including hidden cost) against purchase price), and other quantitative means that reflect critical supplier elements in relation to business outputs (Gryna, 2001:423).

2.8 SUMMARY

In this chapter different quality management definitions are put forward. Recent trends view quality management as an integrative process that involves the entire supply chain. It is applicable to both products and services, and both public and private enterprises. Evidence of its applicability to housing is found in the code of Hammurabi, circa 2000BC.

There are a number of tools and techniques available to assess quality and to set procedures in place to ensure continuous improvement. These should not be used in isolation, but should be combined to ensure proper analysis and appropriate application. The quality management process, however, cannot succeed unless there is sufficient and continued support from top management to the extent that quality management must be part of the organization's strategy, implementation and measurement systems.

There appears to be a progressive move towards partnerships with suppliers, but the nature of the task at hand, complexity, and capacity issues need to be evaluated first to assess the appropriate relationship type. Ideally, quality must be planned throughout the supply chain and integrated between buyers and suppliers at the point of interface. Standards and specifications have a role to play in ensuring performance, both from the perspective of the customer, and evaluation of suppliers, to ensure customer requirements are met.

The next chapter seeks to address the relevance of these in the context of housing.

CHAPTER 3 : QUALITY MANAGEMENT IN HOUSING

3.1 INTRODUCTION

The previous chapter dealt with the theoretical framework relating to quality management. This chapter provides an overview of recent research on quality management in the context of housing, and attempts to identify how it has been applied to low-income housing.

Quality management in housing is not new. The Code of Hammurabi, 2000BC stated that "if a builder has built a house for a man, and his work is not strong, and the house falls in and kills the householder, that builder shall be slain" (Gitlow, et al, 1999:15). Around 1450 BC quality control of component parts was undertaken by Egyptians and Aztecs (Central America) by inspecting and measuring the squareness of blocks (Gitlow, et al, 1999:15).

3.2 AN INTERNATIONAL PERSPECTIVE

Most recent international research relating to low-income housing has focused on slums clearance, upgrading of human settlement, and integrated development (International Housing Research Network website). The following international research and applications illustrate quality management in the context of housing:

3.2.1 United States of America

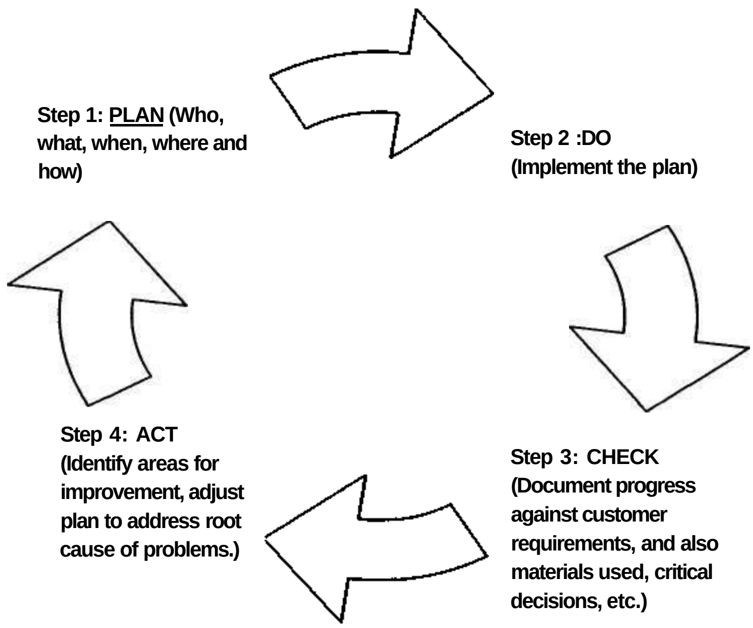
The NAHB Resource Centre (National Association of Homebuilders) has developed a quality assurance programme to assist industry leaders to deliver quality houses. It is the leading resource in America for quality related information in residential construction (NAHB Resource Centre, undated: paragraph 2). NAHB Resource Centre, American Department of Housing and Urban Development and other industry stakeholders, have developed quality certification programs. These include independent audits and reviews to verify compliance with quality assurance programs (NAHB Resource Centre, 1997a: paragraph 2). The NAHB Resource Centre literature covers a wide range of quality assurance matters, including general information, inspections and partnerships (NAHB

Resource Centre, 2005b: paragraph 2). These will be discussed briefly in the section below.

3.2.1.1 NAHB Resource Centre Quality Assurance Systems

NAHB Resource Centre advocates that the ISO 9000 quality assurance standard be implemented through the "Deming wheel" system of Plan, Do, Check and Act, (NAHB Resource Centre, 2005a: paragraph 4 and Gryna, 2001:127) as indicated in Figure 3.1, below:

Figure 3.1 : NAHB Quality Assurance System Approach



(Adapted from NAHB, 2005a: paragraph 4 and Gryna, 2001:127)

NAHB Resource Centre (2005c: paragraph 1) notes that customer expectations in the building industry are increasing. Some builders address this by additional inspections which increase construction costs. The Resource Centre suggests that this can be reduced drastically by "building it **right** first time" (NAHB Resource Centre, 2005c: paragraph 3), as advocated by Crosby in Lindsay and Evans, (2002:106).

Proper quality plans are needed for this. These should address: Clearly defined specifications and required results; quality craftsmen with training, demonstrated skills, experience and abilities that have been certified and verified; approved materials with performance certification; proper tools and equipment; and a documented process (NAHB Resource Centre, 2005c:paragraph 4).

The Resource Centre (2005d: paragraphl) advises that "quality doesn't cost - it pays", thus supporting Crosby's notion of "quality is free" (Evans and Lindsay, 2002:107). The Resource Centre advised that findings from a survey indicated that quality assurance programmes reduced "call-backs" for some contractors by 50%, reduced operating costs, and improved builder satisfaction ratings (NAHB Resource Centre, 2005e: paragraphl). This involves the inclusion of continuous improvement into work plans (NAHB Resource Centre, 2005d: paragraph 4).

A formal quality assurance programme is critical in demonstrating that, in the event of a lawsuit, every reasonable effort has been made to ensure quality construction (NAHB Resource Centre, 2005f: paragraph 7). ISO 9000 is often used by lawyers to determine quality negligence. The following are often called into evidence, and are elements of a sound quality assurance system (NAHB Resource Centre, 2005f: paragraph 3):

(1) Well defined specifications (drawings/designs, construction details and materials, tolerances, etc).
(2) Detailed work procedures.
(3) Recruitment and qualification criteria of labour.
(4) Pre-work-, compliance- and completion inspection systems.
(5) Corrective and evaluation systems.
(6) Documented proof that the system is applied consistently, e.g. inspection records.

(NAHB Resource Centre, 2005f: paragraph 3)

The Resource Centre suggests a, "100%, Zero defects" approach to housing delivery (NAHB Resource Centre, 1997a: paragraph 3). Buyers assess quality at the time of delivery. Faith in the builder is lost once customers detect defects before they are fixed. The hundred percent, zero defect approach (by Crosby Evans and Lindsay, 2002:106), in the context of house construction, suggests houses be inspected for defects, documented (snagged) and fixed before final inspection by the customer. This increases customer satisfaction, referral rates and trust, that problems would be addressed, if any, whilst also reducing warranty items to resolve (NAHB Resource Centre, 1997a: paragraph 3).

It also recommends the following be maintained on site to ensure high performance:

(1) Detailed installation instructions (including step-by-step illustrations and work procedures, tolerances, environmental conditions, specialized tools, storage requirements and limitations on use);
(2) Approved materials lists described in detail (by brand, type, dimensions, etc);
(3) Craftsmen qualification requirements defined in detail;
(4) Standard contracts, clearly defining expectations, roles and responsibilities;
(5) Jobsite inspection forms to be completed at specified inspection points, and to include critical job conditions, materials used and state of satisfaction of work completed; and
(6) Quality manual, consistent with the requirements of ISO 9000.

(NAHB Resource Centre, 2005g: paragraph 1).

The above forms part of ISO 9000 recommended quality assurance programmes that includes: (1) quality controls that should ensure qualified materials and clear installation procedures are followed, and qualified installers are used; (2) a list on site specifying tasks to be performed and person/s responsible; (3) specified quantities and qualities of products and monitored and documented usage; (4) sales and other that clearly describe work requirements, roles and responsibilities; (5) availability of competent staff to read the contract and ensure that obligations are fulfilled correctly; (6) construction specification and specific instructions; (7) jobsite inspections with findings and corrective measures documented on checklists; and (8) periodical audits of quality systems and work progress must to ensure adherence, and to effect improvements, (NAHB Resource Centre, 1997b: paragraph 5 and 1997c: paragraph 1).

3.2.1.2 NAHB Resource Centre on inspections

Continuous improvement should form part of "work in progress" inspections thereby greatly reducing problems on snag lists (punch lists) (NAHB Resource Centre, 2005h: paragraph 4). This can be achieved by:

(1) Inspecting work of all trades against specifications, as work progresses.
(2) Attending to repairs as work progresses.
(3) Walking the house often as it nears the completion stage.
(4) Testing appliances, tubs and fixtures.
(5) Ensure finer details and clean ups are attended to at defined stages.
(6) Record and review findings to improve systems.

(NAHB Resource Centre, 2005h: paragraph 6).

Quality inspection checklists are useful to ensure critical items are addressed (NAHB Resource Centre, 2005i: paragraph 1). Inspections should be a verification process that work has been completed correctly against designs and specifications and in terms of the scope of work, by qualified personnel, with the correct type, quantity and quality of materials, and that any quality problems have been addressed (NAHB Resource Centre, 1997b: paragraph 15). The aforementioned should be included in standardized check lists that should provide information on the site establishment, start date, product description, and state of readiness for work to commence (including suitability of building and environmental conditions that may affect quality) (NAHB Resource Centre, 2005i: paragraph 3).

Current non-routine problems may be addressed through "hot spot" checklists that need specific interventions. "Hot spot" check lists and inspections are tailored to address extraordinary situations that could impact on quality performance. Once the problem is resolved, the item is removed from the checklist (NAHB Resource Centre, 2005j: paragraph 4, bullet 6).

Inspection efforts should not be duplicated unnecessarily as these add unnecessary costs. ISO 9000 provides some guidance with regard to inspection frequency, which could reduce dependency on inspections, and "by doing the job right the first time" (NAHB Resource Centre, 2005c: paragraph 2).

The Resource Centre (NAHB Resource Centre, 2005k: paragraph 2) cautions against the use of building practice that is considered normal, but incorrect (such as incorrect roof ties and truss attachments and framing techniques). Building techniques can vary widely.

"Self-inspection could ensure that a contractor's own practices adhere to recommended building codes (NAHB Resource Centre, 2005k: paragraph 3).

The role of inspection staff and supervisors must not be underestimated as they can provide valuable inputs in quality improvement efforts, problem and solution analysis, change management systems and feedback on quality management effectiveness. The responsibility for improving production systems and leading quality improvement should remain with management, but inspection staff and supervisors should be engaged in these efforts (NAHB Resource Centre, 20051:paragraph 3).

Quality inspectors at production level should be transformed to quality managers that take ownership of construction processes and quality improvement initiatives, through reliable processes aimed at delivering defect free units. This involves developing process thinking, problem solving and quality control system skills (NAHB Resource Centre, 2005m: paragraph 6).

3.2.1.3 NAHB on partnerships

Leadership is essential to setting consistently high performance standards and achieving quality and performance excellence (NAHB Resource Centre, 2005n: paragraph 7). This can be facilitated through partnerships. These should include product manufacturers, as quality products and proper installation are a foundation for quality in the end product (NAHB Resource Centre, 2005g: paragraph 2).

Collaborative efforts that focus on skills development also contribute towards quality efforts. This should include joint efforts to secure quality craftsman training, both from trade schools and product manufacturers; collaborative quality and safety plans that details all resources, qualifications and specifications and inspection requirements; and define inspection and control systems and interaction (NAHB Resource Centre, 1999b: paragraph 2).

The Resource Centre supports the PATH initiative (Partnership for Advancing Technology in Housing), that aims to improve housing durability and reduce maintenance cost by 50% by 2010. This includes "reducing the cost of home ownership, improving energy efficiency and environmental performance of new and existing homes and reducing failures due to natural disasters (NAHB, 1999c:2). Durability in this sense relates to the expected service life of a house or component parts under standard conditions of use with standard maintenance (NAHB, 1999c:3).

Baselines for durability performance must be set, and strategies need to be adopted in partnership with manufacturers and users of building materials. These should include improving the performance of existing products and materials; ensuring selection and use of more durable products; minimizing premature failure due to manufacturing and installation problems; and encouraging preventative maintenance and early detection of maintenance areas needing attention (NAHB Resource Centre, 1999c:5-7). The Resource Centre recognizes that home owners and occupants have varied levels of skills in attending to maintenance issues and recommends that businesses consider this as an additional service that could assist owners in extending the durability of their homes (NAHB Resource Centre, 1999c: 7).

The above illustrates that total quality management is applicable to housing construction and provides many benefits. In spite of this, quality issues still prevail in low-income housing, especially rental schemes where landlords refuse to repair and maintain buildings, even though inspections are done (Clampet-Lundquist, 2003:135).

3.2.1.4 Mixed income developments and Quality

Smith (2002:2) suggests that mixed income housing developments can de-concentrate poverty and contribute to delivering affordable units of high quality. He states that low-income housing in America is stigmatized as poor quality high density developments with standardized designs, providing little private space, for the lowest income groups (2002:10). He suggests that mixed income developments may contribute to high quality units and subsequent maintenance of these developments to a higher standard (2002:11). This is postulated on the theory that such developments need to attract a variety of income groups, thus having to raise the standard to attract higher income earners that seek market rated designs. Likewise maintenance is likely to improve as landlords need to ensure that the expectation of higher income earners are satisfied (Smith, 2002:11).

This approach requires careful consideration of environmental factors such as the condition of the housing market, nature of the target market, population dynamics, financing, size of project, community dynamics and feasibility of income mixes (Smith, 2002:2).

3.2.1.5 Housing quality and health

Krieger and Higgins (2002:758) identify substandard housing as a major public health issue as scientific evidence has demonstrated a relationship between housing and health, and substandard housing and increased risk of chronic diseases. Substandard housing is associated with the lack of safe drinking water, absence of hot water for washing, ineffective waste and food disposal and carriers of disease (Krieger and Higgins, 2002:758). Crowding and lack of housing in temporary shelters are found to contribute to respiratory diseases and the spread of tuberculosis (Krieger and Higgins, 2002:758).

Conditions resulting in damp, such as overcrowding in units and water penetration, nurture an environment for mites and cockroaches, viruses and molds, which increase respiratory diseases such as asthma, as well as recurrent headaches, nausea, vomiting and sore throats. Children with asthma exposed to these conditions have an increased risk to hospitalization, whilst mouse allergens increase morbidity (Krieger and Higgens, 2002:758), whilst such poor living conditions and health impact on mental health (Krieger and Higgins, 2002:759). Injuries occur more commonly in low-income housing due to exposed heating sources, unprotected upper-storey windows and low sills, slippery surfaces, poorly designed stairs and poor lighting; coupled with a lack of resources to repair them (Krieger and Higgins, 2002:759-760).

The above factors result from structural defects that permit entry of cockroaches and rodents; leaking pipes; inadequate food storage and disposal facilities; inefficient thermal qualities; toxic substances such as lead in paint and other volatile particle substances (e.g. particle board and floor coverings); asbestos exposure; and poor ventilation (Krieger and Higgins, 2002:759).

Krieger and Higgins (2002:763) suggest that this calls for enhanced housing codes, to include health factors to new and existing stock, and greater involvement of public health departments. The article however, also demonstrates the need for quality management to be implemented in low-income housing and to include health aspects in standards and specifications, thus for public health departments to become partners in housing quality management.

3.2.2 <u>Hong Kong</u>

Environmental management and sustainability has received growing attention in Hong Kong and has been incorporated into government policies. Programmes have been developed to replace old housing stock with more environmentally and financially sustainable housing (Keung and Edmunds, 2004:2), thus improving quality.

The Hong Kong Building Environment Assessment Method (HK-BEAM), has played an important part in achieving these objectives. HK-BEAM was established in 1996 as an independent certification programme aimed at stimulating sustainable and environmental friendly developments and meeting its requirements through "best environmental practice" (Keung and Edmunds, 2004:11 and 2).

HK-BEAM has developed standards for both new and existing developments. (Keung and Edmunds, 2004:3). The most significant environmental issues are assessed at each stage of the building's life cycle, from planning through to construction (Keung and Edmunds, 2004:5). It includes site and locational aspects; material selection (including usage and waste management); energy use; water consumption (including quality and conservation); indoor environmental quality (such as thermal comfort, air, lighting, and noise); and innovation (Keung and Edmunds, 2004:6). The process of evaluation is summarised in Figure 3.2, below.

Figure 3.2 : The HK-BEAM Assessment Process

Client: Approaches HK-BEAM assessors with selected building for evaluation

Assessor: Distributes user-friendly assessment checklists to collect information from building designers/managers

Assessor: Appraises the building against HK-BEAM best practice criteria and computer simulation to predict energy and thermal performance, and presents provisional report

Client: Pursues critical adjustments and resubmits for re-evaluation.

Assessor: Evaluates amendments and undertakes construction site visits to verify adoption of agreed standards.

Final assessment report and HK-BEAM certification *(Bronze, Silver, Gold or Platinum rating for overall environmental performance)*

(Adapted from Keung and Edmunds, 2004:4)

HK-BEAM has assisted in increasing the sustainabihty and efficient use of resources in housing in Hong Kong, through partnerships with all stakeholders in the building industry (Keung and Edmunds, 2004:11). This sustainabihty is seen as a key to becoming a world class city (Keung and Edmunds, 2004:10).

3.2.3 Singapore

The Singapore government provides low cost housing to low-income groups through its Housing Development Board. Its policy (including aspects of design, construction and renewal programmes) is driven by community dynamics and sustainabihty (Meng and Yin, 2004, paragraphs 1 and 2). It aims to promote community bonding and building by meeting the needs of the community. Developments are aimed at ensuring lifetime homes, which are facilitated through ongoing research into new housing forms to ensure community needs are met (Meng and Yin, 2004, paragraph 3), thus ensuring quality.

Programmes are in place to replace old units, aimed at improving quality and amenities on par with new ones. This is facilitated by pre-cast technology which reduces disturbance of the family, reduces cost and other inconvenience factors, thus increasing the speed of delivery (Meng and Yin, 2004, paragraph 4).

Designs are aimed at improved convenience, accessibility and design efficiency (Meng and Yin, 2004, paragraph 3). Family units are self contained flats with ample living space, a kitchen and bathroom. There are different size options and the needs of the elderly are accommodated in elderly friendly features such as barrier free entry and non-slip tiles (Meng and Yin, 2004, paragraph 3). This is similar to aspects of the Department of Housing's urban renewal programme of renewing old buildings, but this is not as "generous" as the Singapore policy.

3.2.4 Namibia

Namibia is focusing its low-income housing policy on informal settlement upgrades (The World Bank, 2002:7). Quality is controlled in terms of National policy which requires:

(1) minimum sanitation of a communal toilet within 30 meters;
(2) access to communal potable water within 200 meters;
(3) roofed structure of durable materials of not less than $6m^2$;
(4) minimum plot size of $300m^2$ unless consented to by the Minister where justified by design, implementation or marketing concepts.

(The World Bank, 2002:8).

In addition to this, the Windhoek City Council has set the following principles and guidelines:

(1) Services in all development options should be based on reasonable health standards.
(2) Appropriate technical development levels to be used.
(3) Reasonable social acceptance and understanding of development concepts and options.
(4) Promotion of community initiative and responsibility to gradually improve developments, in order to manage and optimize financial and institutional resources.
(5) Permanent ownership forms to be promoted.
(6) Minimization of financial risk to the Council and its clients.

(7) Standardized, yet flexible costing, pricing and administrative systems for land sales and leases to be applied.

(8) Optimization of all natural, human and financial resources.

(9) Environmental, social and financial sustainability to be ensured.

(10) Full cost recovery and "the user pays" should be the underlying principle of low-income programmes.

(The World Bank, 2002:14).

Six different levels of development packages have been formulated, with different levels of services, for different target groups to ensure affordability (The World Bank, 2002:14). The top-down setting of standards/service levels may lead to inappropriate service levels which are not affordable to the greater majority, and waste occurs in the provision of infrastructure and services that people don't need. This highlights the need to involve communities in the planning and implementation of housing schemes that affect them (The World Bank, 2002:18).

3.3 LOW-INCOME HOUSING QUALITY MANAGEMENT IN SOUTH AFRICA

3.3.1 Research initiatives

The South African government's policy on housing for the poor (1994) was originally based on maximising the volume of delivery. Many stakeholders have raised concerns regarding the resultant quality of units that have been delivered (Department of Housing, undatedfa):l, and Sisulu, 2005a:5). This study is informed by the following research initiatives:

3.3.1.1 CSIR (Council for Scientific and Industrial Research)

The CSIR is a statutory body which undertakes research in a number of fields, including infrastructure, materials, engineering and technology (CSIR, 2005a: paragraph 1). Its research focus is more on the technical aspects, product innovation and suitability of alternative construction materials and building practice (CSIR, 2005b: paragraph 1).

3.3.1.2 Construction Industry Development Board (CIDB)

The Construction Industry Development Board (CIDB) has suggested best practice for labour intensive technology for earthworks and pre cast concrete products, bricks and block making. Both guides include best practice suggestions to ensure proper tools and inspections are undertaken (CIDB, 2005:15). It also incorporates building standard requirements of the South African Standards (SABS/SANS), and provides a template for inspections and recommended quality control checks. This includes items; (materials, production and other operations), properties; tests and its sources; and frequency (CIDB, 2005:19). The CIDB has also developed supplier improvement programmes, screening and registration, to improve quality in the construction industry (Hodgson and Milford, 2005:7).

The CIDB has also published *"Inform practice notes"* to guide implementers on best practice principles in construction procurement and delivery (CIDB, 2006:1). Whereas the construction output needs to double in volume over the next 5 to 10 years, the first practice note "identifies systematic problems and outlines approaches to contracting strategies that increase the size and duration of contracts to enable enhanced delivery and the efficient use of resources; and sustainable enterprise growth, employment, workforce skills development and sustainable empowerment" (CIDB, 2006:1).

It suggest that a range of contracting options be used that would accelerate project completion times; provide shared incentives to meet contractor and customer requirements; appropriate risk sharing; and phasing of projects. This could be achieved through partnering approaches (CIDB, 2006:4). It also suggests the use of larger contracts to attract larger firms. This would increase access to expertise in contract management, technical skills, quality assurance and financial capacity; increase delivery rates at large scale; and benefits derived through economies of scale, such as reduced risk, reduction of fees and better resource utilisation (CIDB, 2006:6).

It also recommends projects over longer periods of time, but phased appropriately through a systems and programme management approach. This could enhance economies of scale benefits; allow developers to develop their staff and subcontractors over time; thus improving proficiencies in performing on contracts; increase predictability of work flow; and supports long term jobs and skills development (CIDB, 2006:8).

3.3.1.3 National Department of Housing

A policy review commissioned by the National Department of Housing for the period 1994 to 2003 confirms perceptions of poor quality houses (Charlton, et al, 2003:10). The report highlights that slightly better quality is achieved where people built their own homes through the "People's Housing Process", but the roll out of such a programme at a large scale may be limited. The report also identifies the need for more environmentally and energy efficient housing (Charlton, et al, 2003:10), to improve asset value (Charlton, et al, 2003:53). It identifies the need for long term usage of houses with improved designs, positioning and construction that enables a range of uses (Charlton, et al, 2003:10), through innovative design (Charlton, et al, 2003:53). It acknowledges that construction quality improvement research is required but that this should not detract from deeper concerns of location and integrated development (Charlton, et al, 2003:17). The report also identifies inadequate aftercare from provincial and municipal levels.

3.3.1.4 Eastern Cape Province

The Provincial Eastern Cape Government developed "A Basic Guide to Quality Housing Development Norms and Standards", aimed at residential structures delivered through government-subsidised low-income houses, built by the people themselves. The document reflects standards, materials, quantities, sample plans and graphic representation of mixing methods, and general construction requirements to deliver a completed 40m^2 unit. It also incorporates a checklist for inspections, from site preparation, through to completion and handover to the occupant (Province of the Eastern Cape, 2005:3).

3.3.1.5 NHBRC

The National Home Builder's Registration Council (NHBRC) is a statutory body that aspires to achieve quality to protect home owners (Department of Housing, 2005e). It has identified the following quality concerns in house construction in general, supported with photographic evidence, but the extent in the context of low-income housing is not provided:

(1) Poor quality bricks.

(2) Insufficient cement in mortar mix.

(3) Poor plaster applications to exterior walls.

(4) Poor storm-water management.

(5) Structural failure due to poor founding conditions.

(6) Incorrect use of brick force.

(7) Incorrect or no brick bonding.

(8) Vertical cracks in plaster - poor quality sand and mix.

(9) Not built to plan.

(10) Poor workmanship.

(11) Structural defects.

(12) Use of substandard building material.

(13) Lack of general maintenance.

(14) Storm-water management control non-existent.

(15) No on-site quality control and supervision.

(16) Sagging and leaking roofs.

(NHBRC, 2002a: paragraph 1).

The NHBRC on its website (NHBRC, 2002a: paragraph 3) identifies the shortage of project management skills, construction and financial management skills and construction execution skills as major challenges. It has identified the building of high quality houses in the government-subsidised houses as a major challenge that needs to be assessed (Department of Housing, 2005e: paragraph 4).

3.3.2 <u>Institutions that affect Standards and Specifications in Low-income Housing in South Africa</u>

3.3.2.1 International standards

International Organization for Standardisation (ISO) is a network of technical committees with representatives from 156 national standard organizations. The coordinating committee is situated in Switzerland. Standards are debated between member countries. Democratic votes determine acceptance of the standard. The ISO standards are voluntary and are aimed at improving quality (ISO, undated: paragraph 3).

3.3.2.2 National and industry Standards

(a) <u>Standards South Africa</u>

The Standards Division of the South African Bureau of Standards (SABS) changed its name to "Standards South Africa". The National standards formerly designated "SABS" are now "SANS" (ASOSH, undated : paragraph 1). It is mandated by the Standards Act, 1993 (Act 29 of 1993), to develop and publish standards for products and services, developed in conjunction with interest groups such as the CIDB. It works closely with the International Standards Organization to protect interests, whilst adopting international standards where appropriate (STANSA, 2005a: paragraph 5). It is also involved in certification schemes, quality system certification and consignment inspection services (ASOSH, undated: paragraph 2). It also provides: technical advice; arbitrates disputes lodged by builders against approval authorities; compiles technical reports of building defects for legal purposes; improves legislation; workshops stakeholders on legislation; and evaluates qualifications of building control officers, in relation to construction matters (SABS, undated: paragraph 2).

(b) <u>Construction Industry Development Board (CIDB).</u>

This Board was established by the Construction Industry Board Act, 2000 (Act 38 of 2000). It is responsible for developing standards relating to good practice, procedures, and procurement and delivery management within the construction industry. It has developed a code of conduct for procurement practice in the industry (CIDB, 2002b: paragraph 1). These have been regulated (Republic of South Africa, 2004b: paragraph 2).

It is also involved in developing methods for monitoring and regulating performance and registration of projects and contractors (CIDB, 2002c).

(c) National Home Builders Registration Council (NHBRC)

The Council is a statutory body established in terms of the Housing Consumer Protection Measures Act 1995, (Act 95 of 1995), to protect the interest of housing consumers and to regulate the home building industry (Department of Housing, 2005e: paragraph 2). Its *Home Building Manual* provides guidelines from practical experience in implementing the National Building Regulations, and is applicable to low-income urban developments. The manual deals with general requirements, design-, and construction standards which have been incorporated into the Department of Housing's Procurement Documents (Department of Housing, 2002(b): 1.1).

3.3.2.3 "Company" standards

(a) Department of Housing

The Department is responsible for housing and delivery of low-income housing through the housing subsidies. The Minister must determine national housing policy, including national norms and standards (Act 107 of 1997, section 3(2)(a)). The Department's *"National Housing Code ",* which contains national norms and standards for low-income housing, is binding on the provincial and local spheres of government (Act 4 of 2001, section 3(b)). It addresses basic product types and fixes the amount to be spent in respect of municipal services and dwelling, respectively. The amount is revised annually when the subsidy quantum is revised (Department of Housing, 2000:178-180).

(b) Municipalities

Municipalities have by-laws that govern town planning and engineering design and construction issues (including land use controls, minimum lot sizes, omnibus servitudes, building line distances, etc). These vary between municipalities. The Department of Housing acknowledges this need and allows for some flexibility, provided the standards are not less than that prescribed by the Department (Department of Housing, 2002b: 1.1).

3.3.3 Standards and specifications in the South African government-subsidised low-income housing initiatives

The specifications and standards applicable to government-subsidised housing are briefly summarised below. These include simple specifications (function and fit-, market grade- and qualified product specifications); and complex specifications (commercial standards, design specifications, engineering drawings and material- and-method of manufacture).

3.3.3.1 Simple specifications

These are very basic types that require few resources and description. It is used to define simple products or services, e.g. "a 30 cm standard stationery ruler" (Burt, et al, 2003:239).

"Function and fir specifications are used to describe what a product/service is required to do. The desired performance is described in detail, including functions to be performed, its relationship to other components, and design outcomes required (Burt, et al, 2003:240), e.g., the "deemed to satisfy" standards in the application of national building regulations (SABS, 1990:4).

Market grade is used to describe and determine the quality and or standard ranges of commodity type products. Trade associations, standard setting authorities and government agencies determine grades for specific commodities (Burt, et al, 2003:243).

Qualified product specifications are used where it is critical to know up front whether a product or service would be able to comply with expectations, e.g. research equipment. The product and/or service is pre-qualified through a review and qualification testing process, and registered on an approved list of suppliers (Burt, et al, 2003:243-244), such as the use of building contractors registered with the National Home Builder's Registration Council (NHBRC), in low-income housing (Department of Housing, 2005f: paragraph 3).

3.3.3.2 Complex specifications

Complex specifications are far more detailed and describe exactly what the buyer wants. They include commercial standards, design specifications, engineering drawings and material and method-of-manufacture (Burt, et al, 2003:244).

Commercial standards are developed by industry and government where there is a high frequency of recurring needs for certain materials and or/performance requirements. They entail a complete description of the materials, quality, finishing, testing methods and standards, dimensions, composition, etc. They form part of most mass production systems, and provides a measurement for quality standards (Burt, et al, 2003:244-245), e.g. Standards South Africa.

Design specifications set detailed specifications for non-standardized materials, to meet specific design requirements (Burt, et al, 2003:245). In the South African context, these require Agrement Certification (Agrement South Africa, 2002: paragraph 2, and SABS, 1990:44).

Engineering drawings form part of design specifications and to specify shapes, dimensions, spatial relationships of technical details of a product. These require explicit descriptive instructions and details. It is an accurate and precise form of specification commonly used in construction projects or where high mechanical outputs are required (Burt, etal, 2003:245-246).

Material-and-Method of Manufacture is very prescriptive. Prospective suppliers are given precise instructions in the use and processing of materials. It is costly as it requires very detailed preparation of documents and detailed inspections to ensure compliance with requirements (Burt, et al, 2003:246). This may apply to areas such as specific foundations designed by an engineer or sanitation systems.

3.3.4 <u>Standards and specifications applicable through the project life cycle</u>

A number of specifications and standards are applicable throughout the life cycle of a low-income housing project, i.e. procurement, preparation, planning and design of township and engineering services, and house construction (NHBRC, 2002c: paragraph 1). These will be discussed briefly in the section, below.

3.3.4.1 Procurement

Legislation governs the manner in which funds are spent by organs of state, and the manner in which service providers are procured (a schedule of such legislation, is attached ***(Appendix 1).***

The Department of Housing has developed standard procurement documents that include CIDB and South African Standards requirements. The specifications came into effect on 1 April 2003 (Department of Housing, 2002b: 1.1), and include essential features of standardized documents for a particular contract option (Department of Housing, 2002a:2.1). A summary is attached ***(Appendix 2).***

The Construction Industry Development Board (CIDB) has published regulations (Notice 63 of 2004, Government Gazette No 26427), to ensure transparent and uniform procurement procedures and practices relevant to construction (CIDB, 2004b, paragraph 1). These became applicable to all organs of state undertaking procurement for construction, from 14 November 2005 STANSA, 2005b: paragraph 7, and Republic of South Africa, 2004b: paragraph 2). It is noted that the Department of Housing documents have not been updated to reflect this standard.

Standards South Africa has developed standard procurement specifications in response to the CIDB regulations aimed at ensuring uniformity, transparency and predictability of the procurement of construction services (CIDB, 2002c: paragraph 4). Different suites have been developed to describe key characteristics and to ensure maximum order in the procurement of each type of service relating to civil engineering construction (STANSA, 2005b: paragraph **1),** *(see* ***Appendix 3).***

3.3.4.2 Project preparation

The Department of Housing's standard procurement documents include all requirements relating to preparatory work, including procedures and documents required for land identification and purchasing, project motivations and technical reports such as geotechnical site investigations and environmental impact assessments where required (Department of Housing, 2002b: 1.1 and 2002e:1.1). Refer to *Appendix 4* ***and*** 5, for a summary of geotechnical investigation and environmental impact assessment requirements and contents of specifications.

ISO has revised its versions of its ISO 14001 and ISO 14004 standards, aimed at setting standards for efficient environmental management systems. ISO 14001 addresses the control and continuous improvement of companies' activities, products and services of its impact on the environment. ISO 14004 focuses on the implementation of environmental management systems (STANSA, 2005c: paragraph 7). The auditing standards of environmental systems have been revised by ISO 19011, and provide a single set of guidelines for all aspects relating to quality and/or environmental management system audits. The standards can be extended to other audit types, such as production and regulatory compliance (STANSA, 2005d: paragraph 8). ISO 14001 and 14004 have been adopted as South African National Standards, published under SANS 14001, *Environmental Management Systems,* and SANS 14004, *Environmental management systems-general guidelines on principles, systems and support techniques* (STANSA, 2005c: paragraph **1).**

3.3.4.3 Planning and design for township establishment

The Department of Housing has standardized documents and specifications for procurement of services for town planning and engineering. The town planning specifications outline the qualification criteria for a town planner, and key outputs required. The planning activities; minimum information and aspects to be addressed in the motivation and commentary; relevant sources to be consulted; mapping; and reporting requirements are specified (Department of Housing, 2002c:Introduction).

The Department's specification for the design and construction of services are performance based. It provides the minimum requirements for engineering infrastructure (roads, storm water, drainage, sanitation and water and high mast security), based on the Departments norms and standards, National Home Builder's Registration Council

(NHBRC) requirements, and SANS requirements that prevailed at the time (Department of Housing, 2002c: Introduction).

The minimum level of service in terms of the National Housing Code (Department of Housing, 2000:180) is summarised in Table 3.1, below.

Table 3.1: Department of Housing minimum norms and standards for services

TYPE OF SERVICE	DESCRIPTION
Water	Single standpipe per stand (metered)
Sanitation	Ventilated Pit Latrine (VIP)
Roads	Access to each stand with graded or gravel paved road
Storm-water	Lined open channels
Street lighting	High mast security lighting for residential purposes where feasible and practical

(Department of Housing, 2000:180)

The NHBRC has specific requirements for drainage capabilities to also ease maintenance; and storm-water disposal systems to prevent soil erosion or flooding that may adversely affect housing structures (Department of Housing, 2002c:Introduction).

SANS specifications cover all aspects pertaining to engineering design and construction activity, including earth works, erosion control, storm- water drainage, sanitation systems, etc (SABS, 1990:5). The headings of the different standards are self explanatory, as reflected in *Appendix 6.*

The specifications provide a breakdown of civil engineering components and define the needs and performance requirements for each. These include pipe dimensions, -diameters, -gradients and -velocities for storm-water drainage and water supply, slopes and gradients for roads (Department of Housing, 2002c:Introduction).

3.3.4.4 House construction

House construction is the final part in the project delivery cycle. A number of standards impact on house construction. The Department has specified a minimum house size of $30m^2$ gross floor area, (Department of Housing, 2000:181). It developed performance based standard specifications for the design and construction of houses that incorporates the mandatory requirements of the National Building Regulations, SABS, NHBRC

(Department of Housing, 2002g:1.1). The content of the specifications is summarised in ***Appendix*** *7.*

(SABS0400-1990) *Code of Practice for the application of the National Building Regulations* was developed to ensure a proper interpretation of the National Building Regulations and Standards Act, 1977 (Act 103 of 1977), (SABS, undated). It was approved by the former Council of the South African Bureau of Standards on 23 August 1993. "The Code sets out prescriptive provisions that are deemed to satisfy the technical aspects of the National Building Regulations"(SABS, 1990:4). It deals with all the technical aspects relating to building construction and sets out the minimum requirements to ensure that buildings are designed and built in a manner that ensures people could live and work in a safe and healthy environment. It was intended to minimize regulations and to focus primarily on health and safety aspects. It was also intended at informing innovation - not to impede it (SABS, 1990:3). The regulations are the basis upon which inspections are conducted by the Department of Housing (Shabalala, 2006). See ***Appendix 8*** for a summary of the content of the document in the context of low-income housing. Standards applicable to house construction in the government-subsidised housing scheme are listed in ***Appendix 9.***

3.3.5 Standards and specifications in low-income housing : Benefits and challenges

3.3.5.1 Benefits

(a) Enables mass production

Standardisation increases the potential to use interchangeable parts (Burt, et al, 2003:254), e.g. use of standard different window frames across projects. It stabilizes production processes and encourages continuous improvement (Burt, et al, 2003:254). The experience and learning curve effect is expedited as a standard product is built within a particular project.

(b) Enables customisation

Standards facilitate the production of a wide variety of finished products from a relatively small number of parts (Burt, et al, 2003:255), e.g., a range of different house designs are possible, using the same quantities, but this is limited to the placement of windows, doors, internal wall and plumbing, and roofs. Houses built by people themselves may allow more flexibility as the cost of labour is replaced by the builder's own sweat equity. Additions and materials purchased by owner builders from other sources may be used to achieve customization.

(c) Improves supplier coordination

Standardized parts and specifications facilitate a clear understanding of dimensions, characteristics and performance standards (Burt, et al, 2003:255). It enables proper quantification and need estimates that inform negotiations for bulk supplier/customer discounts. This is very relevant to housing projects as it is critical to ensure that the right quantity of sand, water and cement is available to ensure the correct mixture of concrete for the desired purpose (e.g. slabs versus plastering), and to ensure that the cement is not delivered prematurely, to guard against the theft and/or expiry of the material.

(d) Improves quality

The standard products and design facilitate the experience and learning curve effect, which lowers defects (Burt, et al, 2003:255) as the same process and product are delivered throughout a particular project.

(e) Enables simplification

Standards facilitate the identification of bare minimum quantities and qualities of materials required to deliver the desired performance standard, thus resulting in the simplification of the product (Burt, et al, 2003:255). Standards guard against exploitation to ensure that the absolute minimum still complies with health and safety requirements, as determined by the relevant standards and regulations (SABS, 1990:40).

(f) Lowers inventories

Where the product is standardized, quantities and delivery needs can be more accurately projected, thus reducing waste with regard to disposable items, and keeping inventory levels low, thus improving inventory and quality control (Burt, et al, 2003:255). Items such as cement have a limited shelf life. Steel products also are at risk of rusting and would require special storage (and security against theft). Low inventory levels reduce this risk.

(g) Other potential benefits

Standard products and processes reduce risk perceptions, compared to those that are unknown or untested. Budgets are easier to compile as quantities, features and quality costs are more predictable as prices are easier to compare.

It creates a comparable base for tender evaluation as the minimum requirements are transparently defined in standardized procurement specifications. Financial controls are enhanced as payment and performance can be measured against standard specifications.

Mass production is enabled through standardisation, which increases the speed of delivery, and reducing costs through economies of scale. Uniform product reduces perception of discrimination amongst same income profile housing beneficiaries in different regions. Expected product features and performance is also easy to communicate, and to inspect.

3.3.5.2 Challenges

(1) The referencing system used for SABS (now SANS) standards, is complicated, and in some cases a vast number of references need to be explored before the appropriate standards are found. This is also applicable to the organization's electronic referencing system. The standards are not readily available unless they are ordered through the organization, and can only then be obtained at a cost. This could be a limiting factor, as one could search for specifications in the Department of Housing's documents, only to find that additional sources need to be obtained, at additional costs, which may be limiting to owner builders and emerging concerns.

(2) Product innovation, customization and competition based on product differentiation and low cost is extremely limited. The subsidy is set at a fixed amount with which a product is to be delivered to meet the Department's minimum norms and standards.

(3) The housing process and documents required for the procurement of services and approval of projects are complicated, especially for emerging contractors who may be less familiar with the specified procedures.

(4) Building Regulations are "deemed to satisfy rules", the interpretation of which is manipulated by unscrupulous developers who still abuse subsidy funds through fraud and poor substandard or very borderline materials.

3.4 SUMMARY

Quality management in housing is not new. Most recent international research relating to low-income housing has focused on slums clearance, upgrading of human settlement and integrated development.

In the international arena, the National Association of Home Builders (United States of America) has developed extensive literature on quality management in relation to housing. This is based on total quality management philosophies.

Research indicates that mixed income development also appears to facilitate quality in housing, as higher income earners demand better quality, thus also benefiting low-income earners.

In Hong Kong, quality efforts are aimed at creating environmentally friendly and sustainable housing. These are facilitated through the HK-BEAM system (Hong Kong Built Environment Assessment Method.

Singapore is focusing its efforts on urban renewal and views quality as ensuring a life time asset.

Quality improvement is not only important from an economic perspective. Poor quality house construction may have adverse health implications to its occupants.

The National Home Builder's Registration Council has identified a number of generic quality defects in housing in South Africa, but these have not been quantified. There are a number of standards and specifications that guide house construction in the low-income market, relating to houses subsidised by government. These have benefits such as enabling mass production, customization, simplification, improving quality and inventory management, costing and financial programming and speed of delivery. It also has several challenges, such as complicated coding of norms and standards, duplication between several organisations, limiting differentiation, accessibility to information, and manipulation of interpretation of "deemed to satisfy" rules.

The CIDB suggests that larger contracts, phased over a period of time using a programmatic systems approach, coupled with a variety of contract strategies such as partnerships, can enhance efficiencies through economies of scale. This could also assist with skills development over the longer term and increase quality.

From the literature consulted it appears that research in relation to quality management systems in low-income housing in the local arena has been extremely limited. This study investigates the local quality management systems in low-income housing in the Pietermaritzburg area. The research methodology is explained in the next chapter.

CHAPTER 4 : RESEARCH METHODOLOGY

4.1 INTRODUCTION

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. The problem statement has been formulated in Chapter 1 (paragraph 1.2.1), as follows : *Ongoing quality concerns in lo-income housing have allegedly not been addressed adequately.*

Chapter 1 (paragraph 1.2) details the motivation for this study, and refers to recent concerns on quality in low-income housing. Limited research has been done in the local context regarding quality management in house construction, in spite of prevailing concerns sited by the NHBRC (2002a: paragraph 1) and the National Minister of Housing (Sisulu, 2005c:4) and notwithstanding the applicability of norms, standards and specifications (as outlined in Chapter 3, paragraph 3.3 hereof).

Government has allocated an average of R34 million to low-income housing delivery initiatives in the Pietermaritzburg area (Provincial Treasury, 2005:300), which is to be spent in a cost effective, transparent and equitable manner (Republic of South Africa, 1999: sections 2 and 38 and 2004a, section 2). Juran (Juran and Gryna, 1988:4.4), Gitlow (1999:14), Gryna (2001:10) and Evans and Lindsay, (2002:25) all indicate that a holistic approach to quality management can achieve this.

4.2 RESEARCH QUESTIONS

The following questions need investigation:

(1) Are there quality problems in projects in the Pietermaritzburg area?
(2) What is the nature and extent thereof and how does it measure against acceptable industry norms?
(3) What are the perceived causes of quality concerns?

(4) What systems, norms and standards are in place to ensure sustained quality management?

4.3 RESEARCH OBJECTIVES

In answering the research questions, the following objectives were set:

(1) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(3) To identify how house construction quality issues are currently being addressed.

4.4 RESEARCH DESIGN

Research was aimed at identifying quality problems in the construction of low-income houses, within the Pietermaritzburg area, funded through government's conditional grant. Ethical clearance was granted by the University *(Appendix 10).*

The research comprises of two phases. **Phase 1** deals with *Objective 1,* (see paragraph 4.3(1) above).

Phase 2 deals with *Objectives 2* and *3,* (see paragraph 4.3(2) and 4.3(3) above).
The research design for each phase is discussed separately in the sections below.

4.4.1 <u>Phase 1</u>

4.4.1.1 Population

The population is all low-income units in the Pietermaritzburg area.

4.4.1.2 Sample and limitations

This was **all** completed and inspected housing units, of which inspections were done by the same team in order to increase the reliability of data in terms of its stability (i.e. the extent to which repeated results with the same measure of the same items with the same instrument will yield the same results (Cooper and Schindler, 2001:215). Convenience sampling was used (Wegner, 2002:171). The following limitations were applied:

(1) The units were inspected during 1 April 2005 to 31 December 2005 with complete datasets;

(2) The units were from low-income housing projects that have been initiated by the municipality, aimed at addressing slums clearance;

(3) The units were all from active projects (i.e. more housing unit construction is still underway);

(4) The units were inspected by the same inspection team.

The timeframe in (1) above was selected as this is the latest financial year following the most recent announcements regarding quality concerns (Sisulu, 2005a:2, and 2005e:4-5). More consistent approaches over this shorter time frame can also be expected, thus increasing the reliability of data.

The projects from which the sample was drawn, were those initiated by the municipality, (see (2) above), as purely developer driven projects may have different quality perspectives (e.g., less stringent quality requirements and bureaucracies).

The slums clearance initiative (see (3) above), is currently a high priority area at National level (Anonymous, 2005), and has been a Provincial Priority since 2000 (Makhaye, 2000:15). Most of the projects in the Pietermaritzburg area are aimed at addressing slums (Janse van Vuuren, 2006).

Active projects were chosen as the data is more recent and it should, thus, be easier to verify details.

A total of 1838 completed units were inspected during the said timeframe (Department of Housing Inspection Records). The data collection process (see paragraph 5, below) yielded 1359 units that complied with the limitations set out above, thus the sample size is 1359 units, which represents 74% of the total number of units inspected over the time frame.

One thousand and thirty two (1032) units have been paid for over this period in six (6) projects (Cinderella Park; Matshaheni Phases 1, 2 and 3; Slangspruit; and Edendale H) in the Pietermaritzburg area. A total of one thousand three hundred and thirty two units (1332) have been built and paid for in the entire Pietermaritzburg area, over the same period of time (Janse van Vuuren, 2006).

4.4.2 <u>Phase 2</u>

The population and sample for this phase was the same for both objectives.

4.4.2.1 Population

This comprised three distinct groups in the supply chain, as follows:

(1) Officials responsible for low-income housing projects within the municipality ;
(2) Developers involved in projects as defined in the sample for Phase 1 of the research (see 4.4.1.2 above). There are four (4) developers involved in low-income housing construction in Pietermaritzburg, at the time of the study.
(3) Officials from the Department of Housing : Province of KwaZulu-Natal, involved in low-income housing projects in the Pietermaritzburg area.

4.4.2.2 Sample

Judgement sampling (Wegner, 2002:171) was applied. The subjects chosen were only those directly responsible for quality management in the context of low-income housing, thus increasing reliability (Cooper and Schindler, 2001:218), and for the following reasons:

(1) The Msunduzi municipality has a newly established Housing Unit. The following four (4) unit managers were approached:

(i) Manager responsible for low-income housing.

(ii) Official responsible for quality assurance and housing construction evaluation.

(iii) Manager responsible for the building inspectorate.

(iv) Process Manager responsible for the above activities.

The above represent all the units involved in the construction aspects of low-income housing in the municipality (Janse van Vuuren, 2006). Only 2 responses were received (50 %), being that from the manager responsible for housing delivery, the other being the manager responsible for quality assurance (Denoted in the findings as Respondent 1 and 2, respectively);

(2) Only one (1) developer was involved in the nature of units outlined in Phase 1 (see 4.4.1.2, above) (Department of Housing, 2006). The developer's project managers involved in the construction aspects of these units were approached. There were 3 project managers of which responses were received from 2 (thus 67% response rate). One respondent was a former employee of the Department and responsible for monitoring the projects in the sample for Phase 1. The other was a senior project manager, with over 12 years experience in this market. These are denoted as respondents 3 and 4, respectively; and

(3) The Department of Housing has three project management units in three regions. The Pietermaritzburg area falls within the Inland Region. There are four teams in the Inland Region, responsible for various municipalities. (Janse van Vuuren, 2006). The <u>entire technical team</u> responsible for housing delivery in the Pietermaritzburg area was approached. This comprised two inspectors and two monitors responsible for the projects in the sample outlined in Phase 1 (Respondents 6 to 8). A 100% response rate was achieved.

4.5 METHODOLOGY

4.5.1 <u>Phase 1</u>

4.5.1.1 Datatype

Data collection was aimed at identifying the number and type of defaulted units using discrete ratio scaled data. Discrete data can only have whole number values (Wegner, 2002:11). Ratio scaled data is quantitative and can be used to perform the widest range of statistical analysis (Wegner, 2002:10). Whereas the defaults will be categorised in the data collection process, the data will become ordinal scaled, thus reducing the range of statistical methods that can be applied (Wegner, 2002:8 and 10). Ordinal scaled data is normally associated with qualitative data (Wegner, 2002:10).

4.5.1.2 Data collection and tools

Internal records from the Department of Housing, for which approval had been obtained from the Head of Department, were used. The Department keeps inspection records as it is required to verify work prior to the release of payment to developers. (Department of Housing, 2000:212). These comprised manual snag sheets, triplicate book copies and electronic data on sites passed. The snag sheets contained information regarding defects to be addressed. The triplicate book copies contained information on units passed. The electronic database contained information on units inspected and passed (Shabalala, 2006). The advantage of internal records is that it reduces any bias. The disadvantage of this type of data collection is the inability to probe into findings (Wegner, 2002:12).

Units were selected based on the sample criteria and limitations outlined in 4.4.1.2 above.

A spread sheet (see *Appendix* ***11)*** was designed through a simplified process analysis, in consultation with technical supervisors and inspectors from the Department of Housing. Process analysis outlines systems and helps to identify process and quality problems (Beckford, 1998:227). This was achieved by listing issues typically inspected where problems have been found historically, and guided by defects found by the NHBRC (see Chapter 3, paragraph 3.3.1, hereof)- These were grouped into 3 broad categories, based on the construction inspection stages (i.e. foundation and slab, wall plate (before roof is constructed) and completion, as summarised in Table 4.1, below (also appended as *Appendix 12* for ease of reference).

Table:4.1 Summary of default categories and descriptions

MAIN CATEGORY	SUBCATEGORY	INSPECTION STAGE/ DEFECTIVE UNIT	COMMENTS
A : MAJOR STRUCTURAL ISSUES These will cause the stage to be failed by the inspector	(1) Workmanship (Construction)	Foundation and Slab	Includes leveling, waterproofing, major cracks, pad and lintels, etc.
		Wall Plate	Includes: block work; mortar mix; lintels; plumpness of building, windows and door; brick force, brick courses (building height), etc.
		Completion	Structural design, pitch, ties, beam spacing, and fixture (screw spacing, etc), overhang and overlap, etc)
	(2) Materials (quality)	Foundation and Slab	Lintels, concrete, blocks and DPC (Plastic membrane for waterproofing)
		Wall Plate	Blocks, mortar mix, lintels (windows, doors and partitions, where applicable).
		Completion	Sheeting type, thickness and rust free, beams and purlins to specification and SABS/SANS compliant
B: INCOMPLETE WORK These will cause the inspector to fail the unit as it is not habitable, or cannot be accessed for inspection.	(1) Inadequate services	Water, Sanitation, Access	These should be completed before the house is occupied, but needs to be available to ensure that the plumbing and water supply is in working order, and that the property is accessible.
	(2) Other	Incomplete/ not ready	Includes outstanding pre-certification by engineer/building professional.
		Access/Keys	Where keys are not available, or the unit could not be accessed for final inspections,
C: FINISHING	(1) Clearance		Used in records to describe both site preparation, and clearing materials after construction.
	(2) Plumbing		
	(a) Workmanship	Toilet	Entire system, including pipes and rodding eyes
		Outlet and gulley	Fitting, leaks, gradient of fall, and positioning over the gulley and condition of gulley
		Pipes	For water, and including taps
		Basin	Fitting
		Shower	System and all fittings
	(b) Materials (quality)	Tap	
		Gully	
		Water tank	
	(3) Other finishes		
	(a) Workmanship	Block work	
		Fillings	
		Plaster	(and/or bag washing, where applicable)
		Fitting windows, glass and door frames	
		Glazing	
		Screed	(Topping of slab)
	(b) Materials (quality)	Window and/or door frames	
		Plaster/Cement/Bag wash material	
		Door	
		Glazing	

Subcategories were developed to assess the extent of the quality concerns, (i.e. whether a sizable portion of the sample has quality problems), and the nature thereof. Photographs of such examples are attached as *Appendix 13.*

The nature of the quality concerns were assessed against the extent to which it related to major structural issues and/or incomplete work that would cause the unit to fail the inspection; or finishing. Finishing type causes would typically not result in the unit being failed outright, depending on the seriousness and number of issues reported (Shabalala, 2006).

Provision was also made to categorise defects to indicate whether they related to workmanship or materials. These were used to identify the cause of quality concerns in terms of either poor workmanship, or due to quality of materials received from suppliers.

The spreadsheet also reflected:

(1) The number of completed units inspected in three stages, being foundation and slab; wall plate (to roof height excluding the roof); and completion (Department of Housing, 2000:211). Photographic examples of the different stages in construction are attached as *Appendix 14.*
(2) The date of each inspection was recorded in the format month, day, year.
(3) The number of units inspected without any quality concerns (i.e. "defect free").
(4) The type of default or comment made by the inspector, categorised in terms of its severity, as indicated in Table 4.1 above.
(5) The number of defaults in each type of category of the sample (per project) and percentage thereof.
(6) Timeframes between the three relevant stages of inspection (foundation, wall plate and completion).
(7) The mean, mode, median of each default type, and of data relating to timeframes, as well as the minimum and maximum number of occurrences in respect of each.

4.5.1.3 Data processing

Data was captured onto an electronic spreadsheet. 1838 Units were captured in total. The data was then sorted against site numbers to eliminate duplications and was then refined. This yielded 1359 units, as summarised in **Table 4.2,** below:

Table 4.2 : Summary of units, per project

Project	Number of units from inspection records	Duplicated sites	Revised sample size	Foundation/slab dates omitted	Second revised sample size	Inspection out of sequence (Slab and Completion)	Third revised sample size	Wall plate dates omitted	Revised Total number of units
Cinderella Park	346	**0**	346	**0**	346	**0**	346	**0**	346
Edendale Unit H	809	55	754	43	711	**57**	654	**0**	654
Matshaheni (Phases 1, 2 and 3)	548	13	535	223	312	33	279	32	247
Slangspruit	135	**0**	135	**4**	131	**3**	128	16	112
Total	**1838**	**68**	**1770**	**270**	**1500**	**93**	**1407**	**48**	**1359**

In addition to this, the time frames were compared to the *"Housing Project Programming Guide"* (Department of Housing, 1997:42-49).

4.5.1.4 Analysis tools

(a) Check sheets

The spreadsheet used for data collection is a type of check sheet. Check sheets provide a simple method for collecting data on the occurrence of defects or values, in a wide range of areas (Kanji and Asher, 1996:164). It is used to collect numerical values of nonconforming aspects for Pareto analysis and/or histograms (Gitlow, et al., 1999:685). The frequency of each default type was calculated as a portion of the sample to identify the most common default types, and presented in graphic and tabular format.

(b) Pareto analysis

A Pareto analysis was used to identify the most critical problems to be addressed for maximum impact (Kanji and Asher, 1996:56). The resultant charts provide a graphic representation of factors in descending order of the frequency of occurrences (Develin and

Hand, 1995:137), to identify the starting point for problem solving, monitor progress and identifying basic causes (Gitlow, et al, 1999:686). It is also known as the 80/20 principle in which 80% of problems are caused by 20% of the observations and these are the critical areas to be addressed for maximum impact (Kanji and Asher, 1996:58). It is a useful technique to present facts and reach consensus on the prioritization of issues to be resolved. The Pareto analysis was used to identify the most critical quality concerns in the sample.

(c) Descriptive statistics

Descriptive statistics were used to summarize data relating to defects in low-income housing, represented by the sample and to confirm the validity of the research. Descriptive statistics is an appropriate tool to summarize data and extract essential information through summary measures (Wegner, 2002:5). These include measures of central location and dispersion (Wegner, 2002:6).

(1) Measures of central location quantify where the majority of data is concentrated around a central value (Wegner, 2002:54). It includes the mode, median and mean.

The "mode" is the most frequently occurring value in a set of data (Wegner, 2002:58).

The "median" represents the value of the point at which an ordered dataset is divided in two equal parts (Wegner, 2002:61).

The "mean" is the average number of occurrences of a characteristic (Wegner, 2002:55). Field and Hole (2003:126) view it as the best model of a data set, as it takes into account all values in a set of data.

(2) Measures of dispersion quantify the spread of observations around the central value and guide the reliability thereof - the lower the concentration of data, the wider the dispersion thereof, and the lower the reliability of the central value (Wegner, 2002:84). It is also a means of confirming validity in terms of content. Content validity measures the extent to which a sample represents the population (Cooper and Schindler 2001:211). Measures of dispersion indicate the extent to which a mean represents data (Wegner,

2004:84), and from this perspective provide a means to judge content validity. Dispersion measures include the range, variance, standard deviation and skewness.

The "range" is the difference between the highest and lowest value.

The "sample variance" is most commonly used as a power statistic to measure dispersion (Wegner, 2002:87), indicating variability in the data and accuracy of the mean. Lower variability indicates that the mean is a reliable measure to represent data (Field and Hole, 2003:128).

The "standard deviation" describes the average spread of observations around the mean (Wegner, 2002:92) and indicates how well the mean represents the sample (Field and Hole, 2003:131). A low figure indicates a low rate of deviation, thus data is dispersed closer to the mean, which indicates that the mean represents the data well (Field and Hole, 2003:131). Where data distribution is almost symmetrical, 68% of data will fall into 1 standard deviation from the mean, while 95,5 % of the data will fall within 2 standard deviations (Wegner, 2002:92).

"Skewness" is the degree of departure from symmetry (Wegner, 2002:94). If positive, data dispersion is skewed to the right, indicating that there are few relatively large values in the dataset (Wegner, 2002:94). The more extreme the skewness, the less effective the mean becomes in representing the data (Wegner, 2002:69).

(d) Frequency distribution and histogram

An analysis of timeframes and completion inspections was done to compare whether time frames are in accordance with the model developed by the Department of Housing's "Housing Project Programming Guide". The aim of this was to investigate delivery rates as it could be an indicator of service delivery quality as customers require a reduced cycle time, as part of quality improvement (Gryna, 2001:625). The Department used a medium risk approach in modeling development timeframes in its guide (Department of Housing, 1997:9) and assumes a timeframe of 129 days from the start of construction to the final inspection (Department of Housing, 1997:49). The histogram was used as a graphic means of the frequency distribution (Wegner, 2002:37), specifically to illustrate the distribution of completion inspections over 30 day intervals. A histogram is effective in elementary data analysis (Beckford, 1998:251, and Gryna, 2001:244), as was used in this study. The 30 day interval was used to simulate a monthly cycle.

4.5.1.5 Hypothesis testing versus Poisson probability

Hypothesis testing is normally used to indicate whether a generalisation based on findings in a sample is a true reflection of the entire population (Wegner, 2002:214), thus it is a means to confirm the reliability and validity of data.

Field and Hole (2003:259) suggest that the Chi squared test would be applicable where frequencies are used in the sample (as is the case in this study). However, the results of such a test are only valid when the subject contributes to *one* category only (Field and Hole, 2003:262). The nature of this study provides for the possibility of more than one defect type per unit, thus the Chi squared test would not be suitable.

Hypothesis testing for a single population mean would also not be sufficient if the sample mean, sample size and/or the population standard deviation is unknown, as these elements are required to use the "z" statistic hypothesis test (Wegner, 2002:222).

Due to the nature of this study, and whereas the research was dependent largely on qualitative information, detailed hypothesis testing was not done. Cooper and Schindler, (2001:138) explain that it is difficult to accept or reject a hypothesis based on this type of data (Cooper and Schindler, 2001:138).

In view of the above, **Poisson probability analysis** was done through the application of Excell software descriptive statistics to test the probability of finding defects in low-income housing projects in Pietermaritzburg, thus as a means to confirm reliability. The Poisson analysis can be used where data is discrete and relates to random variables in a predetermined time, space, volume or interval (Wegner, 2002:141). Data in this study was discrete and was taken from a sample over a predetermined time.

4.5.2 Phase 2

4.5.2.1 Data type

Qualitative, interval scaled data was collected as it was aimed at identifying the causes of house construction quality problems in low-income housing within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal; and how house construction quality issues are currently being addressed, by the entities responsible for these projects.

4.5.2.2 Data collection and tool

Data collection was done through a *closed question, self-administered questionnaire* that offered respondents choices from a predetermined selection, based on issues identified in the literature review *(Appendix 15),* to obtain qualitative data. It was administered to pre-identified respondents who were directly responsible for quality management in the context of low-income housing, thus a judgement sampling technique was used (Wegner, 2002:171). This served as a survey mechanism and was hand delivered to the pre-identified respondents. A three week timeframe was given for the return of information, with an individually agreed collection arrangement.

This collection tool reduces the disadvantage of low response rates and provides control by ensuring knowledgeable responses are received (Wegner, 2002:16). It also provided an opportunity to explain the purpose and requirements of the investigation and agree on the method of collection. Its main advantages are that results are collected fairly quickly, and questions are generally better understood (De Vos, 2002:180). It also provides a structured means for data collection (Wegner, 2002:15). Interviewer bias is limited. Respondents have time to consider the responses and whereas anonymity is ensured, more honest responses and willingness to provide personal information is increased (Wegner, 2002:16). However, some information may be missed as the responses are limited to the options provided (De Vos, 2002:180).

A *Likert scale* was used to record and analyse responses. Field and Hole (2003:45) explain that this tool is used to record the extent of agreement to responses (Field and

Hole, 2003:45). The data is interval scaled. Such data provides a means to quantify the qualitative random variables as ratings are provided on a continuum with extreme positions (Wegner, 2002:10). The Likert scale in this study reflects a continuum of agreement. Disagree reflects a negative perception of the statement, agree reflects a positive perception. In this study, 0 presents a strong negative perception; 4 reflects a strong positive perception; 2 indicates that the respondent disagrees generally, but agrees slightly; 1 indicates that the respondent disagrees with the statement, more than is the case with a score of 2; and 3 indicates that the respondent agrees more with the statement than he/she disagrees. "Not sure" presents a neutral position and no score is allocated.

The questionnaire comprised three sections:

Section 1 : The objective of this section was to establish possible causes of quality concerns in respect of low-income housing in the Pietermaritzburg area, from the perspectives of the Department of Housing officials, developers, and the municipality, respectively. Questions were grouped as follows:

Question 1 : Perception on existence of quality concerns.
Questions 2 and 3 : Nature of defects.

Questions 4 to 9: Confirmation of possible causes, as identified in the spreadsheet used for Phase 1, *Appendix 11* ***and*** *12.* These were grouped as follows:

Question 4 : Confirmation of possible causes : Resources
Question 5 to 7 : Confirmation of possible causes : Materials quality
Question 8 : Confirmation of possible causes : Workmanship
Question 9 : Possible causes of poor workmanship

Question 10 : Perception of acceptability of defects rates.
Questions 11 and 12 : Perceptions of impact of quality management.
Questions 13 and 14 : Use of warranties.
Questions 15 to 22 : Perception on delivery rates and measurement.
Question 23 : Provision for respondent to list other possible causes.

Section 2 : The objective of this section was to establish which systems are in place in each organization and to review the efficiency of these. Questions were based on total quality management theory, grouped as follows:

Question 1 : Presence of a quality management system and its focus in terms of customer orientation.

This question was designed to confirm the existence of a quality management system within each institution, and to confirm whether all internal and external role players are involved. Theoretically, both internal and external views on quality are important (Gryna, 2001:15) as customer satisfaction, from both perspectives is central to quality improvement (Kanji and Asher, 1996:1).

Question 2 : Correlation of quality management system with ISO 9000.

This question was designed to confirm whether regular company wide assessments were done, and whether ISO 9000 principles were applied. Gryna (2001:45) indicates that all organizations should undertake such assessments.

Question 3 : Application of different approaches for chronic and sporadic problems.

The question was designed to investigate whether the institution treats chronic problems and sporadic ones differently, and whether a diagnostic approach is followed. Chronic cases need more time and resources, thus, are the type that needs concerted effort in relation to major quality issues (Gryna, 2001:49). Improvement processes should address chronic issues (Gryna, 2001:96). A diagnostic approach is an important aspect to achieving quality leadership as it allows for decisions to be made on facts (Gryna, 2001:105).

Question 4 : Continuous improvement through benchmarking and tapering quality systems to a spectrum of customer needs.

The question was designed to identify whether the institution applies benchmarking, and customizes quality management approaches. Benchmarking facilitates continuous improvement (Gryna, 2001:105). In order to sustain quality, the different quality needs and values need to be determined to facilitate proper product or service planning (Gryna, 2001:118). This also needs to be reflected in the quality policy, which serves as a broad guideline for action (Gryna, 2001:185).

Question 5 : Quality control and responsibility.

This question looked at quality control and perceptions of responsibility, understanding of all role players of quality control requirements and processes, and the extent to which inspections take place. A quality score card is central to quality control processes as it is a performance management vehicle that also informs strategic initiatives (Gryna, 2001:123). It is important for all role players to understand the system so as to know what to expect, and to guide acceptable tolerances (Gryna, 2001:544). The extent of inspections may vary, and should be flexible in relation to product features and processes (Gryna, 2001: 563). No inspection may be done where prior testing occurred; small samples including the first and last few units are typically used where product and processes are inherently the same; large samples may be needed for new processes, products, or product elements and 100% inspections may be needed where defect rates are high, or specialized products (Gryna, 2001:564).

Question 6 : Strategic quality management.

The question was designed to get insight into some aspects of strategic quality management issues, including the existence of typical obstacles, such as lack of leadership, infrastructure, skeptics, exhortation, attempting too much too soon and lack of use of statistical tools (Gryna, 2001:184).

Question 7 : Quality culture.

This question was designed to explore the organisational culture and the extent to which it is conducive to total quality management implementation. An enabling culture practices situational leadership, participative management, and management by fact. It also measures team and individual performance regularly and provides constructive feedback on progress. Staff are also encouraged to share ideas, feelings and needs in an open and trusting manner (Gryna, 2001:218).

Question 8 : Inclusion of customer needs.

The question explores the extent of customer orientation within the institution. Total quality management is customer focused, thus market research is critical (Gryna, 2001:329).

Question 9 : Supply chain management and quality control.

The question seeks to identify the extent to which supplier performance is measured as it affects quality (Gryna, 2001, 425, and Burt, et al, 2003:332), and to which suppliers are certified. Certified suppliers can be expected to deliver consistent quality standards (Burt, et al, 2003:149 and Gryna, 2001:428). The question also looks at other quality control methods and the extent to which self control (also self regulation, Beckford: 1998:296) is used. Gryna (2001:442) views self control as the ultimate form of quality control, and as a means to differentiate between worker controllable aspects and those that need management intervention. Self control requires role players to understand how and what to do and how this is measured (Gryna, 2001:442). These aspects have been incorporated in the question.

Question 10: Statistical control system.

The question seeks to identify whether institutions use statistical control measures. These provide management with a basis for making decisions based on facts (this process is also called "management by fact") and this is an enabling factor for total quality management (Gryna, 2001:495).

Questions 11 : Quality management in administration and support activities.

This question aims to identify the extent to which support functions (administration, finance and information technology) are measured in terms of quality, using typical measures in literature (as illustrated by Gryna, 2001:639). These activities could benefit by applying quality management principles (Gryna, 2001:639).

Question 12 : Quality management information systems.

A quality management information system is a formalised method of collection, storing, analyzing and reporting information, thus is a key element in quality improvement initiatives at all levels (Gryna, 2001:656).

Question 13 : Presence of a quality systems audit and assurance programme.

Quality assurance is a means to provide confidence that a predetermined quality standard will be achieved, thus providing a measure of performance expectation. Quality audits are independent performance reviews of elements that impact on quality (Gryna, 2001:681).

Section 3 : Provision was made here to list any additional concerns, comments and/or suggestions regarding quality management in the context of Government subsidised low-income housing, thus providing some additional information that may otherwise have been missed in the closed question questionnaire.

4.5.2.3 Data processing

Questionnaires were delivered and/or collected by hand and captured on an Excell software spreadsheet to facilitate the counting of scores allocated by respondents.

Data for Section 1 was dealt with as a collective response from all respondents, as the purpose of this section was to identify perceived causes of quality defects. Scores of 3 and 4 ("Agree" and "Strongly Agree"), were recorded as "Agree". Scores of 0, 1 and 2 ("Strongly Disagree", "Disagree", and "Slightly Agree") were recorded as "Disagree". "Slightly Agree" was recorded as "Disagree" as this category provided for responses where the respondent did not completely disagree, or had felt a slight sense of agreement, but disagreed with the statement in general terms. "Not sure" was recorded as such. These findings are presented in tabular format in Chapter 5, and in accordance with the groupings of question statements as described in 4.5.2.2, above.

Data for Section 2 was summarised in accordance with the extent of agreement between respondents per institution (municipality, developer and Department of Housing). Scores were recorded on the same basis as was used for Section 1. The findings are described in Chapter 5.

Section 3 recorded any additional information provided by respondents.

4.5.2.4 Data analysis

Responses were analysed against quality management literature reviewed, and the findings presented in Chapter 5.

Data analysis for Sectionl of the questionnaire entailed quantifying the extent to which respondents agreed, disagreed, or were not sure, in responding to the statement, as a percentage of the number of responses received.

Data analysis for Section 2 was dealt with descriptively as a summary of responses received, per institution, and based on those responses where responses correlated, and against quality management theory.

Data analysis for Section 3 entailed mainly presenting comments from respondents and evaluating these against quality management theory.

4.5.2.5 Hypothesis Testing

Hypothesis testing was not done, due to the qualitative nature of the research, as explained in paragraph 4.5.1.5, above.

4.6 SUMMARY

This chapter described the research questions, objectives, population and sample. The research was approached in two phases. Phase one was designed to identify whether quality concerns existed in the low-income housing projects in the Pietermaritzburg area; and to identify the nature and the extent thereof.

Phase 2 was designed to explore the perceived causes of quality concerns, and to identify the systems used by the municipality, its developing agent and the Department of Housing, to ensure sustained quality management.

The chapter set out the data type, collection methods and total quality management tools applied in the process. It was noted that the Poisson Probability analysis was used as a means to indicate the probability of defects occurring in the entire population of low-income housing in Pietermaritzburg.

The findings are presented in Chapter 5.

CHAPTER 5 : FINDINGS

5.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area.

In answering the research questions (see Chapter 4, paragraph 4.2), the following objectives were set:

(a) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(b) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(c) To identify how house construction quality issues are currently being addressed.

Research was aimed at quality problems in the construction of low-income houses, within the Pietermaritzburg area, funded through government's conditional grant. It comprised of two phases. **Phase 1** dealt with *Objective /*, (see paragraph (a) above).

Phase 2 dealt with *Objectives 2* and *3,* (see paragraphs (b) and (c) above).

Details of the research design are outlined in Chapter 4. This Chapter will focus on the findings. Each phase will be presented separately.

5.2 PHASE **1** : FINDINGS

5.2.1 **Data refinement**

Table 5.1: Data refinements

Project	Number of units from inspection records	Duplicated sites	Revised sample size	Foundation/slab dates omitted	Second revised sample size	Inspection out of sequence (Slab and Completion)	Third revised sample size	Wall plate dates omitted	Revised Total number of units
Total	**1838**	**68**	**1770**	**270**	**1500**	**93**	**1407**	**48**	**1359**
Units paid	**1332**								

Results: Data of 479 units were deleted (26%), resulting in the sample of 1359 units, due to duplicated site numbers, omission of inspection dates, and inspection recorded out of sequence. The developer has been paid for 1332 units of 1359 inspected.

5.2.2 **Defects analysis**

A number of defects were found. The findings are presented in section 5.2.2.1 and 5.2.2.2. The defects analysis findings of major defect types that caused units to fail the inspections are presented in section 5.2.2.2(a). Defect types relating to incomplete work is presented in section 5.2.2.2(b), and defects relating to finishing are addressed in section 5.2.2.2(c). Industry statistics on defects in this sector were not obtainable. This was mainly as a result of none of the projects in the Pietermaritzburg area having been enrolled with the National Home Builders Registration Council (Janse van Vuuren, 2006). The only published guide obtainable was the Departments Housing Project Programming Guide, which was used to inform the timeframe analysis in section 5.2.3 hereof.

5.2.2.1 Defects in Sample

Table 5.2 : Number of defects in sample

DEFECTS ANALYSIS	No. Defects	% of Sample
Total number of sites	1359	100.00
Totally Defect free	799	58.79
Number of Units with defects	560	41.21
Total number defects **in** sample	742	54.6
Total Re-inspections	79	5.81

Results : 58,79 % of the units inspected were defect free throughout each stage of the inspection. 41,21% of units had defects. 5,81% of the inspections in the sample related to rework.

5.2.2.2 Frequency of defects in sample

(Refer to *Appendix **11*** for a description of the defects)

Table 5.3 : Frequency of defects per category

	POTENTIAL FAILURE				Clearance	***FINISHING***			
	MAJOR STRUCTURAL		**OTHER**			**PLUMBING**		**OTHER FINISHES**	
	Construction	Material	Access/ Not Ready	Inadequate Services		Workman-ship	Material	Workman-ship	Material
Total per defect Sub- category	75.00	22.00	33.00	90.00	65.00	93.00	5.00	269.00	90.00
%No. Defects	10.11	2.96	4.45	12.13	8.76	12.53	0.67	36.25	12.13
% of Sample	5.52	1.62	2.43	6.62	4.78	6.84	0.37	19.79	6.62
	Major Structural		**Other**			**Plumbing**		**Other Finishes**	
Total per main category	97.00		33.00	90.00	65.00	98.00		359.00	
% No. Defects	13.07		4.45	12.13	8.76	13.21		48.38	
% of Sample	7.14		2.43	6.62	4.78	7.21		26.42	
	Potential Failure of Unit					**Finishing**			
Total per level of severity	220.0				65.00	457.00			
%No. defects	29 65				8.76	61.59			
% of Sample	16.19				4.78	33.63			

Results:

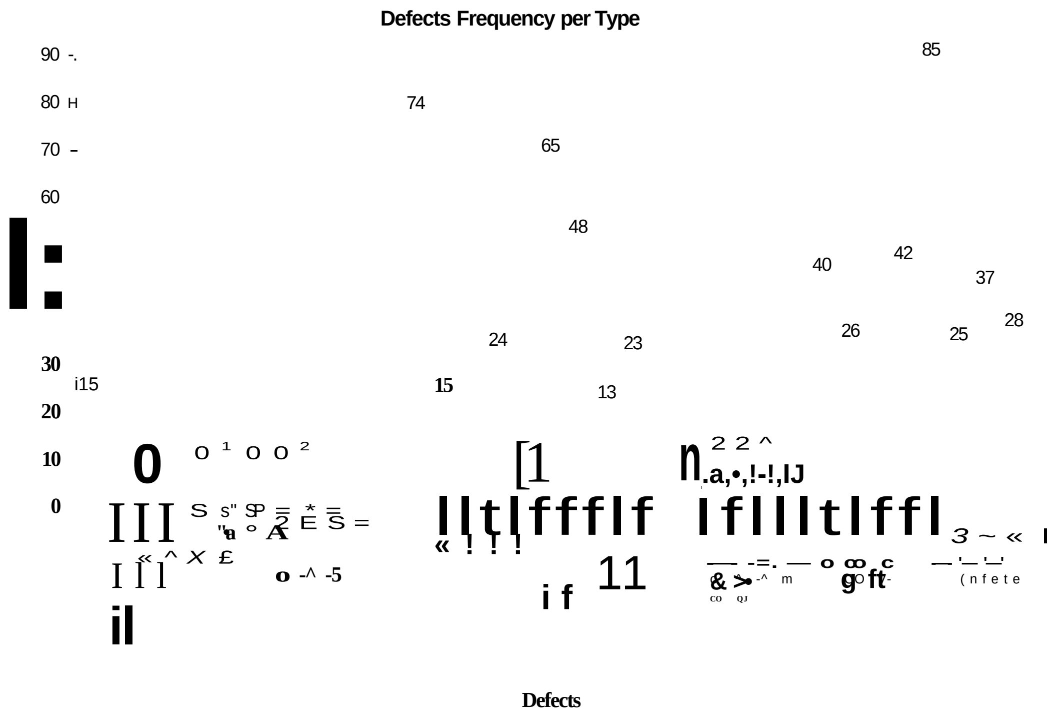
(1) 61,59% of all defects related to "finishing", and this is found in one third of the sample. 13,21% of the defects related to plumbing matters, whilst 48,38% related to other finishes. Workmanship matters contributed more to defects found in all

finishing related activities (48,78% of all defects), than is the case in materials (12.8% of all defects).

(2) 29,65% of all defects resulted in units being failed at inspection, and this was found in 16,19% of the sample. 13,07% of all defects related to major structural issues, whilst 16,58% related to matters other than structural. Defective materials used in the main construction activities contributed to 2,96% of all defects.

(3) Materials contributed the least to all defects (15,76% of all defects). Workmanship contributed the most to all defects (58,89%).

<u>Figure 5.1 : Frequency of defects in sample</u>



Results: Most defects were due to poor screeding (85 occurrences), followed by inadequate water supply (74 occurrences), and then by site clearance (65 occurrences). Construction of wall plates was the highest occurring error in the main construction process and caused 51 units to fail the inspection.

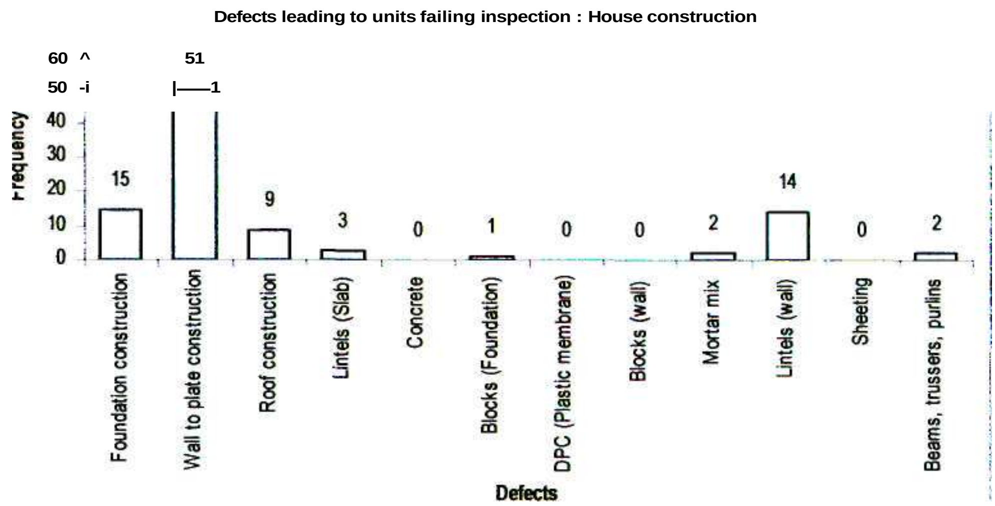
No defects were found in materials relating to concrete in the foundation; plastic waterproofing material of the foundation; blocks for the wall; roof sheeting; and basin.

(a) Defects leading to units failing inspections

Table 5.4 : Defects leading to units failing inspections

	MAJOR STRUCTURAL												OTHER		INADEQUATE SERVICES		
	Construction			Materials													
				Foundation				Wall			Roof						
	ounds S Sla	all to ate s	'5 a.	ntels	oncr & W	ocks co	on f l	ocks m	ortar m x 2	ntels windo door, partitions	heeting (thic ess to rust free en	earns ns	Incomp te/nc ead	eys <	/ater s	anita	ccess <
Total (per defect type)	15	51	9	3	0	1	0	0	2	14	0	2	24	9	74	15	1
% No. Defects	2.02	6.87	1.21	0.40	0	0.13	0	0	0.27	1.89	0	0.27	3.23	1.21	9.97	2.02	0.13
% of Sample	1.10	3.75	0.66	0.22	0	0.07	0	0	0.15	1.03	0	0.15	1.77	0.66	5.45	1.10	0.07
	Construction			Materials									Other		Inadequate Services		
Total per defect sub category	75			22									33		90		
% No. Defects	10.11			2.96									4.45		12.13		
% of Sample	5.52			1.62									2.43		6.62		
	Main Structural Activities												Other		Inadequate Services		
Total per main category	97												33		90		
% No. defects	13.07												4.45		12.13		
% of Sample	7.14												2.43		6.62		
Overall position with regard to defect leading to units fttiling ins pections																	
Total per level of severity															220		
% No. of defects															29.65		
% of Sample															16.19		

Figure 5.2 : Defects leading to units failing inspections (excluding incomplete work)



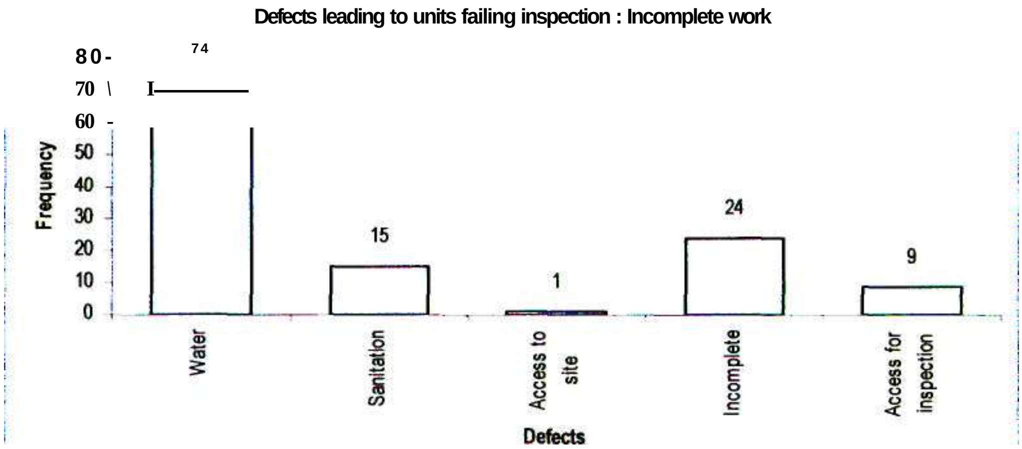
Results: Construction issues are the second highest cause of units failing inspection (as a sub-category with 75 cases (6%). Wall plate construction problems contribute to most construction failures, (51 cases in the sample, representing 4%) and is the second highest contributing factor with regard to units being failed through inspection. Materials quality contributed the least to quality concerns (22 cases, representing 2%, mainly due to faulty lintels used for windows, doors or internal partitions).

(b) Defects relating to incomplete work

Table 5.5: Units failed due to incomplete work

	OTHER		INADEQUATE SERVICES		
	Incomplete/ not ready	Access/Keys	Water	Sanitation	Access
Total (per defect type)	24	9	74	15	1
% Number Defects	3.23	1.21	9.97	2.02	0.13
% of Sample	1.77	0.66	5.45	1.10	0.07
	Other		Inadequate Services		
Total per defect sub category	33		90		
% Number Defects	4.45		12.13		
% of Sample	2.43		6.62		

Figure 5.3 : Units failed due to incomplete work



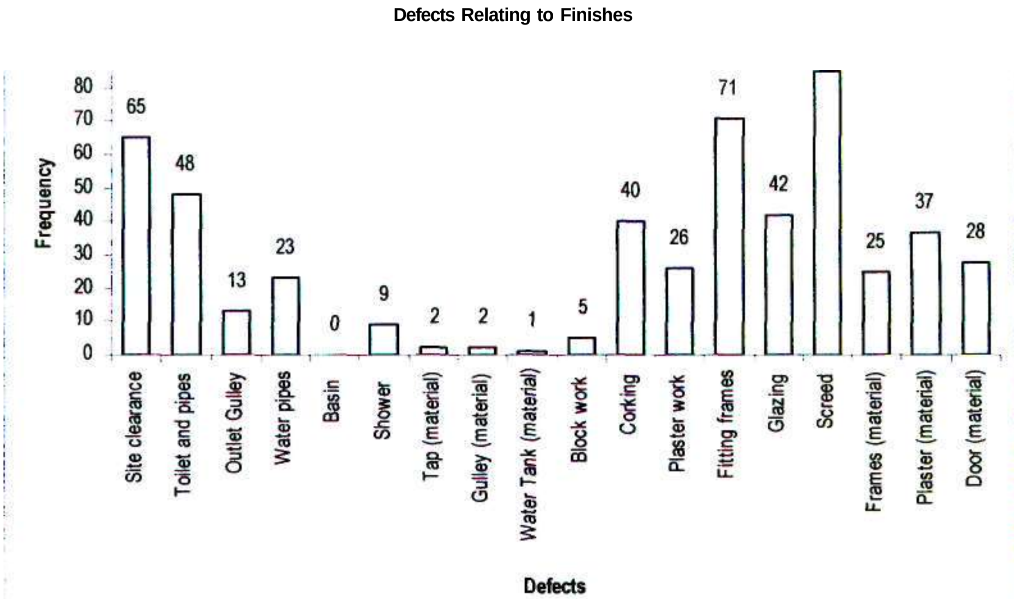
Results: Inadequate services caused most failures (90 occurrences =12,13% of all defects in the sample). Inadequate water supply was the highest cause in this subcategory, contributing 9,97% to all defects, and 5,45% of the entire sample.

(c) Defects relating to finishing

Table 5.6: Defects relating to finishing

	PLUMBING								OTHER FINISHES								
	Workmanship					Material			Workmanship						Material		
Find ngs(Of o !fc o one o mal)	Toilet pipes	Outlet and G f	Water pipes 1	Basin	Showe	JL	Gully	1 1	m o o s b	Cork/F ill/Gro	Plaste	Fitting window-, o mes	CD d M	Screec	Windowand/ord o E	Plaster/Cemcrete m 3	Door
Total (per defect type)	48	13	23	0	9	2	2	**1**	5	**40**	**26**	**71**	**42**	**85**	25	37	28
% No. Defects	6.5	1.8	3.1	0	1.2	0.3	0.3	**0.1**	0.7	**5.4**	**3.5**	**9.6**	**5.7**	**11.5**	3.4	45.0	3.4
% of Sample	3.4	1.0	1.7	0	0.7	0.2	0.2	**0.1**	0.3	**2.9**	**1.9**	**5.2**	**3.1**	**6.3**	1.8	2.7	2.0
Total per defect sub category	93					5			269						90		
% No. Defects	12.5					0.7			36.3						12.1		
% of Sample	6.8					0.4			19.8						6.6		
Total per main category	98.0								359								
% No. defects	13.21								48.4								
% of Sample	7.2								26.4								
Total per level of severity	457.0																
% No. of defects	61.6																
% of Sample	33.6																

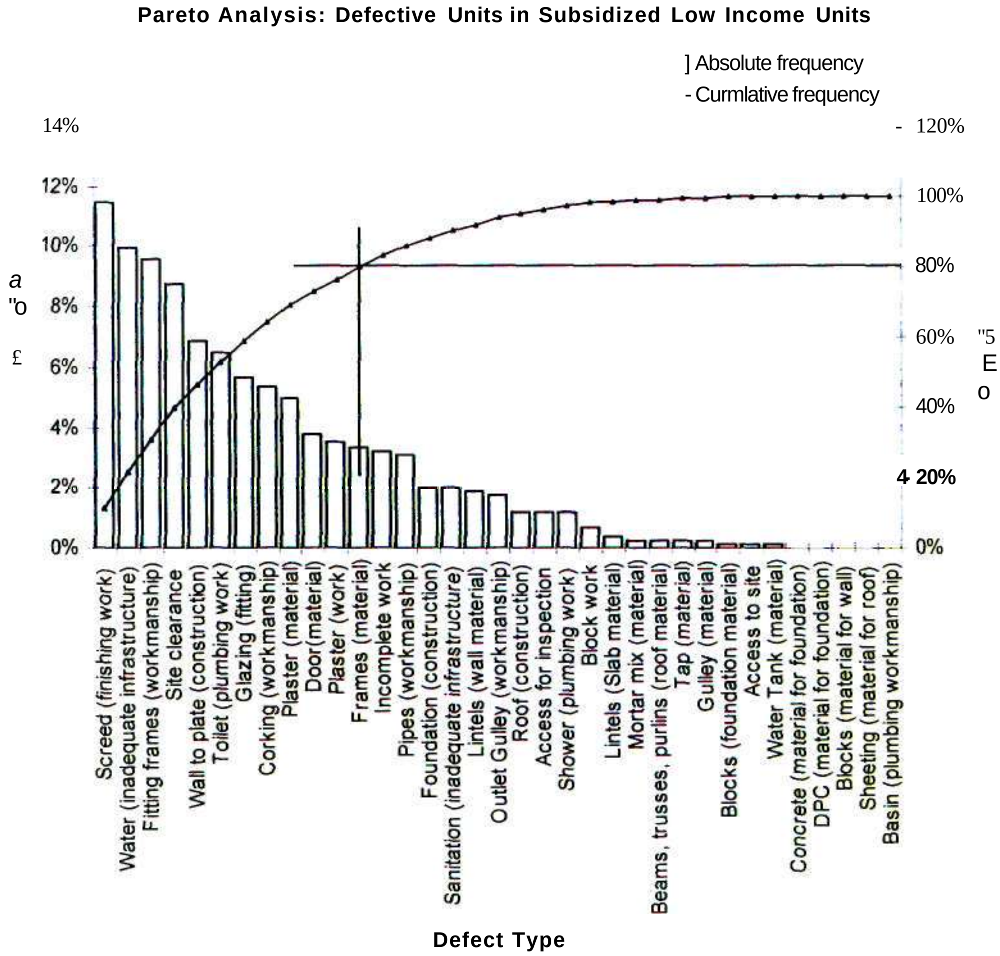
Figure 5.4: Defects relating to finishing



Results: Workmanship had the most significant impact on finishing type defects (48.78% of all defects, representing 26,63% of the sample as a whole). Screeding had the highest defect count (85 cases representing 6% found in sample, and 11% of all defects found in the sample), followed closely by fitting windows, glass and door frames (71 cases). Materials have the lowest defects count (less than 5% each, and 7% overall).

5.2.2.3 Pareto analysis

Figure 5.5: Pareto analysis of defective units in subsidised low-income units



Results : 12 of 35 defect types contribute to 80% of the defects in the total sample, and need to be addressed to have a significant impact of quality improvement. These are presented in Table 5.7.

Table 5.7 : Pareto analysis of critical defects to be addressed

Main Category	Sub-category	Cause	Activity	Number of Occurrences	Cumulative %	Priority
Finishes	Other finishes	Workmanship	Screed (Finishing work)	**85**	11.46%	1
Incomplete work	Inadequate services		Water (inadequate infrastructure)	74	21.43%	2
Finishes	Other finishes	Workmanship	Fitting frames (workmanship)	71	31.00%	3
Finishes	Clearance	-	Site clearance	**65**	39.76%	4
Major structural	Construction	-	Wall to plate (construction)	**51**	46.63%	5
Finishes	Plumbing	Workmanship	Toilet (plumbing work)	**48**	53.10%	6
Finishes	Other finishes	Material	Glazing (fitting)	**42**	58.76%	7
Finishes	Other finishes	Workmanship	Corking (workmanship)	40	64.15%	8
Finishes	Other finishes	Material	Plaster (material)	37	69.14%	9
Finishes	Other finishes	Material	Door(material)	**28**	72.91%	10
Finishes	Other finishes	Workmanship	Plaster (work)	26	76.42%	11
Finishes	Other finishes	Material	Frames (material)	**25**	79.78%	12

5.2.2.4 Descriptive statistics

(a) Defects per unit

Table 5.8: Descriptive statistics : Defects per unit

Descriptive statistics	Defects per unit
Number of defects	742
Mean	0.546
Standard Error	0.025
Median	0
Mode	0
Standard Deviation	0.925
Sample Variance	0.856
Skewness	1.794
Range	5
Minimum	0
Maximum	5
Sum	742
Count	1359
Largest(1)	5
Smallest(1)	0
Confidence Level (95.0%)	0.049

Results: The *mode* indicates that most units are defect free. The largest number of defects per unit was 5, the lowest number of defects was 0. The *mean* indicates an average of 0.546 defects per unit. In reality, the presence of a defect is absolute, thus, this may be viewed as an average of 1 defect per unit. The *standard error* of 0.03 is low, thus the mean is a good representation of the population. The *standard deviation* 0.93 is low, indicating that there is not a significant distribution of scores away from the mean, thus the mean is a good representation of the data (Field and Hole, 2003:131). The *sample variance* of 0.86 is also low, thus indicating that the mean is a good representation of the data. *Skewness* : The data is positively skewed to the right, indicating that there are relatively few large values in the data set (i.e. not many unit have close to 5 defects per unit), indicating that the frequent scores are at the lower end of the distribution. The confidence level (at 95%) indicates that hypothesis testing would result in accepting any hypothesis (Ho) seeking to prove that the population mean is equal to the sample mean at a 95% significance level, as the z-calc statistic used for this purpose indicates that the resultant value lies between -1,96 and +1,96 (Wegner, 2002:219). Hypothesis testing may result in accepting the hypothesis which may not be true. The population standard deviation required for a meaningful calculation (Wegner, 2002:222) is unknown, thus making hypothesis testing less reliable. Hypothesis testing, thus would be inappropriate throughout this study, as explained in Chapter 4, paragraph 4.5.1.5.

(b) <u>Defects per type</u>

(i) Major structural (excluding defects observed with a zero (0) count)

<u>Table 5.9 : Descriptive statistics : Major construction defects</u>

Descriptive statistics	Construction			Materials				
				Foundation				
	Foundation and Slab	Wall to olate	Roof	Lintels	CD o o	Mortar mix	Lintels (window -, door, partitions	Beams and Purlins
Number of defects	15	51	9	3	1	2	14	2
Mean	1	1	1	1	1	1	1	1
Standard Error	0	0	0	0	8.3E-15	0	0	0
Median	1	1	1	1	1	1	1	1
Mode	0	0	0	0	0	0	0	0
Standard Deviation	0	0	0	0	=0	0	0	0
Sample Variance	0	0	0	0	=0	0	0	0
Skewness	0^1	0^1	0^1	0^2	0^2	0^2	0'	0^2
Range	1	1	1	1	1	1	1	1
Minimum	0	0	0	0	0	0	0	0
Maximum	1	1	1	1	1	1	1	1
Sum	15	51	9	3	1	2	14	2
Count	15	51	9	3	1	2	14	2
Largest(1)	1	1	1	1	1	1	1	1
Smallest(1)	0	0	0	0	0	0	0	0

Note 1: Standard Deviation = 0, thus 0

Note 2: Fewer than 3 data points, and Standard Deviations, thus 0

Results: The *mode* indicates that most units are free from any of the defects identified. The largest number of defects per unit was at least 1, the lowest number of defects was 0. This is the case in respect of all defect types relating to major construction. The *mean* indicates an average of 1 defect per unit in all instances. The *standard error* in all cases is 0. The standard error in respect of "Blocks" is insignificant, thus also close to 0. This indicates that the *mean* is a good representation of the population. The same is found in respect of the *standard deviation,* and *sample variance,* thus supporting indications that the mean represents the data well. *Skewness,* is 0, thus the data is not skewed, indicating that data in all instances is distributed around the mean.

(ii) Incomplete Work (excluding defects observed with a zero (0) count)

Table 5.10 : Descriptive statistics : Incomplete work

Descriptive statistics	OTHER		INADEQUATE SERVICES		
	Incomplete/not ready	Access to unit	Water	Sanitation	Access to property
Number of defects	24	9	74	15	1
Mean	1	1.111	1	1	1
Standard Error	0	0.111	0	0	8.3E-15
Median	1	1	1	1	1
Mode	0	0	0	0	0
Standard Deviation	0	0.333	0	0	=0
Sample Variance	0	0.111	0	0	=0
Skewness	0[1]	3	0[1]	0[1]	02
Range	1	1	1	1	1
Minimum	0	0	0	0	0
Maximum	1	2	1	1	1
Sum	24	10	74	15	1
Count	24	9	74	15	1
Largest(1)	1	2	1	1	1
Smallest^)	0	0	0	0	0
Note 1: Standard Deviation = 0, thus 0					
Note 2: Fewer than 3 data points, and Standard Deviation=0, thus 0					

Results: The *mode* indicates that most units are free from any of the defects identified. The largest number of defects per unit was at least 1, the lowest number of defects was 0. This is the case in respect of all defect types relating to incomplete work. The *mean* indicates an average of 1 defect per unit in all instances. The *standard error* in all cases is very low, thus indicating that the mean is a good representation of the population. The same is found in respect of the *standard deviation,* and *sample variance,* thus supporting indications that the mean represents the data well. *Skewness* for units that were incomplete or not ready for inspection; inadequate water and sanitation; and access is 0, thus the data is not skewed, indicating that data in all instances is distributed around the mean. Data for access is positively skewed, indicating that the low number of defects (9) are skewing the data to the right, and is increasing the value of the mean.

(iii) Finishes (excluding defects observed with a zero (0) count)

Table 5.11 : Descriptive statistics : "Finishing" defects

Descriptive Statistics	[illegible]	PLUMBING							OTHER FINISHES								
		Workmanship				Material			Workmanship					Material			
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Number of defects	65	48	13	23	9	2	2	1	5	40	26	71	42	85	25	37	28
Mean	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Standard Error	0	0	0	0	0	0	0	8.23 E-15	0	0	0	0	0	0	0	0	0
Median	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mode	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Standard Deviation	0	0	0	0	0	0	0	=0	0	0	0	0	0	0	0	0	0
Sample Variance	0	0	0	0	0	0	0	=0	0	0	0	0	0	0	0	0	0
Skewness	0'	0'	0'	0[1]	0[1]	0[2]	0[2]	0[2]	0'	0'	0'	0[1]	0[1]	0[1]	0[1]	01	0[1]
Range	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sum	65	48	13	23	9	2	2	1	5	40	26	71	42	85	25	37	28
Count	65	48	13	23	9	2	2	1	5	40	26	71	42	85	25	37	28
Largest(1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Smallest^)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Note 1: Standard Deviation = 0, thus 0																	
Note 2: Fewer than 3 data points, and Standard Deviation=0, thus 0																	

Results:

The *mode* indicates that most units are free from any of the defects identified. The largest number of defects per unit was at least 1, the lowest number of defects was 0. This is the case in respect of all defect types relating to finishing. The *mean* indicates an average of 1 defect per unit in all instances. The *standard error* in all cases is 0, thus indicating that the mean is a good representation of the population. The same is found in respect of the *standard deviation*, and *sample variance*, thus supporting indications that the mean represents the data well. *Skewness* is 0, thus the data is not skewed, indicating that data in all instances is distributed around the mean.

5.2.2.5 Poisson analysis

(a) Number of defects per unit

Table 5.12: Poisson probability analysis : Number of defects per unit

Probability sample value	% Probability
0.546	100
>0	100
1	100

(b) Major construction

Table 5.13 : Poisson probability analysis : Major construction defects

Poisson results: Using Overall Sample Mean : % Probability of occurrence												
Probability sample value	MAJOR STRUCTURAL											
	Construction			Material/s								
				Foundation				Wall			Roof	
	foundation and Slab	Wall to plate	Roof	Jntels	Concrete	Blocks	DPC	Blocks	vlortar mix	Lintels, (window-, door, partitions	Sheeting (thickness and rust free	Beams and Purlins
0.546	100	100	100	100	100	100	100	100	100	100	100	100
0	100	100	100	100	100	100	100	100	100	100	100	100
>1	100	100	100	100	100	100	100	100	100	100	100	100

(c) Incomplete work

Table 5.14: Poisson probability analysis : Incomplete work

Using Sample Mean : % Probability	OTHER		INADEQUATE SERVICES		
Probability sample value	Incomplete/not ready	Access/Keys	Water	Sanitation	Access
0.546	100	100	100	100	100
0.00	100	100	100	100	100
>1.00	100	100	100	100	100

(d) Finishing

Table 5.15: Poisson probability analysis : "Finishing" defects

Poisson results : Using Sample Mean : % Probability																		
		PLUMBING								OTHER FINISHES								
		Workmanship					Material			Workmanship						Material		
Probability sample value	Clearance	Toilet , pipes and rodding eyes	Outlet and Gully	Water pipes and taps	Basin	Shower	Tap	Gully	Water tank	Block work	Cork/Fill/Grout	Plaster	Fitting window-, and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	Door
0.546	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
≥1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Results : There is a 100% probability of a unit not having any defects and there is an equal probability that one or more defects may occur (Table 5.12). There is also a 100 % probability of any one defect type not occurring in housing projects in Pietermaritzburg and an equal probability of any one such defect occurring (Tables 5.13, 5.14 and 5.15).

5.2.3 Time frame analysis

5.2.3.1 Inspections conducted

Table 5.16: Inspections completed

INSPECTIONS COMPLETED (During 1 April 2005 to 31 December 2005)			
STAGE	Foundation and slab	Wall Plate	Completion
No. inspections	236	758	1359
% of Sample	17	56	100

Results : Only 17% of the units inspected from foundation stage were completed in the 9 month cycle. 56% of the units inspected at wall plate stage were completed over the same time. This translates to 9 months to complete 236 units from foundation through to completion (thus an average of 26.3 units/month), and 758 units from wall and plate level to completion (thus an average of 84.2 units/month).

5.2.3.2 Descriptive statistics

Table 5.17: Time frame analysis : Descriptive statistics

DESCRIPTIVE STATISTICS	STAGE INSPECTION			TIME FRAMES		
	SLAB	WALL PLATE	COMPLETION	Slab to wall	Wall to completion	Total
Average	-	-	-	173	135	307
Mode	-	-	-	0	0	84
Frequency	-	-	-	98	69	137
Median	-	-	-	146	101	316
Standard Deviation				147.38	112.2	170
Sample Variance				21723	12596	28888
Skewness				0.61	1.092	0.095
MIN	24-Feb-03	11-Feb-04	2-Feb-05	0	0	0
MAX	23-Nov-05	20-Dec-05	20-Dec-05	655	510	779
Range	1003	678	321	655	510	779
Stage inspections per day	1.36	2.01	4.24	2.08	2.67	1.75
Average no. stage inspections per month (30 days)	40.68	60.18	127.10	62.29	80.00	52.37
Difference between first slab and last completion stage (Days)						1030
Average number of completed units/day						1.32
Average number of completed units/month (30 days)						39.61

Results: The first slab inspection in the sample was done on 24 February 2003. The last slab inspection was 23 November 2005, thus a total of 1003 days between the first and the last slab inspection. The first wall plate inspection in the sample was 11 February 2004, while the last was on 20 December 2005, thus 678 days from the first wall plate level inspection to the last. The first completion inspection in the sample was 2 February 2005, and the last inspection was 20 December 2005, thus a total of 321 days between the first and last completion inspection in the sample. 1030 days separate the first slab and last completion inspection.

5.2.3.3 Time frame comparison

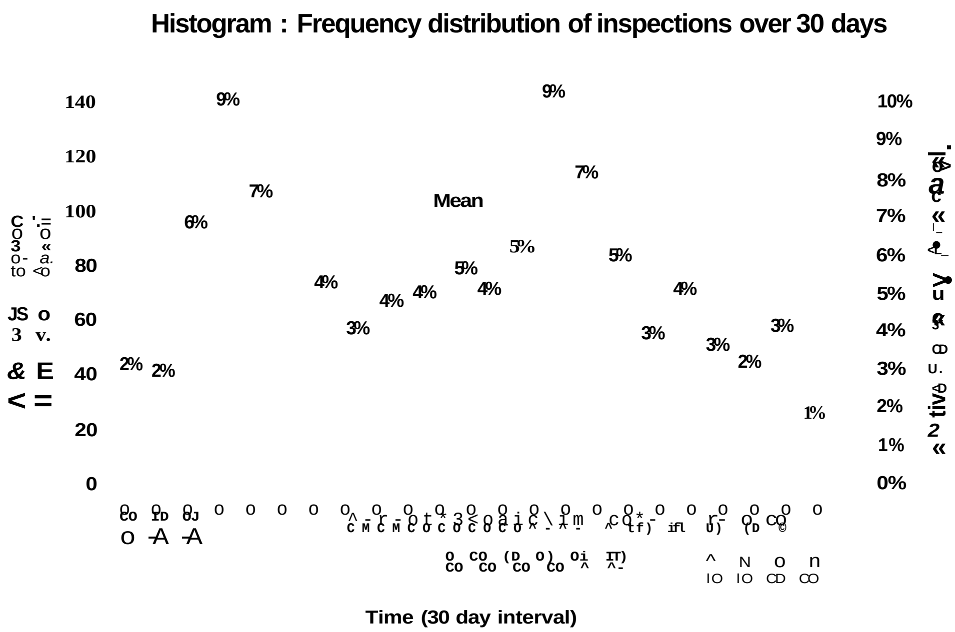
The Department of Housing's Programming Guide uses a medium risk approach in modelling development timeframes (1997:9). In terms of this, it assumes a timeframe of 129 days from the start of construction to the final inspection (1997:49)

Thus, based on the mode it appears that completion inspections are done well within the timeframe. However, this may be due to the fact that some units (8 in sample) were inspected from start to finish in one day, thus skewing the mode and making it a less reliable indicator.

The average timeframe of 307 days indicates that the completion inspections exceed the Department of Housing model of 129 days (1997:49), thus confirming lengthy periods of time to completion inspections. However, the data is highly variable around the mean, and very slightly skewed positively to the right, thus indicating there are very few values that are very high.

5.2.3.4 Frequency distribution : Completion inspections

Figure 5.6: Histogram of inspection frequency



Results : The histogram confirms that data around the mean is highly variable. There is a high frequency of completion inspections that have occurred below the mean of 307 days and in the 91 to 120 day interval, which is the case for approximately 9% of the inspections in the sample. Inspection frequencies below the mean also occurred during the 61 to 90; and 121 to 150 interval (approximately 15% of the units). These coincide with the Department's model that suggests 129 days. Approximately 19 to 25% of inspections are done within 129 days. Most inspections exceed the 129 day timeframe.

Less than a quarter of the completion inspections are done within 129 days, based on the Department of Housing's model in the "Housing Project Programming Guide". The majority of the units fall outside the Department's model.

5.3 PHASE 2 : FINDINGS

This phase of the research dealt with the perceived causes of quality concerns (Section 1 of the questionnaire); exploring the existing systems and efficiencies (Section 2); whilst also providing for additional comments from respondents regarding quality issues in low-income housing (Section 3). These were all done from the perspectives of the municipality, developer, and Department of Housing. Copies of the questionnaire and a summary of scores are attached as *Appendix 15.*

Findings are presented in accordance with the responses, where agreement between respondents from the same institution falls within the categories of agreement (i.e. indications that the respondents agree or strongly agree, are viewed as "agree". Responses relating to disagree, or strongly disagree, are viewed as "disagree"). Where agreement was not clear, these are recorded as "mixed responses".

5.3.1 Section 1 : Possible causes of quality concerns

The objective of this section was to confirm perceptions of possible causes of quality concerns in the Pietermaritzburg area. Findings for this section are, thus, presented for the group collectively, and are presented in tabular format, in accordance with the groupings of questions as outlined in Chapter 4, paragraph 4.5.2.2.

Note : Shaded areas in each table in Section 5.3.1.1 to 5.3.1.7 reflect the minority number of responses to the statement.

5.3.1.1 Question 1 : Perception on existence of quality concerns

Table 5.18 : Perception on existence of quality concerns.

No.	Statement	Agreed (%)	Disagree (%)	"Not sure"(%)
1.	Quality concerns exist in low-income housing in Pietermaritzburg	75.00	25.00	0.00

Results : Most respondents agree that quality concerns exist in low-income housing.

5.3.1.2 Questions 2 and 3 : Nature of defects

Table 5.19 : Nature of defects

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
2.	Most defects in the area relate to structural issues.	**37.50**	**62.50**	**0.00**
3.	Most defects relate to finishing.	75.00	**25.00**	**0.00**

Results : Most respondents agree that most defects relate to finishing.

5.3.1.3 Questions 4 to 9: Confirmation of possible causes

(a) Resources

Table 5.20 : Confirmation of possible causes : Resources

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
4.	Defects are caused mainly through the availability of resources, in terms of:			
(a)	- Finance	75.00	**25.00**	**0.00**
(b)	- Skilled labour	100.00	**0.00**	**0.00**
(c)	- The following major materials			
	Cement	**25.00**	**62.50**	**12.50**
	Sand	**12.50**	75.00	**12.50**
	Stone	**12.50**	75.00	**12.50**
	Steel	**12.50**	75.00	**12.50**
	Timber	**25.00**	75.00	**0.00**
	Water	**12.50**	**62.50**	**12.50**

Results : Most respondents agreed that lack of finance and skilled labour contributed to resource related quality causes. All respondents agreed that skilled labour was such a cause. Most respondents disagreed that availability of materials was such a cause.

(b) Materials quality

Table 5.21: Confirmation of possible causes : Materials quality

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
5.	Defects are caused mainly by poor quality material.	**37.50**	**62.50**	**0.00**
6.	Materials are SABS or Agrement compliant.	**25.00**	**62.50**	**12.50**
7.	Material and product samples are regularly tested against SABS or Agrement requirements.	**37.50**	50.00	**12.50**

Results : Most respondents disagree that defects are caused mainly through poor quality material. Most respondents disagree that materials are SABS or Agrement compliant and/or that sample tests are undertaken regularly against these requirements.

(c) Workmanship

Table 5.22 : Confirmation of possible causes : Workmanship

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
8.	Defects are caused mainly through poor workmanship	62.50	37.50	0.00

Results : Most respondents agree that defects are caused mainly through poor workmanship.

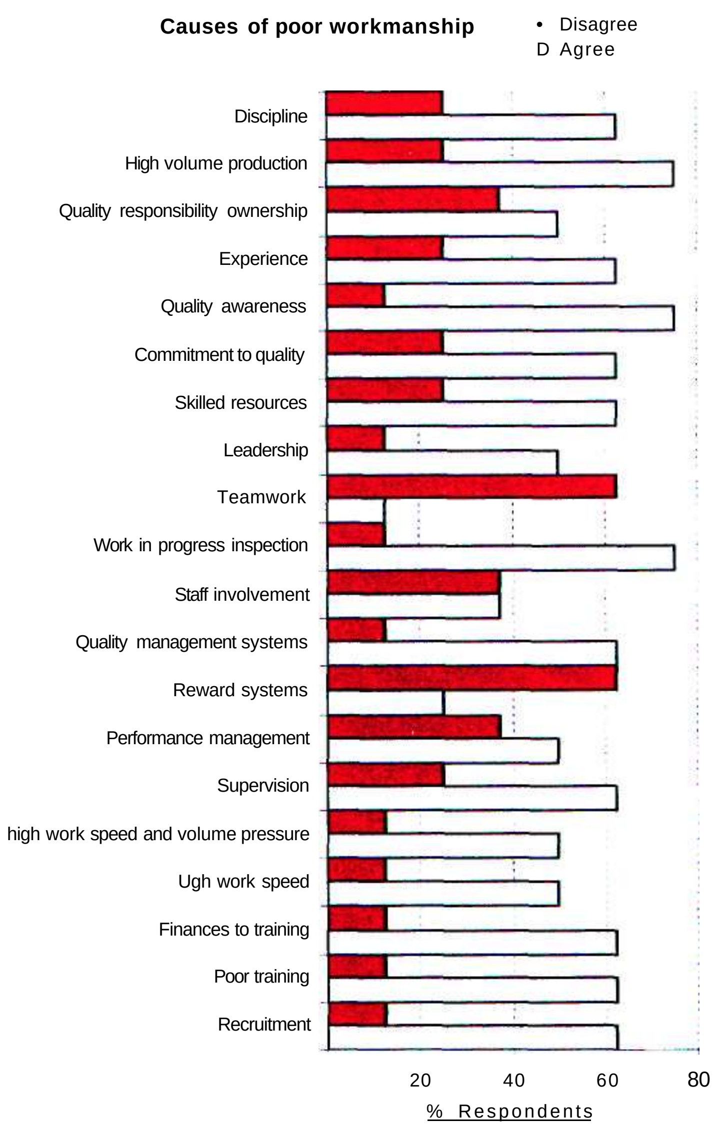
(d) Causes of poor workmanship

Table 5.23 : Perceptions of causes of poor workmanship

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)	Item not selected
9.	Poor workmanship is caused by:				
(a)	- Inappropriate recruitment processes.	62.50	12.50	0.00	25.00
(b)	-Poor training.	62.50	12.50	0.00	25.00
(c)	- Lack of financial support for training	62.50	12.50	0.00	25.00
(d)	- High work speed requirement	50.00	12.50	0.00	37.50
(e)	- Pressure (stress) relating to high volume and short time frames.	50.00	12.50	0.00	37.50
(f)	-Lack of supervision.	62.50	25.00	0.00	12.50
(fl)	- Lack of performance management.	50.00	37.50	0.00	12.50
(h)	- Lack of reward systems.	25.00	62.50	0.00	12.50
(')	- Lack of proper quality management systems	62.50	12.50	0.00	25.00
(l)	- Lack of staff involvement in problem solving.	37.50	37.50	0.00	25.00
(k)	- Lack of inspection during production processes.	75.00	12.50	0.00	12.50
(1)	- Lack of team work.	12.50	62.50	0.00	25.00
(m)	- Lack of leadership.	50.00	12.50	0.00	37.50
(")	- Lack of competently skilled resources.	62.50	25.00	0.00	12.50
(o)	- Lack of commitment to quality.	62.50	25.00	0.00	12.50
(P)	- Lack of quality awareness.	75.00	12.50	0.00	12.50
(q)	-Lack of experience.	62.50	25.00	0.00	12.50
(0	- Lack of quality responsibility ownership.	50.00	37.50	0.00	12.50
(s)	- High volume production within shortest possible timeframes.	75.00	25.00	0.00	0.00
(t)	- Lack of discipline	62.50	25.00	0.00	12.50

These findings are graphically represented in Figure 5.7, below.

Figure 5.7 : Possible causes of poor workmanship



Results : These perceived causes of poor workmanship are: Lack of inspection during production processes; high volume production within the shortest possible time frames; lack of quality awareness, competently skilled resources, commitment to quality, proper quality management systems, experience, supervision, and discipline; inappropriate recruitment processes; poor training; and lack of financial support for training.

5.3.1.4 Question 10 : Perception of acceptability of defects rates

Table 5.24 : Perception of acceptability of defects rates

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
10	Quality defect rates are within acceptable tolerances.	**12.50**	75.00	**12.50**

Results : Most respondents do not agree that defect rates are within acceptable tolerances.

5.3.1.5 Questions 11 and 12 : Perceptions of impact of quality management

Table 5.25 : Perception of impact of quality management

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
11.	Quality defects result in major rework and/or re-inspections.	**25.00**	62.50	**12.50**
12.	Quality defects impact on cash flow.	**62.50**	25.00	**12.50**

Results : Most respondents do not agree that quality defects result in major rework and/or re-inspections. Most respondents agree that quality defects impact on cash flow.

5.3.1.6 Questions 13 and 14 : Use of warranties.

Table 5.26 : Use of warranties

No.	Statement	Agreed (%)	Disagree (%)	"Not sure" (%)
13.	Product warranties are in place.	**25.00**	62.50	**12.50**
14.	Claims against warranties are measured.	**12.50**	75.00	**12.50**

Results: Most respondents do not agree that product warranties are in place. Most respondents do not agree that claims against warranties are measured.

5.3.1.7 **Questions** 15 **to** 22 : **Perception of delivery rates and measurement.**

Table 5.27 : Perception of delivery rates and measurement

No.	Statement	Agreed (%)	Disagree **(%)**	"Not sure"(%)
15.	The average yield of 40 units per month (completed and passed for payment) is acceptable.	**25.00**	**62.50**	**12.50**
16.	Construction stages (foundation and slab : wall plate : completion) are programmed and monitored.	**12.50**	**75.00**	**12.50**
17.	Delivery rates between timeframes are acceptable.	**0.00**	**75.00**	**12.50**
18.	Product specifications and timeframes are stipulated in the contract.	**50.00**	**37.50**	**12.50**
19.	Timeframes, costs and product specifications are adhered to at all times.	**0.00**	**75.00**	**25.00**
20.	Variations to the contract are negotiated with all stakeholders and are formalised.	**0.00**	**87.50**	**12.50**
21.	Quality concerns are addressed at site meetings	**25.00**	**62.50**	**12.50**
22.	Repetitive quality problems are included in organisational strategies.	**25.00**	**62.50**	**12.50**

Results : Most respondents agree that product specifications and timeframes are stipulated in the contract; and disagree that the yield is acceptable, construction stages are programmed and monitored, delivery rates are acceptable, variations to contract or negotiated with all parties are formalised, quality concerns are addressed at site meetings, and/or that repetitive quality problems are included in organisational strategies.

5.3.1.8 Question 23 : **Provision for respondent to list other possible causes.**

Table 5.28 : Comments received regarding other possible causes

Respondent No.	**Comment**
1.	Poor selection of contractors.
	Lack of Cooperation from Implementing Agent.
3.	Poor education to the end user. Customers are first time home owners and need thorough education on how to care for their new homes.
4.	There is a direct correlation between finance, experienced and qualified skills and supervision. The product is financially constrained, limited to local semi skills, and appropriate supervision for the aforementioned is not affordable.
6.	Unskilled supervisors contribute to quality concerns.
	Scope of work hot being fully explained to work force.
	Lack of competent and higher qualified trainers or instructors on site.
	National Building Regulations unknown or not practiced by contractors.
8.	Lack of proper equipment.
	Lack of proper site supervision, engineer or building professional on site.
	Lack of inspection resources within municipality.

5.3.2 Section 2 : Quality Management Systems and Efficiencies

The objective of this section was to explore current quality management systems and efficiencies within the municipality, implementing agents and the Department of Housing, respectively, and specifically in relation to low-income housing projects in the Pietermaritzburg area. Findings are recorded in tabular format, in accordance with the groupings of questions as outlined in Chapter 4, paragraph 4.5.2.2. A Mixed response is interpreted as "inconclusive".

Note : Shaded areas in each table in Section 5.3.2.1 to 5.3.2.13 reflect areas with mixed, unsure, or not selected responses, resulting in inconclusive findings on the direct responses.

5.3.2.1 Question 1 : Presence of a quality management system and its focus in terms of customer orientation

Table 5.29 : Presence of quality management system and customer focus

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
1.1	Your organization has a quality management system.	Agree	Agree	Disagree	Disagree
1.2	In your organization, quality management involves aH internal components.	Disagree	Mixed	Disagree	Disagree
1.3	In your organization, quality management involves ajj external role players	Disagree	Mixed	Disagree	Disagree
1.4	Quality concerns are defined by:				
(a)	- Primarily the customer.	Mixed	Mixed	Mixed	Mixed
(b)	- Primarily the developer.	Mixed	Agree	Disagree	Disagree
M	- Primarily the municipality	Agree	Mixed	Disagree	Disagree
(d)	- Primarily the Department of Housing.	Agree	Agree	Agree	Agree
(e)	-All of the above.	Mixed	Mixed	Disagree	Disagree
(f)	- None of the above.	Mixed	Mixed	Mixed	Mixed
1.5	The responsibility for quality lies with:				
(a)	- Primarily the customer.	Disagree	Mixed	Disagree	Mixed
(b)	- Primarily the developer.	Agree	Agree	Disagree	Agree
(c)	- Primarily the municipality.	Agree	Mixed	Disagree	Agree
M	- Primarily the Department of Housing.	Agree	Mixed	Agree	Agree
(ep	-All of the above.	Mixed	Mixed	Mixed	Mixed
(f)	- None of the above.	Disagree	Mixed	Disagree	Mixed

Results : The municipality and the developer appear to have a quality management system, but internal and external role players are not involved in the process in either of the systems. The Department of Housing does not have a formalised system. All respondents view quality as primarily the responsibility of the Department of Housing.

5.3.2.2 Question 2 : Correlation of quality management system with ISO 9000

Table 5.30 : Correlation with ISO 9000

Note: "-"=Not selected		**Municipality**	**Developer**	**Department of Housing**	
				Monitors	**Inspectors**
No.	**Statement**				
2.1	Your organization undertakes regular company wide quality assessments (at least once a year).	Disagree	Mixed	Disagree	Disagree
2.2	Your organization follows ISO 9000 quality standards.	Mixed	Mixed	Disagree	Disagree
2.3 (a)	Quality management in your organization is customer focused.	Mixed	Agree	Agree	Disagree
(b)	Quality management is practiced with effective leadership.	Mixed	Agree	Disagree	Disagree
(c)	Quality management follows a process approach.	Mixed	Agree	Disagree	Disagree
(d)	Quality management supports a systems approach to management.	Mixed	Agree	Disagree	Mixed
(e)	Quality management focuses on continuous improvement.	Mixed	Agree	Disagree	Mixed
(f)	Quality management includes a factual approach to decision making.	Mixed	Agree	Disagree	Mixed
(9)	Quality management is aimed at mutual beneficial supplier relationships.	Mixed	Agree	Disagree	Disagree
M	Quality management is practiced with effective leadership.	Mixed	Agree	Disagree	Disagree

Results:

(1) The municipality and Department of Housing do not undertake regular company wide quality assessments. Information regarding this in respect of the developer is inconclusive.

(2) The Department does not follow ISO 9000 quality standards. Information regarding this aspect from the municipality is inconclusive. The Developer appears to follow ISO quality management principles listed in question 2.3(a)-(g).

5.3.2.3 Question 3: Application of different approaches for chronic and sporadic problems

Table 5.31 : Flexibility of problem solving approaches

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
3.1	Different approaches are followed for quality problems that occur less often and/or are less severe, than those that happen often and/ or have a major impact on delivery.	Mixed	Agree	Agree	Disagree
3.2	A diagnostic approach is followed in solving quality management problems.	Mixed	Agree	Agree	Mixed

Results: Information from the municipality is inconclusive. The developer and monitors within the Department appear to have a more flexible approach to problem solving than the inspectors.

5.3.2.4 Question 4 : Continuous improvement through benchmarking and customisation of quality systems to range of customers

Table 5.32 : Benchmarking and customization of quality management system

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
4.1	Quality is benchmarked against competitors.	Mixed	Mixed	Disagree	Disagree
42	Quality management in your organization recognizes a range of different customers with different needs.	Disagree	Mixed	Disagree	Mixed
4.3	A quality management policy is in place.	Disagree	Mixed	Disagree	Disagree

Results : Information from the developer is inconclusive in all of the above aspects. None of the organs of state has a quality management policy, nor are the quality management approaches customised to recognise different needs with regard to quality.

5.3.2.5 Question 5 : Quality control and responsibility

Table 5.33 : Quality control and responsibility

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
5.1	Quality control includes a quality score card.	Mixed	Disagree	Disagree	Mixed
5.2	Final inspections are the responsibility of:				
Ja)_	- Primarily the customer.	Mixed	Agree	-	Mixed
(b)	- Primarily the developer.	Mixed	Agree	-	Agree
(c)	- Primarily the municipality.	Mixed	Agree	-	Agree
(d)	- Primarily the Department of Housing.	Mixed	Agree	Agree	Agree
(e)	-All of the above.	Mixed	Agree	-	-
(f)	- None of the above.	Mixed	Agree	-	Mixed
5.3	Inspections are carried out by:				
(a)	- Primarily the customer.	Mixed	Agree	-	Mixed
(b)	- Primarily the developer.	Mixed	Agree	-	Mixed
(c)	- Primarily the municipality.	-	-	-	Agree
(d)	- Primarily the Department of Housing.	Mixed	Agree	Agree	Agree
(e)	- All of the above.	-	-	-	-
(f)	- None of the above.	-	-	-	-
5.4	All stakeholders are aware of the criteria used in inspection processes.	Mixed	Mixed	Mixed	Mixed
5.5	Inspection processes are based on prior knowledge of product quality, similarity within the lot and allowable risk.	Mixed	Agree	Agree	Mixed
5.6	The following is typical of inspections :				
(a)	- No inspection.	-	-	Mixed	-
(b)	- Small samples.	Mixed	Mixed	Mixed	-
(c)	- Large samples.	-	Mixed	-	-
(d)	-100% inspection.	-	Mixed	Mixed	Mixed
(e)	- Snags are done prior to final inspections.	Agree	Mixed	Mixed	Disagree
(f)	- Snags are addressed properly and within the given time.		Mixed	Mixed	Disagree

Results : Mixed responses were received in most instances, however, most of the respondents perceive final inspections as being the responsibility of the Department, and agree that these are being carried out by the Department.

5.3.2.6 Question 6 : Strategic quality management

Table 5.34 : Strategic quality management

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
6.1	Quality is part of the strategic management process to ensure long term customer satisfaction goals.	Disagree	Mixed	Disagree	Agree
6.2	In your organization:				
(a)	Quality management is lead and supported by top management.	Mixed	Agree	Disagree	Mixed
(b)	Proper infrastructure (including plans, goals, organisational mechanisms and resources, performance measurement and rewards) exist at all levels to implement a quality management system.	Disagree	Agree	Disagree	Disagree
~WH	Role players are not skeptic about the need for new quality management programmes.	Mixed	Disagree	Disagree	Mixed
(d)	Management relies ***principally on strong motivational technique to encourage improvement,*** once statistical strong evidence has been used to convince all of the seriousness of the problem.	Agree	Disagree	Mixed	Mixed
(e)	An incremental approach is followed is solving quality problems *(i.e. prioritization of quality problems to address, as opposed to trying to resolve all problems simultaneously).*	Mixed	Agree	Disagree	Disagree
(f)	Different techniques are used to achieve quality goals "(Please refer to Appendix 1 for typical tools and kindly indicate the 5 most frequently used in your organization).	Mixed	Agree	Disagree	Disagree
(9)	Sufficient time and resources are available to address quality, and the need to change priorities as a result thereof is supported by management).	Disagree	Mixed	Disagree	Disagree
6.3	Quality strategies are implemented throughout all line function activities.	Disagree	Agree	Disagree	Disagree

Results : Quality does not appear to be part of the municipality's strategy. Information on this aspect is inconclusive with regard to the other institutions. Neither the municipality nor the Department appear to have the necessary infrastructure in place, and quality strategies do not appear to be implemented throughout all line function activities. Whilst the developer appears to use an incremental approach, this does not appear to be the case within the Department.

*Note: Respondents indicated that the following techniques are used:

(1) Municipality: Typical tools used in quality management include process analysis; specification and standardisation; and Gantt Charts. Supply chain management was rated between 4 and 5, representing a transactional focus.

(2) Developer: Tools used by the project manager include process analysis and histograms. The senior project manager also uses run charts, control charts, and organisational structure. Both respondents use specification and standardisation; and Gantt charts. Supply chain management was rated between 5 and 6, thus between transactional and proactive.

(3) Department of Housing: The inspectors typically use check sheets and standards and specifications. Project monitors use Process analysis, run charts, specification and standardisation. Supply chain management was rated between 4 and 5, representing a transactional focus.

5.3.2.7 Question 7 : Quality culture

Table 5.35: Quality culture

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
7.1	Quality is part of the organization's vision.	Mixed	Agree	Mixed	Mixed
7.2	Decision making styles (command, consultative and consensus/agreement) are adapted to suit the situation at hand).	Mixed	Mixed	Disagree	Disagree
7.3	Management creates an environment that encourages learning from mistakes to encourage improvement.	Disagree	Disagree	Mixed	Disagree
7.4	Employees participate in quality related decision and take ownership of work related thereto.	Mixed	Mixed	Disagree	Disagree
7.5	Individual and team performance is measured regularly and are provided with feedback on progress.	Disagree	Disagree	Disagree	Disagree
7.6	Management base decisions on facts and scientific instruments.	Disagree	Agree	Disagree	Disagree
7.7	Staff is encouraged to share ideas, feelings and needs freely, in an open and trusting manner without fear of punishment.	Disagree	Agree	Disagree	Disagree
7.8	Managers act as role models for ethical practices.	Disagree	Agree	Disagree	Disagree

Results: Only the developer is conclusive that quality appears to be part of its organisation's vision. The management culture within each of the organisations does not encourage learning from mistakes. Team and individual performance does not seem to be measured and communicated. Only the developer appears to base decisions of fact and encourages staff to share ideas openly. Management within the developer's organisation are perceived as role models for ethical practice. This is not perceived to be the case within the organs of state.

5.3.2.8 Question 8 : Inclusion of customer needs

Table 5.36 : Inclusion of customer needs

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
8.1	Customer needs are well understood.	Disagree	Mixed	Disagree	Disagree
8.2	Customer needs defined based on proper market research.	Disagree	Mixed	Disagree	Mixed
8.3	Customer satisfaction is measured in terms of product features and freedom from deficiencies.	Disagree	Agree	Disagree	Disagree
8.4	Customer satisfaction surveys inform product development.	Disagree	Mixed	Disagree	Disagree

Results: Customer needs considerations are excluded within the organs of state. The information is inconclusive in respect of the developer, although it appears to measure customer satisfaction in terms of product compliance to specifications.

5.3.2.9 Question 9 : Supply chain management quality control

Table 5.37 :Supply chain management and quality control

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
9.1	Suppliers are evaluated regularly against quality defaults.	Mixed	Agree	Disagree	Disagree
9.2	Supplier quality problems are resolved through partnerships.	Mixed	Agree	Disagree	Disagree
9.3	Certified suppliers are used.	Mixed	Mixed	Disagree	Mixed
9.4	Suppliers understand all specification and standards clearly, and these are stated in quantitative terms.	Mixed	Agree	Mixed	Mixed
9.5	All role players understand **what** they should be doing. *(Please rate each of the role players listed in (a) to (e) below).*				
(a)	- Implementing agent, project manager or developer	Mixed	Agree	Mixed	Agree
(b)	- Suppliers	Mixed	Agree	Agree	Mixed
(c)	- Department of Housing	Mixed	Agree	Agree	Mixed
(d)	- Municipality	Mixed	Mixed	Agree	Mixed
(e)	- Community	Mixed	Mixed	Disagree	Disagree
9.6	All role players know **how to** undertake their functions.*(Please rate each of the role players listed in (a) to (e) below).*				
(a)	- Implementing agent, project manager or developer.	Mixed	Agree	Mixed	Mixed
(b)	- Suppliers.	Mixed	Agree	Agree	Mixed
(c)	- Department of Housing.	Mixed	Agree	Agree	Mixed
(d)	- Municipality.	Mixed	Agree	Disagree	Mixed
(e)	- Community.	Mixed	Agree	Disagree	Mixed
9.7	All stakeholders have suitable, controllable processes to meet specifications. *(Please rate each of the role players listed in (a) to (e) below).*				
(a)	- Implementing agent, project manager or developer.	Disagree	Agree	Disagree	Mixed
(b)	- Suppliers.	Mixed	Agree	Mixed	Disagree
(c)	- Department of Housing.	Disagree	Agree	Disagree	Mixed
(d)	- Municipality.	Disagree	Mixed	Agree	Disagree
(e)	- Community.	Disagree	Mixed	Disagree	Disagree

Results : Information is largely inconclusive in respect of the organs of state. The Department, however, does not appear to evaluate suppliers against defaults and also do not tend to resolve problems through partnerships. This is perceived to be occurring within the developer's organisation. The developer also perceives itself and the Department to understand what needs to be done, and that all role players understand how this should be done. Departmental monitors do not appear to agree with this statement.

5.3.2,10 Question 10 : Statistical control system

Table 5.38 ; Statistical control system

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
10.	Statistical process control systems are used to measure and analyse all processes.	Disagree	Agree	Disagree	Mixed

Results : The organs of state do not use statistical process. The developer appears to use the tool.

5.3.2.11 Question 11 : Quality management in administration and support

Table 5.39 : Quality management in administration and support activities

Note : "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
11.	Rate the extent to which the administration and support activities in 11.1 to 11.3 are measured in terms of quality.				
11.1	Finance (Rate *the extent to which items (a) to (d) is measured by your organization).*				
i?L	- monetary value of invoices paid late.	Disagree	Agree	Disagree	Mixed
(b)	- average number of days to issuing of invoices.	Mixed	Mixed	Disagree	Disagree
(c)	-% of invoices returned due to errors.	Mixed	Agree	Disagree	Disagree
(d)	-monetary value of unrecoverable accounts receivable.	Not sure	Mixed	Mixed	Agree
11.2	Personnel *(rate the extent to which items (a) to (d) are measured by your organization).*				
(a)	-% resumes (cv's) received that result in interviews	Not sure	Mixed	Mixed	Disagree
(b)	-number of candidates interviewed before an offer is made and accepted.	Not sure	Mixed	Mixed	Disagree
(c)	-average number of days from request for personnel to initial employment date.	Not sure	Agree	Mixed	Disagree
(d)	-% certified/qualified workers in critical activities.	Not sure	Agree	Mixed	Disagree
11.3	Information technology *(rate the extent to which items (a) to (e) are measured by your organization)..*				
J§L	-% system uptime *(i.e. when systems can be used).*	Not sure	Agree	Agree	Mixed
(b)1	- Mean (average) time between failures.	Not sure	Agree	Agree	Agree
(c)	- Mean (average) time to restore services.	Not sure	Agree	Agree	Agree
(d)	- Turnaround time for reports *(how long it takes to get reports out of the system).*	Mixed	Agree	Disagree	Mixed
M	- Software/programming errors.	Not sure	Agree	Agree	Mixed

Results : Information from the municipality is largely inconclusive, other than confirming that monetary value of invoices paid late are not measured. The developer appears to measure all support functions, whilst the department al representative agree that within the Department, system failures and time to restore information systems are measured.

5.3.2.12 Question 12 : Quality management information systems

Table 5.40 : Quality management information systems

Note : "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
12.	A quality information system is in place and includes the following items listed in (a) to (l) below:				
(a)	- Key Performance Indicators.	Disagree	Mixed	Disagree	Disagree
(b)	- Action Plan for Improvement	Disagree	Mixed	Disagree	Disagree
(c)	- Progress on action plan	Disagree	Mixed	Disagree	Disagree
(d)	- Evaluation and feedback mechanism.	Disagree	Mixed	Disagree	Disagree
(e)	- Customer satisfaction data.	Disagree	Mixed	Disagree	Disagree
(f)	Product design, specification and standards information.	Disagree	Agree	Disagree	Disagree
(9)	- Material, equipment and supplier test results.	Disagree	Agree	Disagree	Disagree
(h)	- Work in progress.	Disagree	Agree	Disagree	Disagree
(i)	- Complaints.	Disagree	Mixed	Disagree	Disagree
(j)	- Management control.	Disagree	Mixed	Disagree	Disagree
(k)	- Delivery cycle timeframe projections, actual and variation.	Disagree	Mixed	Agree	Disagree
(l)	Variation data and problem solving process management data.	Mixed	Agree	Disagree	Disagree

Results: None of the organs of state appear to have a quality management information system. The developer appears to have such a system but the emphasis appears to be on product design, material, equipment and testing results, and variation data.

5.3.2.13 Question 13 : Presence of a quality systems audit and assurance programme

Table 5.41 : Quality systems and audits

Note: "-"=Not selected		Municipality	Developer	Department of Housing	
				Monitors	Inspectors
No.	Statement				
13.	A quality audit and assurance programme is in place.	Disagree	Disagree	Disagree	Disagree

Results: None of the institutions have a quality audit and assurance programme.

5.3.3 Section 3 : Comments, Concerns and Suggestions

Additional comments and concerns from respondents in relation to quality management are presented in Table 5.42 below.

Table 5.42 : Additional comments received from respondents

Respondent No.	Comment
2	"Quality Management systems: For the Infrastructure, Planning and Survey Unit (Housing Delivery is a section of this unit) a new committee has been put in place called the Quality Management Committee. The first meeting was on 28 June, 2006. Its purpose is to address processes and procedures in the work environment to manage quality."
3	"Low-income housing is good for indigent people, but the Department's policy needs to be revisited in terms of qualifying criteria, to address each province's culture and unique needs of people. Communities need to be part of the entire process, from conceptualization, not just during implementation. Provision should be made by the Department for home owner education, and to educate people that low-income housing are starter homes, and that these low-income houses are also homes to people. Municipal officials should also be sent on courses regarding low-income housing policies, and understand that development is their responsibility and what this entails, especially in the context of low-income housing. Municipalities do not seem to understand their role in low-income housing and these needs to be addressed for low-income housing to be taken seriously. Municipalities need to adjust their policy standards to match those applicable to low-income housing in terms of service levels, etc."
4	"Comment : Low-income housing is a simple product with a complex process. There are many role players whose performance determines the efficiency of delivery. The product is low on margins and is cash flow sensitive. Any non-performance by one role player has a compounding effect on the profitability of low-income housing.
	"Policy : The policy is rigid and needs to be more flexible by recognizing the inherent differences between in-situ upgrade, green fields, People's Housing Processes, terrain, locality, size of project, etc all of which has differing influences on the viability of projects.
	"Performance : The developer/implementing agent has performance clauses in the agreement. Similarly, performance clauses need to be incorporated into the agreement to govern the department and municipalities. The Department of Housing needs to set the example in minimizing red tape and seeking solutions rather than obstacles and then to encourage municipalities to follow suite. The Department needs to go further and ensure performance within given timeframes for functions outside project agreements (e.g. the time to provide an agreement from the date of resolution).
	"Socio-political : The constant learning curve on each new project because of communal dicatates hinders experience. The Department needs policy to govern this to bring balance by requiring a percentage of skilled (outside) contractors to be employed on a project.
	"Product : As the subsidy increases (to negate inflation) there appears to be a drive to increase the unit size (which contradicts the reason for escalation increases). If anything, attention should be the quality of the product by calling for a minimum specification (e.g. thickness of doorframes, exterior doors, window frames, etc.)

Respondent No.	Comment
4	"Education : The Department and municipalities need to be more proactive in the education of communities in the rights and responsibilities of home ownership. This should be an ongoing programme and not once-off workshops."
6	"Beneficiary allocation is wrongly structured because not all role players are fully involved in this process. Both the Municipality and the Department of Housing are not hands on in this process. They leave the ward committee structures to run the show and this creates a lot of problems, for example the beneficiary mix (incorrect allocations, e.g. higher income earners receiving completed structures, and then not willing to pay in the excess)
	"The Department of Housing monitors should not monitor projects in their offices. At least twice a week they must visit the projects they monitor. They must also enforce the presence of building professionals on sites as quality controllers.
	"The Department of Housing Management should revisit the issue of inspectorate and survey component within the organization as an independent component which will only deal with building and inspections, as well as minimizing the cost of private surveys.
	"The Department of Housing should improve the communication between them and beneficiaries in order to monitor the housing occupation due to the fact that all the time most of our projects are not occupied by rightful beneficiaries that cause the crisis within the community as well as the departmental official."
7	"Even though the industry, department and local government strive to provide integrated development and have a holistic approach to development, the question needs to be asked if in the long run beneficiaries will really benefit. The beneficiaries have now been given an asset which becomes a liability in the long run as they cannot sustain the maintenance of the asset. Government should rather look at developing a sustainable economy which must create jobs in the market for all skills levels. Once this is achieved, then people can assist themselves with housing."
8	"Scope of works is often not well defined in tenders. Tender procedures in general are insufficient with regard to quality assurance.
	"Lengthy approval processes by organs of state increase costs, thus reducing value that can be achieved through construction.
	"Lack of inspection capacity within the Department and the municipality results in a reactive approach to quality control."

5.4 SUMMARY OF FINDINGS

5.4.1 Phase 1 : Defects

There are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship. The occurrence of defects is unpredictable as any one unit can have any one type of defect, or be totally free from any defect.

There were no defects in materials relating to concrete in the foundation, plastic waterproofing material of the foundation, blocks for the wall, roof sheeting and basin. Although most of the matters listed by the NHBRC (2002a: paragraph 1) were found in the sample, frequency in the sample was low in respect of materials used, poor sand, mortar or plaster mix, and/or major structural defects. Most defects were related to finishing, especially toping of slabs.

Although the defects analysis indicates that workmanship issues are the main contributing factor to quality concerns, the Pareto analysis indicates that there are a mixture of defect types and causes that need to be addressed and across categories. These relate to both workmanship and materials, as indicated in the Table 5.7 hereof.

Less than 25% of the completion inspections are done within the Department of Housing's model, which indicates inefficiencies in the system.

5.4.2 Phase 2 : Existing quality management systems

Role players are at different stages of advancement with regard to quality and supply chain management. The Developer appears to be most advanced and has a more conducive environment to implement total quality management than the organs of state. The organs of state appear to have limited resources according to responses received to implement quality management systems and are faced with the typical challenges to total quality management.

The institutions appear to have an internal focus to quality management that is not customer focussed and lacks involvement of all stakeholders. No proper market research and/or customer satisfaction surveys are undertaken.

There is no formalised policy on quality management, and strategic direction with regard to total quality management appears to be poorly formulated. Such a policy is needed to guide quality improvement and monitoring systems (Gryna, 2001:185). Performance management is required, but developers require this to be reciprocal.

None of the institutions appear to have a quality management strategy, or have an fully integrated quality perspective. The Department and the municipality would need to overcome many challenges in implementing quality management. It appears that the proper infrastructure is not in place to implement a quality management system, and there is a lack of ability to reprioritise resources to achieve quality targets.

The management environment within the municipality and the department, respectively, does not appear to be conducive to encourage a learning organisation approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality (Gryna, 2001:251).

It appears that managers mostly do not act as role models for ethical practices. The management environment and organisational culture within the department does not appear to be conducive to encourage a learning organisation approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality and needs to be led from the top (Gryna, 2001:251). It appears that managers mostly do not act as role models for ethical practices. In the case of the developer/implementing agent, quality is part of the organisation's vision, however, management approach to learning from mistakes needs improvement. Individual and team performance measurement, evaluation and feedback appear to be lacking.

The Department does not appear to measure the time taken to issue invoices, or percentage returned due to errors. It is thus, not possible for the Department to measure how many invoices are returned due to errors, or how long staff take to process these.

A lack of a proper information system exists and this is a barrier to effective quality improvement implementation programmes, and to effective project management.

Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes.

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects. Sample tests should be undertaken on critical materials to ensure the continued use of sound quality materials.

There is no common understanding regarding roles, responsibilities and inspection criteria and processes.

None of the institutions appear to have a quality assurance and audit process in place in the context of low-income housing developments. These are critical elements to a sound quality management system (Gryna, 2001:682).

Discussion and conclusions on the findings presented in this chapter are presented in the next chapter, Chapter 6.

CHAPTER 6 : DISCUSSION AND CONCLUSIONS

6.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area.

The following objectives were investigated:

(1) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(2) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(3) To identify how house construction quality issues are currently being addressed.

The municipality, department and developers have a range of different approaches to quality management. Conclusions on findings in answering the research questions are discussed in the section below.

6.2 DISCUSSION AND CONCLUSIONS

6.2.1 Objective I : Quality concerns in government-subsidised low-income house construction in the Pietermaritzburg area

6.2.1.1 Existence of quality problems

There are quality concerns in low-income housing in Pietermaritzburg related directly to housing delivery, and within support systems.

Housing delivery related findings indicate that most units are defect free, but 41,21% had some defects, of varying degrees that needed to be corrected prior to the Department releasing payment, thus confirming the existence of quality problems.

Information management is not efficient in terms of recording inspections as 479 units (26%) could not be used due to its unreliability as a result of duplicated site numbers, omission of inspection dates, and inspection recorded out of sequence, (Chapter 5, paragraph 2.1). This illustrates quality concerns within support systems. A total quality management approach results in reduced rework, thus reducing internal failure costs (Gitlow, et al, 1999:178), but needs a reliable quality information management system that informs quality improvement (Gryna, 2001: 656). A variety of software applications are available. Compatibility with organisational goals, and inclusion of key performance measurements are essential, whichever system is used (Gryna, 2001:656).

Delivery rates are slow, thus also indicating quality concerns. Less than a quarter of the completion inspections are done within 129 days, based on the Department of Housing's model in the *"Housing Project Programming Guide'"* (Department of Housing, 1997:42-49). The majority of the units fall outside this model. The reasons for this are not clear, but it is noted that there were 79 re-inspections (5,81%) and this may have contributed to the delays. Whereas the Department's model is based on a medium risk approach (Department of Housing, 1997:9), it may also be possible that developers are programming construction against a lower risk programme, but this needs to be researched separately.

1030 days separate the first slab inspection and the last completion inspection in the sample, thus indicating a lengthy delivery time to completion, and lower yields than programmed in agreements. This is also the perception of officials within the municipality and the department, as confirmed in responses received (Chapter 5, paragraph 5.3.1.7). This indicates dissatisfaction with service delivery, thus supporting findings of quality concerns in the construction of low-income housing units. Whereas customer satisfaction defines quality (Kanji and Asher, 1996:1), the dissatisfaction with delivery rates indicates poor performance, thus service delivery quality and this needs to be rectified to change perceptions of public sector inefficiency (Beckford, 1998:5) In addition to this, unnecessary rework wastes human capital and talent, especially when resources are scarce, thus demoralizing individuals (Beckford, 1998:10). Unnecessary duplications in inspections must be reduced to protect human resources from these effects.

6.2.1.2 Nature of quality concerns

The occurrence of defects is unpredictable as any one unit can have any one type of defect, or be totally free from any defect. Findings were supported by descriptive statistics and supported by a Poisson probability analysis. The nature of defects is summarised in Table 6.1, below.

Table 6.1. : Nature of defects found in the Pietermaritzburg area (see *Appendix 11* for a description of defect types)

Main Cateqorv	**Sub cateqories**			**COUNT**
Major structural	Construction		Foundation	**15**
			Wall to plate	**51**
			Roof	**9**
	Materials	Foundation	Lintels (Slab)	**3**
			Blocks (Foundation)	**1**
		Wall	Mortar mix	**2**
			Lintels (wall)	**14**
		Roof	Beams, trusses, purlins	**2**
Incomplete work	Inadequate services		Water (connections not done)	**74**
			Sanitation	**15**
			Access	**1**
	Other		Incomplete	**24**
			Access	**9**
Finishes	Clearance		Site clearance	**65**
	Plumbing	Workmanship	Toilet	**48**
			Outlet Gulley	**13**
			Pipes	**23**
			Shower	**9**
		Material	Tap	**2**
			Gulley	**2**
			Water Tank	**1**
	Other finishes	Workmanship	Block work	**5**
			Corking	**40**
			Plaster	**26**
			Fitting frames	**71**
			Glazing	**42**
			Screed	**85**
		Material	Frames	**25**
			Plaster	**37**
			Door	**28**
Total				**742**

There were no defects in materials relating to concrete in the foundation, plastic waterproofing material of the foundation, blocks for the wall, roof sheeting and basin.

Most quality defects relate to finishing due to poor workmanship in the screeding (topping) of slabs, thus confirming the National Home Builder's (NHBRC) findings (see Chapter 3, paragraph 3.3.1 hereof). This may contribute toward delivery delays, as indicated in completion inspection timeframes that exceed the Department's guidelines. Block work was the most problematic with regard to construction activities, thus also confirming the NHBRC findings. Although most of the matters listed by the NHBRC were found in the sample, frequency in the sample was low in respect of materials used, poor sand, mortar or plaster mix, and/or major structural defects. Most defects were related to finishing, especially topping of slabs.

6.2.1.3 Extent of defects

Most units are defect free. The Poisson analysis indicates that there is an equal 100% probability of a unit having one or more defect or not. The sample mean of 0,546 is a good representation of the population as the standard error, standard deviation and sample variance are all low. In reality, the presence of a defect is absolute, thus, this may be viewed as an average of 1 defect per unit, but the data clearly illustrates that there are more defect free units. Thus some units have defects, whilst others do not.

Likewise, where defects occur, there is an equal 100% probability that any one of the defect types could occur at a point in time in low-income housing house construction in Pietermaritzburg, or for it not to occur. The average of 1 defect of any type per unit is a good representation of the population as the standard error for each type of defect is 0, or close to 0. The same is found in respect of the standard deviation, and sample variance for each type of defect, thus supporting indications that the mean represents the data well. The frequency tables and mode clearly illustrates that there are units with defects, thus some units have defects, whilst others don't. Defects thus have a random occurrence. This is supported by the Poisson analysis. It would, therefore, be difficult to establish confidently whether a defect is likely to occur or not.

6.2.1.4 Measurement against industry norms

Quality defect rates seem not to be within acceptable tolerances, based on responses received from officials within the municipality and the Department of Housing. Statistics were not obtainable, nor industry norms. This was mainly as a result of none of the projects in the Pietermaritzburg area having been enrolled with the National Home Builders Registration Council (Janse van Vuuren, 2006). The only published guide obtainable was the Departments Housing Project Programming Guide, which indicated that completion inspections exceeded expected timeframes, as discussed in paragraph 6.2.1, above. Gitlow, et al, caution that industry norms on quality in relation to costs are seldom available (1999:186), thus motivating the need for quality performance measurement from an internal perspective to monitor progress on improvement. Findings of this study, can, thus be used to set a benchmark for quality performance of low-income house construction in the Pietermaritzburg area, and to guide research in other municipal areas.

6.2.2 Objective 2 : Causes of quality concerns

6.2.2.1 Actual findings

The "actual findings" relate to those emanating from Phase 1 of the research (see Chapter 4, paragraph 4.4.1, and Chapter 5, paragraph 5.2).

(a) Payment

Quality management should not be effected by outstanding payments as the developer has been paid for most of the units inspected.

(b) Severity

Finishing related matters were the main cause of defects (61,59%), thus the concerns appear to relate to minor issues in terms of construction. Less than 8% of defects related to structural issues.

(c) Workmanship

Poor workmanship in the screeding process had the highest frequency defect count. The main cause of units failing inspection was inadequate water supply, and had the second highest number of occurrences overall. Materials quality contributed the least to all defects found, overall, and within the respective sub-categories, thus contrary to the NHBRC findings (NHBRC, 2002a: paragraph 1).

(d) Priorities

Although the defects analysis indicates that workmanship issues are the main contributing factor to quality concerns, the Pareto analysis indicates that there are a mixture of defect types and causes that need to be addressed and across categories. These relate to both workmanship and materials, as indicated in Table 6.2, below.

Table 6.2 : Pareto analysis of defects

Main Category	Sub-category	Cause	Activity	Number of Occurrences	Priority
Finishes	Other finishes	Workmanship	Screed (Finishing work)	85	1
Incomplete work	Inadequate services		Water (inadequate infrastructure)	74	2
Finishes	Other finishes	Workmanship	Fitting frames (workmanship)	71	3
Finishes	Clearance	-	Site clearance	65	4
Major structural	Construction	-	Wall to plate (construction)	51	5
Finishes	Plumbing	Workmanship	Toilet (plumbing work)	48	6
Finishes	Other finishes	Material	Glazing (fitting)	42	7
Finishes	Other finishes	Workmanship	Corking (workmanship)	40	8
Finishes	Other finishes	Material	Plaster (material)	37	9
Finishes	Other finishes	Material	Door(material)	28	10
Finishes	Other finishes	Workmanship	Plaster (work)	26	11
Finishes	Other finishes	Material	Frames (material)	25	12

The Pareto analysis gives more specific details of critical issues that need to be resolved than purely using the frequency distribution.

6.2.2.2 Perceived causes

The perceived causes are those obtained from respondents in Phase 2 of the research (see Chapter 4, paragraph 4.4.2 and Chapter 5, paragraph 5.3).

(a) Confirmation of Findings

Respondents confirmed the findings in Phase 1 that quality concerns exist in low-income housing and that these are caused mainly by poor workmanship, thus also confirming the

NHBRC concerns. The causes relating to poor workmanship in the sample are presented in Table 6.3, below:

Table 6.3 : Causes of poor workmanship

Statement	Agreed (%)
- Lack of inspection during production processes.	**75.00**
- High volume production within shortest possible timeframes.	**75.00**
- Lack of quality awareness.	**75.00**
- Lack of competently skilled resources.	**62.50**
- Lack of commitment to quality.	**62.50**
- Lack of proper quality management systems	**62.50**
- Lack of experience.	**62.50**
-Lack of supervision.	**62.50**
- Lack of discipline	**62.50**
- Inappropriate recruitment processes.	**62.50**
-Poor training.	**62.50**
- Lack of financial support for training	**62.50**

(b) Acceptability of delivery rates

Respondents from the municipality and the department feel that the delivery rate of forty units per month is not acceptable, and therefore needs to be improved.

(c) Materials

Issues such as availability and quality of materials were not perceived to be the main cause, and this was confirmed by the findings of the defects analysis (Chapter 5, paragraph 5.3.1.3).

(d) Other causes

Respondents listed other possible sources, individually, (Chapter 5, Paragraph 5.3.1.7), but the extent thereof had not been examined. These need to be verified in future research.

6.2.3 Objective 3: Current quality management practice

6.2.3.1 Quality management systems

The municipality appears to have a weak quality management system which does not include all its internal and external role players. Ideally, both internal and external role players should be involved to optimize quality management efforts (Gryna, 2001:15).

From the perspective of the municipal officials, quality concerns are defined primarily by the municipality and the Department of Housing.

The developer appears to have a more advanced quality management system than the public sector participants, (thus confirming the statement made by Evans and Lindsay (Evans and Lindsay, 2002:75), however, inclusiveness of all stakeholders is unclear as mixed responses were received. The project managers indicated that quality concerns are defined primarily by themselves and the Department of Housing.

The Department appears not to have a formalised quality management system, and quality management does not involve all stakeholders. Concerns appear to be defined primarily by the Department of Housing. This indicates highly internalized quality focus, which also excludes the customer from taking responsibility for quality.

The institutions, thus, appear to have an internal focus to quality management that is not customer focussed and lacks involvement of all stakeholders. The adoption of a formal quality management system based on ISO 9000 principles, and implementation of proper strategies which are led from the top and incorporate measures to include customer satisfaction is needs to be adopted, as the customer is the key to quality (Kanji and Asher, 1996:1). ISO 9000 is a good foundation for aspiring to customer satisfaction, whilst guiding the various institutions on how to structure a quality assurance plan (Burke, 2003:242).

6.2.3.2 Correlation of quality management system with ISO 9000

Neither the municipality, nor the department undertakes regular company wide assessments in relation to low-income housing projects in the Pietermaritzburg area. The department does not follow ISO 9000 principles in terms of quality management. The developer however, appears to follow these principles and appears to have a more holistic approach to quality management than the organs of state. Whereas ISO 9000 is internationally recognized as the standard for quality management systems (Beckford, 1998:238), the principles should inform quality management systems within all three institutions for optimal performance.

6.2.3.3 Quality management policy

Neither the municipality nor the department has a quality management policy. This may partly explain the "weaker" system when compared to guidelines in the literature review. A quality policy is a guide that informs quality standards, e.g., it considers the extent to which higher quality demands impact on affordability to the organization and its customers, thus also signalling the level of quality that customers can expect (Gryna, 2001:185). In the context of low-income housing, this should also include minimum quality levels of finishes and component parts used in house construction, such as doors, window frames and house size. This will enable beneficiaries to have a more realistic expectation, and guide suppliers in the minimum specifications of products required.

6.2.3.4 Strategic quality management

Quality appears not to be part of the strategic management process within the municipality, thus it is not implemented through all line functions strategic activities. Beckford (1998:13) explains that quality cannot be achieved unless it is an inherent part of strategy, thus needs to be corrected to ensure a focused and integrated approach to quality. For this to occur, inputs are required from internal and external customers, and incorporated into strategic and financial plans that should include critical success factors against which performance is be measured (Gryna, 2001:167).

The organisational culture needs to be changed to a more focused approach on quality as part of all activities to ensure that effective quality service delivery is achieved in terms of quality goals set in strategic plans (Pike and Barnes, 1996:43). This needs to be led by top management (Develin and Hand, 1995:8).

It appears that the proper infrastructure is not in place to implement a quality management system, and there is a lack of ability to reprioritise resources to achieve quality targets. Management relies on exhortation (thus principally on motivational factors once the need has been proven (Gryna, 2001:184)) to achieve targets. These are obstacles to implementing a proper quality management system (Gryna, 2001:185), thus supporting the need for a phased approach to quality improvement and inclusion in strategic plans. A phased approach provides an opportunity for learning and improvement through pilot projects (Gitlow, et al, 1999:223).

Quality is said to be part of the implementing agent's strategic management process. Information on the availability of resources to implement a quality management system is inconclusive. Quality is led and supported by top management. And exhortation is not used as the primary means to achieve goals. An incremental approach is followed in problem solving, and quality strategies are said to be implemented throughout all line function activities. Such factors are enablers for quality management improvement (Gryna, 2001: 185). There appears to be an enabling environment to implementing total quality management in this organization.

The developer is, however, faced with the challenge of scepticism in implementing new systems. This can be overcome with a sound change management approach and by ensuring some tangible results are achieved quickly (Pike and Barnes, 1996:43).

Mixed responses were received regarding the inclusion of quality in strategic management processes within the Department of Housing. It appears that it may not be the case as quality is not perceived to be led by top management alternatively, staff may not be aware of the strategic plans. This needs to be corrected to ensure a focused and integrated approach to quality, whilst the culture should be changed over time to ensure effective quality service delivery is achieved in terms of quality goals set in strategic plans.

As is the case with the municipality, the Department would need to overcome many challenges in implementing quality management. It appears that the proper infrastructure is not in place to implement a quality management system, and there is a lack of ability to reprioritise resources to achieve quality targets. A phased approach will be required, coupled with suitable change management systems, and a culture focusing on quality throughout the supply chain (Pike and Barnes, 1996:43). This should be the responsibility of all managers, across activities and support functions. Quality improvement targets should be incorporated in their performance agreements (Pike and Barnes, 1996:24). As Deming (in McLaughlin, 1995:35) points out: "People work in a system. The job of the manager is to work on the system to improve it continuously with their help".

The use of a facilitator may add value where new quality initiatives are undertaken (Gryna, et al, 2001:201. The initial crafting of quality improvement strategies within either the Department or the municipality will require such assistance, and for such facilitator to perhaps assist with the first quality management project implementation. Such appointment needs to be coupled with a clear brief requiring a mentorship programme to allow skills transfer, and adoption of the system by the organization as its own.

6.2.3.5 Quality culture

The management environment within the municipality and the department, respectively, does not appear to be conducive to encourage a learning organization approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality (Gryna, 2001:251). It appears that managers mostly do not act as role models for ethical practices.

The management environment and organisational culture within the department does not appear to be conducive to encourage a learning organization approach. Individual and team performance measurement, evaluation and feedback appear to be lacking. This is essential in achieving quality and needs to be led from the top (Gryna, 2001:251). It appears that managers mostly do not act as role models for ethical practices.

In the case of the developer/implementing agent, quality is part of the organization's vision, however, management approach to learning from mistakes needs improvement. Individual and team performance measurement, evaluation and feedback appear to be lacking. Decisions are based on facts and staff are encouraged to share ideas freely. Managers also act as role models in relation to ethical issues. These aspects are enablers for quality improvement initiatives (Juran and Gryna, 1988:22.4). These findings also support perceptions that the developer's organization generally, adheres to ISO 9000 principles.

6.2.3.6 Quality management in administration and support activities

Mostly mixed responses were received indicating that staff are not equally aware of quality performance measurements for these activities. This may be as a result of the lack of application of quality management to all activities and the lack of strategic direction in the case of both the municipality and the department. Ideally all staff should be aware of key performance indicators used throughout the organization to ensure an integrated approach to achieving targets (Pike and Barnes, 1996:24 read with Kanji and Asher, 1996:2).

The developer measures finance activities on monetary value of invoices paid. The Department does not appear to measure the time taken to issue invoices, or percentage returned due to errors. It is thus, not possible for the Department to measure how many invoices are returned due to errors, or how long staff take to process these. Information technology is also not monitored on the turnaround times for reports that provide critical information to managers and monitors on project matters, and to developers on subsidy approvals. A lack of a proper information system relating to these issues poses a barrier to effective quality improvement implementation programmes (Beckford, 1998:26).

6.2.3.7 Quality management information systems

Neither the municipality nor the department appears to have a quality management information system in place for its low-income housing projects. An effective quality management information system is needed for the effective monitoring of projects and quality improvement initiatives (Gryna, 2001:656, and Beckford, 1998:26).

The developer's quality information management system appears to include typical project management information such as product design, specification and standards, material, equipment and supplier test results, work in progress and variation data. Attention needs to be given to customer data as this informs the product, monitoring of action plans, and progress to enable proper evaluation and feedback in performance reviews.

6.2.3.8 Inclusion of customer needs

There is a lack of a customer focus within the municipality. A customer orientation is critical to continuous improvement (Kanji and Asher, 1996:1). No proper market research and/or customer satisfaction surveys are undertaken.

Information on customer orientation from the perspective of the developer is inconclusive, although it appears that customer satisfaction is measured in terms of product features and freedom from deficiencies. The lack of shared views on the matter may point to a need to ensure a common understanding of quality in terms of the customer. This should be incorporated in strategic reviews, and should involve all staff (Pike and Barnes, 1996:24).

As is the case within the municipality, there is a lack of customer orientation within the department. It is noted from the literature review that there is a political element to low-income housing construction subsidised by government. The policies and procedures are prescribed by government, including norms, standards and beneficiary profiles. Market surveys and customer satisfaction surveys could, nonetheless assist government in planning future policies regarding housing, and should be explored in the interest of effective service delivery.

6.2.3.9 Tools and techniques

A variety of tools are used by the institutions, including some statistical methods. This is contrary to the statements received by officials from the department and the municipality regarding the use of statistical methods. It may be that the officials are not aware that check sheets and run charts are also means of collecting statistical information. Exposure to other tools through training could assist in improving quality management approaches, such as the use of Pareto analysis to prioritize quality concerns. Statistical tools are an important element of quality management. Total quality management requires a combination of statistical and technical techniques and management techniques (Gryna, 2001:15). A variety of tools should be used as reliance on one specific tool or technique may limit quality improvement initiative (Gitlow, et al, 1999:224).

Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes. This limits quality improvement as total quality management should incorporate both managerial and statistical tools and techniques to ensure management is based on facts, and to optimize quality improvement efforts (Gryna, 2001:185). Management training and exposure to different techniques could facilitate this process.

It appears that the developer has statistical process control systems in place to enable management by fact.

The findings on benchmarking practices were inconclusive from the perspective of the developer and the municipality. The department does not benchmark quality against competitors. It is noted, however, that the department is the main funding agent, thus is unlikely to benchmark to sustain a competitive advantage. Benchmarking in this case is still useful to measure performance against sound practice and to facilitate continuous improvement (Gryna, 2001:105).

The developer uses different problem-solving approaches to suit the situation at hand, through a diagnostic approach, thus applying total quality management techniques in identifying and solving problems for quality improvement. Project monitors from the department also use this approach. The inspectors do not use different approaches. Different approaches should be used for chronic and sporadic problems. Chronic problems have a higher frequency of occurrences, which are more problematic from a quality perspective and tend to be more significant (Gryna, 2001:96).

6.2.3.10 Supply Chain Management

The Supply chain management against world class standards was rated as transactional (Chapter 5, paragraph 5.3.2.6). Given the shortage of resources and relative inexperience in quality management systems, aspiring to world class supply chain management would be unrealistic.

Mixed responses were received regarding suppliers, and understanding of all role players of what they should be doing, and how it should be done, thus inconclusive information was obtained on this aspect. Suitable controls do not appear to be in place throughout the supply chain to ensure specifications are met. Self-regulation should be promoted in all instances as this is the ultimate form of quality control (Gryna, 2001:442).

The developer appears to be more advanced in its supply chain management according to World Class standards than the municipality and the Department of Housing. The project managers rated it between transactional and proactive. Nonetheless, given the challenges faced from other stakeholders in the supply chain, aspiring to be proactive in all cases would be more realistically achievable.

Departmental officials rated its supply chain management as transactional. Evaluation of suppliers is poor as performance of such suppliers is not rated against quality measures. Certified suppliers are not being used (although it is noted from the literature review that building contractors need to be enrolled with the National Home Builder Registration Council, and the relevant professionals need to be registered appropriately (Department of Housing, 2002b:2.1). Suppliers and the Department are perceived to understand their roles, responsibilities, and job requirements. The municipality is perceived to understand what is required but does not have the know-how. Communities are perceived to be lacking an understanding of what is required and how things need to be done in the context of low-income housing. Departmental officials were divided on the extent and suitability of controls, but disagree that these are in place within the communities. There appears to be some scope for self-control to be implemented, as most of the role players know what to do and how it is to be done. According to Gryna (2001:442), this is critical for self-control to succeed. In addition to this all role players must have a common understanding of how quality performance is measured in the context of low-income housing.

Chapter 3 (Paragraph 3.3.2) indicated a range of standards and specifications applicable to this sector. In spite of this, a range of defects still occur, thus indicating that specifications and standards on their own are not an effective means of quality assurance. Although product specifications, timeframes and costs are stipulated in the contract, these are not adhered to, thus resulting in variations to a project's scope. Variations to the contract are also not negotiated and formalised with all parties. This needs to be corrected urgently as it is critical in establishing trustworthy relationships, ensuring customer satisfaction, as well as monitoring reasons for variation to inform quality improvement, which needs to be included in organisational strategies. A formal scope change control system needs to be in place, based on sound project management principles (Burke, 2003:105). Such a system should clearly define the necessary change approval processes and documentation, and persons authorized to make changes. It must also provide for an impact analysis, the client's approval and communication to all stakeholders involved in the project (Burke, 2003:107). A proper system not only provides an audit trail, but ensures current and up to date information regarding the status of a project and its deliverables, whilst also informing future initiatives (Burke, 2003:106).

The perception is that product warranties are not in place, however, there are standard patent and latent defects warranties applicable (Department of Housing, 2005f: paragraph 4), thus illustrating the lack of knowledge of quality management systems in relation to housing. Product warranties are not typically measured. This should be initiated if chronic problems arise, as chronic cases need to be targeted for improvement (Gryna, 2001:96).

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects. Sample tests should be undertaken on critical materials (Gryna, 2001:419) such as cement mixtures, block strength and roofing material, as guided by the best practice guide for construction, SABS0400, and/or ensure Agrement certification is in place for unconventional methods, to ensure the continued use of sound quality materials (SABS, 1990:44).

6.2.3.11 Quality control and responsibility

The municipal officials view final inspections as the responsibility of the developer, municipality and Department of Housing. The inspections are said to be undertaken by the municipality and the Department of Housing.

The project managers perceived final inspections to be the responsibility of the developer, municipality, customer and Department of Housing. It is said to be undertaken primarily by the developer, customer and Department of Housing, but a quality score card is not used.

The departmental monitors indicate that a scorecard is not used. The inspectors had a mixed response to this. Final inspections are perceived to be the responsibility of all, yet are undertaken by the Department, only. Inspectors indicate that pre-inspection snag lists are not done. This may be as a result of this being done by developers, or that these are not done at all, however there is insufficient information to draw a conclusion.

A mixed response was received by all the role players, which indicates that there is no common understanding regarding roles, responsibilities and inspection criteria and processes. This needs to be corrected to improve quality in partnership with stakeholders, but also to develop self control as the ultimate form of quality control (Gryna, 2001:442).

6.2.3.12 Quality assurance and audit process

None of the institutions appear to have a quality assurance and audit process in place in the context of low-income housing developments. The municipality is, thus, not in a position to obtain independent reviews on actual quality performance, against the required standard. The aforementioned information is critical in continuous quality improvement initiatives (Gryna, 2001:682). The NAHB (American National Association of Home Builders) (2005f: paragraph 3) advises that such a system is critical in demonstrating that every reasonable effort has been made to ensure quality construction, should law suits occur. Ideally, such a system should be based on the ISO 9000 principles (NAHB: 2005a: paragraph 5).

One of the respondents eluded to the costs associated to quality control on site. Literature, however, has indicated that "quality does not cost, it pays" (NAHB, 2005d: paragraph 1, and Evans and Lindsay, 2002:107, to quote a few). The "perceived" costs could also be reduced by adopting a "100%, Zero defects" approach (NAHB, 1997a: paragraph 3). The constraints within the construction sector and use of local labour are noted (CIDB, 2002a: paragraph 2) however, members within the supply chain should strive to meet this challenge. Whereas the community may be viewed as a supplier of labour, the Department of Housing, in partnership with the municipality, developers and other stakeholders, should develop communities to enable them to provide work of a suitable standard.

6.3 OTHER CONSIDERATIONS

6.3.1 New **systems**

According to one of the municipal respondents, the Msunduzi Municipality has recently established a quality management committee to address processes and procedures. This could be an opportune time for the municipality to adopt a sound management system, based on ISO 9000, in order to set strategies and policies regarding quality for all municipal line function and support activities.

6.3.2 Department of Housing Policies

There is no formalised policy on quality management. Such a policy is needed to guide quality improvement and monitoring systems (Gryna, 2001:185). Such a policy should take into consideration the differences between communities, external environmental impacts and associated matters that impact on the viability of the projects.

The Department appears to rely on the existence of National Building Regulations and the activities of the National Home Builder's Association. Comments received indicate that the provisions of the National Building Regulations are not always applied. It is noted however, that these are "deemed to satisfy" standards, thus are subjected to interpretation which require a number of factors to be considered to ensure health and safety aspects (SABS, 1990:41).

6.3.3 Sustainability

A comment was received regarding sustainability in the context of housing delivery and economic development. This comment was in relation to the broader housing and development policies, and is not related directly to quality management in the construction of low-income housing. It is, however possibly an area for further research as the state of the economy and affordability to government and the private sector to deliver, would impact on determining an agreed level of quality for a housing unit.

6.3.4 Process and procedures

A comment was received that intimates that the inspectorate should be a separate component within the Department to deal only with building inspections. Beckford, (1998:26) supports the approach of having a quality assurance component separate from the production function to avoid conflicting targets between these two elements. The Department does not construct houses itself, but does this through the municipalities and the private sector. The Department has a project management component that monitors delivery against funding agreements (Department of Housing, undated^ : 36). The Department may need to consider this, should inspections become a primary line function activity, in the absence of this being done through any other means. It is also noted, however, that municipalities have a role to play in terms of approving building plans, and inspections, (Department of Housing, 2002b: 1.1). The National Home Builders Registration Council may also be in a position to assist (NHBRC, 2002b: paragraph 5). These provisions may further negate the need for a specialized component for inspections. Rather, consideration should be given to use experienced inspectors as a means of providing hands on training in construction processes and requirements to communities.

The Department needs to resolve its capacity issues to enable a more proactive approach to housing delivery, including regular site visits to also monitor the presence of building professionals and other quality controllers. In theory, as the supply chain management system improves, the need for this will reduce over time as all role-players should have a common interest in achieving quality goals, through partnerships based on trust and with less focus on bureaucratic processes at all levels (Burt, et al, 2003: 8). The reduction in bureaucracy is a challenge to organs of state due to legislative requirements regarding public funds, but at the very least processes should not involve unnecessary duplication or non-value adding activities (Burt, et al, 2003:28).

6.3.5 Performance management

Performance management is required, but developers require this to be reciprocal. Theoretically, a "World Class" supply chain management places less focus on performance against contract as parties trust each other to honour agreements (Burt, et al, 2003:82). The Department, however, is required to monitor contracts closely due to the implications of the Public Finance Management Act (Act 1 of 1999). Standard target time frames should be developed for all critical activities throughout line function and support units, and these should be communicated to stakeholders to enable them to plan effectively, and to integrate quality in production planning (Gryna, 2001:464).

6.3.6 The end-user

Greater consideration is needed of the end-user.

It appears that problems are experienced with allocation processes in that incorrect beneficiaries are occupying units intended for others. This could be construed as poor quality service delivery. A strategy is needed to resolve this matter and this should include representatives from the target groups.

Other training programmes should be aimed at a needs based approach within municipalities and communities, thus requiring a more targeted and customized approach, based on a proper needs analysis and understanding of customer requirements (Pike and Barnes, 1996:24). Such training should be ongoing and not take the form of once-off workshops. Community training should include home ownership and maintenance issues.

6.3.7 Learning curve effects

One respondent indicated that there are learning curve effects. The learning curve is a relationship between the number of units produced (to specification) and the time taken to produce them optimally (Burt, et al, 2003:419). The sooner a new task is mastered, the quicker and more effective the rate of production, thus learning curve effects need to be expedited (Burt, et al 2003:419). The potential of using this to improve quality is limited in the current format as the learning curve commences from first principles within every new project area due to community pressures to use local labour only. Mixing skilled labour from other areas could expedite the learning curve effects. This should be negotiated upfront with communities as the end-user, and also supplier of labour, within each project area, thus emphasizing the need for community involvement in the conceptualization stages.

6.3.8 Product quality features : size or durability

One of the respondents indicated that as the subsidy increases (to negate inflation) there appears to be a drive to increase the unit size (which contradicts the reason for escalation increases). It was suggested that the focus should shift to increasing product durability in terms of either higher specification and/or more durable material. These possibilities should be considered by the Department, but should also be based on the equivalent of a market research, but also taking cognizance of the unique needs of each community. These issues could be incorporated into a quality policy.

6.4 SUMMARY

It was confirmed that quality concerns exist in low-income housing projects in the Pietermaritzburg area. The nature and extent of defects have been quantified, and the current systems to maintain quality management within the municipality, developer and department have been explored.

This study has achieved its objectives as house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area, and the causes thereof have been identified, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal. The status of quality management systems has also been obtained.

Role players are at different stages of advancement with regard to quality and supply chain management. The Developer appears to be most advanced and has a more conducive environment to implement total quality management than the organs of state. The organs of state appear to have limited resources according to responses received to implement quality management systems and are faced with the typical challenges to total quality management. In spite of these, quality management and improvement should drive service delivery improvement as the basic principles of quality management are equally applicable to service delivery (Gryna, 2001:492). It is also relevant to the pubic sector, which is required to deliver quality services at lower costs to meet public expectations (Beckford, 1998:10).

CHAPTER 7 : RECOMMENDATIONS

7.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area.

The findings recorded in Chapter 5 illustrate that there are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship. The municipality, department and developers have a range of different approaches to quality management. This chapter presents recommendations in terms of the findings and conclusions.

7.2 RECOMMENDATIONS

7.2.1 <u>Strategic Quality Management</u>

7.2.1.1 The Department of Housing needs to take the lead in the drive for quality, through its vision, policies and strategies (Evans and Lindsay, 2002:120 and 130). It needs to work together with all stakeholders to form quality partnerships (Evans and Lindsay, 2002:182). This should be part of its strategic plans, which should include all staff so that they can take ownership and responsibility, and provide inputs to quality improvement initiatives (Kanji and Asher, 1996:2). This should be applicable to all activities as such an approach would enhance service delivery perceptions both internally and externally.

7.2.1.2 A phased approach coupled with suitable change management systems will be required. All managers should be accountable across activities, including support functions, and quality improvement targets should be incorporated in their performance agreements. In the case of new quality improvement initiatives, a facilitator may be appointed for guidance (Gryna, et al, 1999:199). The initial crafting of quality improvement strategies within the Department and municipality may require the appointment of a facilitator to guide initial implementation. Such appointment needs to be coupled with a clear brief.

7.2.1.3 The crafting of a quality policy should be prioritized by all stakeholders, as this should inform standards and measurements for all activities, and inform key aspects of product and service specifications (Evans and Lindsay, 2002:645). It is also a guide used to consider the financial impact on the organization and its customers (Gryna, 2001:185). In the context of low-income housing, such a policy should take into consideration the differences between communities, external environmental impacts and associated matters that impact on the viability of the projects, and inform the general housing subsidy policies. It should also consider the minimum levels of finishes and component parts used in house construction, (such as doors, window frames and floor area/size), and guide decisions on size versus durability type improvement. This would inform beneficiaries of what they can expect and guide suppliers in conforming to acceptable quality standards.

7.2.1.4 A proper planned change management system needs to be in place for quality improvement initiatives to succeed (Pike and Barnes, 1996:77), and should be led and supported by top management (Develin and Hand, 1995:8). It requires sound people based management (Kanji and Asher, 1996:2). A change in management culture is required within the Department to facilitate a learning organization, failing which a quality management system will not be successful. This needs to be led by top management. Progress on these aspects needs to be monitored carefully through staff satisfaction surveys incorporating specific elements such as the extent to which staff are encouraged to share ideas, learn from mistakes, etc. Such surveys would also need to address the various management levels to determine more accurately where problems are, but this would need specialist assistance and should be dealt with sensitively to avoid victimization of both workers, and managers. This would require very specific elements of improvement to be identified, with carefully identified monitoring and evaluation systems.

7.2.1.5 Some quality management initiatives need to be identified that would produce tangible results quickly to facilitate commitment and faith in quality improvement efforts (Pike and Barnes, 1996:43).

7.2.2 ISO 9000

Whereas ISO 9000 is an internationally recognized quality management system, its application would benefit all role players (Evans and Lindsay, 2002:137). Developers are likely to benefit the most as it can provide them with a competitive advantage in the market. It could also inform departmental and municipal procurement processes as ISO certification could provide quality assurance in procurement processes. Whereas it appears that the Department does not have a formalised quality management system, the ISO 9000 standards should be used to guide the development of such a system.

7.2.3 Benchmarking

7.2.3.1 Benchmarking is a means of improving quality based on best practice, and as such it is an essential tool in comparing performance in the market (Spendoli, 1992:8). It may be difficult for the Department to identify a benchmarking partner locally, but it could explore alternatives such as non-governmental organizations (NGO's), the eThekwini Municipality (Durban) and/or other government departments, or housing departments in other provinces. The department should endeavor to identify a suitable benchmarking partner to facilitate quality improvement.

7.2.3.2 In the absence of industry norms on accepted defect rates in low-income housing in the Pietermaritzburg area, the findings of this study could serve as a benchmark. This would be an interim measure, be a starting point in addressing quality concerns in this area, whilst also guiding studies in other municipal areas. Targets need to be set to improve the number of defects. A Pareto analysis indicates how a significant impact can be made by prioritizing those aspects that cause 80% of the problems (Kanji and Asher, 1996:56). The prioritization of areas needing improvement, in accordance with the findings of the Pareto analysis, as set out in Chapter 5, paragraph 5.2.2.3, will greatly reduce the defect rate. This will require a detailed quality improvement plan including actions, task allocation, resource requirements and timeframes. Whereas a project management approach is typically used to coordinate and implement quality improvement initiatives, (Gryna, 2001:199), quality improvement in the Pietermaritzburg area needs to be led by an experienced project manager, supported by an appropriate multi-disciplinary team.

7.2.3.3 Statistical methods are critical in informing improvement measures and for evaluation purposes (Oberlender, 2000:232). Whereas averages were used in this study, the differences in defect rates between project areas were not highlighted. Different projects may well have different causes of defects, thus, a project by project approach should be developed, as different sources of labour are used in each project area (as advised by Respondent 4, Chapter 5, paragraph 5.3.3, "Socio-political"). This should be informed by more quantitative measures being explored in recording the occurrence of problems through well defined, and mutually agreed check sheets, and or control charts that should be kept and maintained on site. The content, measurements and analysis techniques must be agreed between all stakeholders to facilitate a mutual understanding of uniform data recording, processing and analysis systems and to ensure effective implementation.

7.2.4 <u>Information management</u>

7.2.4.1 Inadequate information systems impair quality management (Beckford, 1998:26). Both the Department and the municipality need to urgently address their information management systems to include these activities to enhance quality management in terms of supplier management, project management, delivery and defect rates, and variations to contract. The system needs to include organisational goals; key performance indicators; actions plan for improvement; progress measurement; evaluation and feedback mechanisms; customer requirements and satisfaction data; product design, specification and standards; and material, equipment and supplier test results; delivery cycle timeframe projections, actual delivery timeframe and timeframe variation; and other variation data and problem solving process management data (Gryna, 2001: 656). These factors are required for effective project management.

4.2 All role players need to ensure proper records of inspections, supported by a database. These should include the project visited, site numbers, stage of the inspection, results on pre-agreed aspects and standards for inspection, as informed by the inspection guide to be developed. This will reduce duplications as well as serving as a record for statistical analysis and future research.

4.3 The developer's system should also be improved to include action plans and progress to enable proper evaluation and feedback in performance reviews.

5 Quality control

5.1 All role players should adopt a suitable audit and quality assurance system. ISO 9000 standards could be used to guide the development of an efficient system (NAHB:2005a: paragraph 1).

5.2 Inspection procedures need to be formalised. Clear guidelines need to be developed by the Department of Housing, in consultation with all stakeholders regarding inspection criteria, and quality expectations, including a description of what customers can expect in terms of level of quality. The tolerances, conditions, frequency of inspections and sample size criteria also need to be defined. Documents drafted by the Eastern Cape Provincial Government, the National Association of Home Builders (NAHB), and the Construction Industry Development Board (CIDB), as listed in the references attached to this document, could facilitate this process.

5.3 Elements identified as critical in the proposed inspection guide should be part of a well defined inspection score card. On site control charts should be available to inform decision makers on quality improvement initiatives, and this would also clarify whether pre-inspections were done, and action taken to resolve issues.

5.4 Burke (2003:105) indicates that a formal scope change control system should be in place, based on sound project management principles. The findings of this study indicate that variations to the contract are not negotiated and formalised by all parties. This needs to be corrected urgently as it is critical in establishing trustworthy relationships, as well as monitoring reasons for variation to inform quality improvement, which needs to be included in organisational strategies. The change management system should provide for variations to be informed by the implications of changes to the project scope (time, cost and quality trade-off), acceptance by the customer/client and appropriate approval processes (Burke, 2003:106). Variations need to be properly recorded and communicated to all stakeholders, including inspection staff to ensure a common understanding of revised requirements and its implications on subsequent processes (Burke, 2003:106).

7.2.5.5 Control charts and score cards should be maintained on all sites to assist in performance management and problem solving abilities, whilst also serving as a quality audit. The format of this should be agreed by all parties so as to understand the interpretation of results.

7.2.5.6 Poor materials generally increase the cost of quality (Gryna, 2001:403). Sample tests should, therefore, be undertaken regularly on critical materials (Gryna, 2001:419). Although very few defects in critical materials were found in this sample, sample tests should be undertaken on critical materials such as cement mixtures, block strength and roofing material, as guided by the best practice guide for construction, SABS0400, to ensure the continued use of sound quality materials. This should be the responsibility of staff on site, supported by a proper system for recording data (NAHB, 20051: paragraph 4 and 2005m, paragraph 3).

7.2.5.7 The National Building Regulations need to be revisited in the context of low-income housing, and should be simplified to facilitate a common understanding, even by emerging contractors. Such revisions should be informed by sound building practice and consumer needs, and need to be incorporated into inspection sheets and guidelines of the Department of Housing.

7.2.6 **Customer Focus and Market Intelligence**

7.2.6.1 Leadership needs to create a customer focused vision with clear quality goals which should be incorporated in strategies (Evans and Lindsay, 2002:223). The lack of shared views on customer needs awareness may point to a need to ensure a common understanding of quality in terms of the customer. This should be incorporated in strategic reviews and involve all staff, as quality is defined by both internal and external customers (Gitlow, et al, 1999:3).

7.2.6.2 Market surveys and customer satisfaction surveys would contribute towards a sustained competitive advantage for developers, whilst improving perceptions of service delivery by organs of state (Evans and Lindsay, 2002:184, read with Beckford, 1998:10).

7.2.6.3 Market surveys and customer satisfaction surveys could assist the government in planning future policies regarding housing, and should be explored in the interest of effective service delivery. Organs of state need to ensure a proper customer orientation and recognition of a range of quality needs to be incorporated in a quality policy. This should incorporate housing allocation. It should also consider matters such as how additional funding should be applied to units (bigger size versus durability). This needs to be based on research and local needs, through customer satisfaction surveys (Evans and Lindsay, 2002:184), as it is the customer that defines the extent to which quality is achieved (McLaughlin, 1995:32).

7.2.7 **Performance management plans**

Performance management systems within all institutions should include measures on quality performance initiatives, as defined by the organization, and including all staff. Measures to monitor adherence to ethical standards should be explored, and this may also be an area for further research.

7.2.8 **Process Management**

7.2.8.1 The Department should explore the option of larger contracts, over longer periods of time, but phased appropriately through a systems and programme management approach. This could enhance economies of scale benefits; allow developers to develop their staff and subcontractors over time; thus improving proficiencies in performing on contracts; increase predictability of work flow; and supports long term jobs and skills development (CIDB, 2006:8).

7.2.8.2 Delivery rates (at each stage of the inspection) also need to be programmed and monitored, and communicated to all stakeholders to enhance supply chain management activities, including "just in time" principles (Evans and Lindsay, 2002:367). This should also apply to the Department.

7.2.8.3 A partnership approach should be adopted where possible as this provides a mechanism for sharing risks, skills and expertise and increases the predictability of outcome (CIDB, 2006:4). Joint planning and cross functional teams optimize the knowledge base for quality improvement systems and facilitate the incorporation of quality into all processes (Evans and Lindsay, 2002:365). The Department should develop and communicate the expected timeframes for its internal processes to assist stakeholders in their planning activities and ensure that such stakeholders are involved in the process. The nature of housing projects involve different professional services, thus there is a source for the development of cross-functional teams.

7.2.8.4 From this study, the municipality needs to resolve its processes relating to the processing of water connection application forms, and ensuring water connections are done prior to verification inspections being undertaken by the Department. This could be facilitated through an appropriate information and coordination by an assigned project manager.

7.2.8.5 The developer needs to correct tardiness on site to ensure site clearance has been done (SABS 1990, 63). This needs to be addressed through the site supervisor, but should also be enforced as a standard practice as the responsibility of all site staff (NAHB, 20051, paragraph 4).

7.2.9 **Training**

7.2.9.1 Change management training in the context of quality management, and training on quality improvement through human resources (including performance appraisal systems) needs to be developed and implemented. This could be measured by the extent to which improvement targets are achieved by the municipality and Department of Housing.

7.2.9.2 Human resource management training is required in the context of "the learning organization and quality management approach" to encourage an environment where staff are able to learn from mistakes.

7.2.9.3 Employee and team appraisal need to be pursued to facilitate a conducive environment for quality improvement. Quality circles tend to focus on problems related to personal well being of staff and their frustrations (Gryna, 2001:202), thus this tool may assist in communicating concerns based on punitive approaches to management, where these are perceived to exist.

7.2.9.4 Exposure to a variety of statistical tools could assist in improving quality management approaches, such as the use of Pareto analysis to prioritize quality concerns.

7.2.9.5 Quality management should involve the entire organization, thus training needs to be customized to the needs of each level within the organization, and across functions (Oberlender, 2000:319). Departmental and municipal staff need to undergo quality management training at all levels which should include training on problem solving techniques in the context of low-income housing. It should include the basics of quality management philosophy, cause and effect analysis and basic statistical techniques, as well as interpersonal relations, basic supply chain management and quality management in the context of projects in general.

7.2.9.6 One of the respondents referred to the costs associated to quality control on site. Literature, however, has indicated that "quality does not cost, it pays" (NAHB, 2005d, paragraph 1, and Evans and Lindsay, 2002:107, to quote a few). The "perceived" costs could also be reduced by adopting a "100%, zero defects" approach (NAHB, 1997a: paragraph 3), as doing things right the first time will always be cheaper (Crosby in Evans and Lindsay, 2002:106). The optimum level of quality management must be determined through proper cost benefit analysis, taking cognisance of failure costs, inspection costs and prevention costs (Gitlow, et al, 1999:178).

7.2.9.7 Practical hands on training on how to undertake housing projects in all aspects, especially relating to the municipality and the community needs to be pursued by the department. This should also include modules on controls required to ensure compliance with specifications. Training on the latter should only be done once the Department has completed its guide on inspections, which ideally, should involve all stake holders.

7.2.9.8 Inspection staff and monitors within the department can facilitate hands on training by assisting with corrective action on site during inspections and/or site visits. This could be further enhanced through the use of the control charts, as recommended, as these could guide areas of concerns, and with analysis on a Pareto, could highlight where training impetus is required. Based on the findings of this study, the correct mixing of cement and application of screeding techniques (topping of the slab) should be the first priority within this particular municipal area, followed by the fitting of window and door frames and block work on walls.

7.3 SUMMARY

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. This chapter presents recommendations in terms of the findings and conclusions. The most critical items are summarized as follows:

(1) The adoption of a quality management policy that incorporates all stakeholders;

(2) The inclusion of quality management in strategic plans with a phased implementation programme;

(3) Partnership development and joint planning with all role players;

(4) Use of larger contracts, over a longer period of time through a programmatic systems approach;

(5) Identification of benchmarking partners;

(6) The adoption of an audit and assurance mechanism, based on ISO 9000;

(7) Development of a learning organisation and change management culture, led from the top;

(8) The inclusion of quality performance targets in managers' performance reviews;

(9) Clearly defined inspections procedures and documents (including roles and responsibilities), and availability of these on site;

(10) Information management systems upgrading;

(11) Revision to National Building Regulations in the context of low-income housing;

(12) Improved municipal strategies on water connection;

(13) On site training regarding topping of slabs, fitting windows and door frames and block work; and

(14) Training of all managers and staff on all aspects of quality management theory, tools and techniques, and specifically in relation to low-income housing.

Whereas limitations were applied to the study (as outlined in Chapter 4), these and other limitations and recommendations for future research are discussed in the next chapter.

CHAPTER 8 : LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

8.1 INTRODUCTION

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. Limitations were applied to the study. These limitations and recommendations for future research are discussed in the section below.

8.2 LIMITATIONS

8.2.1 The following limitations were applied to the study (as outlined in Chapter 4):

(1) The units were inspected during 1 April 2005 to 31 December 2005 with complete datasets;
(2) The units were from low-income housing projects that have been initiated by the municipality, aimed at addressing slums clearance;
(3) The units were all from active projects (i.e. more housing unit construction is still underway);
(4) The units were inspected by the same inspection team.

8.2.2 Limitations were applied to the sample and this resulted in data being obtained from one developer only, thus reducing the ability of comparing types and efficiencies of quality management systems. Due to time constraints to the research, a Delphi technique was not feasible. The Delphi technique is useful to obtain consensus amongst all participants, and based on expertise in the field (Heizer and Render, 2004: 107).

8.2.3 The research focused on the Pietermaritzburg area only and should not be viewed as representing quality management in all low-income housing projects, as environmental factors vary between towns, areas and projects. In this regard, a sample was obtained from the Department on a population of low-income housing projects in the uMshwati municipality, and is attached as *Appendix 16*. The findings were not discussed as the data represents a different population. This study looked specifically at quality problems, the nature and extent thereof in projects in the Pietermaritzburg area, thus an analysis of the data relevant to the uMshwati municipality would be beyond the scope of this particular study. It could be considered for future research, either as a comparative study, or to identify quality concerns in low-income housing in that municipal area.

8.2.4 The research was qualitative, thus making it difficult to accept or reject a hypothesis, which is a limitation to effective hypothesis testing (Cooper and Schindler, 2001:138). They explain nonetheless, that qualitative research with an emphasis on detail is a valuable contribution to problem solving, evaluation and strategy, and provides a source for new hypothesis.

8.2.5 A trend analysis (i.e. an analysis that looks into the frequency of an occurrence in relation to specific time intervals (Wegner, 2002:329) was not part of the scope of this research, but may be useful in future research to illustrate whether quality defects occurred mainly in the start-up phase and levels off due to learning curve effects (which may be expected) or whether these occurred consistently throughout the project life cycle.

8.3 RECOMMENDATIONS FOR FUTURE RESEARCH

The following recommendations are made for future research, taking into consideration:

8.3.1 A detailed trend analysis was not done, but could be useful to associate defects with economic trends to illustrate the impact of the macro environment on housing delivery.

8.3.2 A more detailed investigation is required to assess reasons for delivery timeframes exceeding the Department's guide. These also need to be explored to inform the Department's benchmark, and refreeze the target, if necessary, in terms of change management and performance management principles.

3 Whereas it was indicated that this research identified quality concerns in the Pietermaritzburg area only, a similar study should be undertaken in other areas to confirm trends and defect rates within the Province, especially in view of the lack of information in this regard. Also, this can be done on a project by project basis where poor performance is identified, either in terms of lengthy timeframes, or units failing inspections, or high frequency concerns raised by inspection staff. Once an inspection score card is developed, this could signal which projects need to be targeted for such a study.

4 The data obtained in respect of the uMshwati Municipality *(Appendix 16)* could be used to undertake a study in that area, or to compare quality concerns and systems between the two municipalities.

5 Whereas respondents were divided in some responses, a Delphi technique will improve the interpretability of data as it results in one agreed expert response from participants. This could also be applied to the following possible causes of quality defects, as provided by individual respondents in this study:

- Poor selection of contractors;
- Lack of cooperation from the implementing agent;
- Poor education of the end user (including home ownership responsibilities and house maintenance);
- Lack of proper site supervision, and absence of engineer and/or building professionals on site;
- Unskilled supervisors and lack of qualified trainers on site;
- The impact of a set subsidy and product, limited experienced and qualified skills and appropriate supervision and cost implications to the developer;
- Scope of work not being fully explained to the work force;
- Lack of proper equipment;
- Lack of inspection resources within the municipality; and
- Extent to which National Building Regulations are practiced.

8.3.6 This research did not include perceptions of quality from the perspective of beneficiaries (as the ultimate end-user). Research surveys could assist all role-players to improve their "customer" profiles. It is critical to quality management which requires a sound understanding of customer needs in terms of quality (Evans and Lindsay, 2002:184 and Gitlow, et al, 1999:3).

8.3.7 A comment was received regarding sustainability in the context of housing delivery and economic development. This comment was in relation to the broader housing and development policies, and is not related directly to quality management in the construction of low-income housing. It is, however, possibly an area for further research, as the state of the economy and affordability to government and the private sector to deliver would impact on determining an agreed level of quality for a housing unit.

8.3.8 Gryna (2001:656) indicates that there are a number of electronic information systems that could be used for quality management. An analysis of such systems and recommendation of those most suitable to provincial and local government departments involved in projects such as low-income housing would assist in improving the performance of organs of state.

8.3.9 Respondents were not clear on the extent to which managers conduct themselves ethically. Ethics in low-income housing construction could be influenced by many factors due to the political nature of housing in the country, thus may be an area for further research. This could include ethical consideration of all professions involved in housing (engineer, conveyancer, land surveyor, town planner, building professional, social facilitator), in terms of ethical standards of the profession, and in relation to ensuring quality in the interest of beneficiaries, and balancing this against the ultimate goals of business, being profit.

This study was an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. Whereas limitations were applied to the study, these were discussed in this chapter together with recommendations for future research. Final conclusions are discussed in the next chapter.

CHAPTER 9 : FINAL CONCLUSION

This study is an investigation into quality concerns in house construction in government-subsidised low-income housing projects in the Pietermaritzburg area. It is informed by total quality management literature. It investigates the problems statement that "ongoing quality concerns in low income housing have allegedly not been addressed adequately".

In 2005, the National Minister reiterated the need to focus on quality (Sisulu, 2005a:2). She quoted unpublished research which indicates that shoddy construction has been found in the form of poor roofing, cracks, weak doors, damp, poor foundations, and no floors (Sisulu, 2005c:4).

This study is motivated by aspects including: (1) government's accountability for public funds; (2) serving as base research for improved resource allocation; (3) and for quality improvement and sustainability strategies; (4) creating an opportunity for introspection by other members in the supply chain; and (5) a responsibility of all stakeholders to realise the ultimate goal of customer satisfaction.

The research was approached in two phases. Phase 1 was designed to identify whether quality concerns existed in the low income housing projects in the Pietermaritzburg area; and to identify the nature and the extent thereof. Phase 2 was designed to explore the perceived causes of quality concerns, and to identify the systems used by the municipality, its developing agent and the Department of Housing, to ensure sustained quality management.

The findings from Phase 1 illustrate that there are quality concerns in Pietermaritzburg in relation to government-subsidised low-income housing which were caused mainly by poor workmanship, especially the topping of slabs (i.e., the process in which a final layer of cement is applied to smoothen the floor surface, also referred to as "screeding"). The Pareto analysis indicates that there is a mixture of defect types and causes that need to be addressed, and in order of priority. These are : (1) screeding; (2) water connection; (3) fitting frames; (4) site clearance; (5) constructions of walls; (6) plumbing, specifically toilet fittings; (7) glazing; (8) corking/filling of gaps; (9) plaster material; (10) door quality; (11) plaster work; and (12) the quality of frames.

The findings from Phase 2 indicate that role players are at different stages of advancement with regard to quality and supply chain management. The developer is more advanced in the application of quality management systems that the public sector.

The institutions appear to have an internal focus to quality management that is not customer focussed and lacks information and involvement of all stakeholders. There is no formalised policy on quality management. The institutions do not appear to have a quality management strategy, or to have a fully integrated quality perspective. Quality assurance and audit process are also lacking. Neither the municipality nor the Department appears to use statistical process control systems to measure and analyse all processes. There is no common understanding of roles, responsibilities and inspection criteria and processes, and external and internal role players are excluded from quality management processes.

It appears that the proper infrastructure is not in place to implement a quality management system. Information systems are poor.

The management environment within the municipality and the department do not appear to be conducive to encourage a learning organisation approach.

Materials quality is not monitored, although it is noted that materials are not perceived to be the cause, and from the sample it is clear that materials have not contributed much to defects.

The literature review indicates that proper quality management can reduce costs by lowering waste (Gitlow, 1999:172). Poor quality wastes human capital and talent, which demoralizes individuals and contributes to destructive anti-social behaviour (Beckford 1998:7). Such waste must be minimized to maximize employee satisfaction, thus enhancing productivity (Beckford, 1998:10). The literature indicates that the need for quality is equally applicable to the public sector, as observations have been made of governments and society expressing dissatisfaction with public sector cost and effectiveness (Beckford, 1998:5). The public sector is required to deliver services at the same or lower cost to meet public expectations (Beckford, 1998:10). Application of total quality management in this sector has been slow (Evans and Lindsay, 2002:75).

The evaluation of quality concerns, assists in (i) quantifying resultant and subsequent problems if quality is not addressed; (li) identifying other problem areas; (iii) identifying the exact cause of quality problems; and (iv) creates opportunities to identify cost saving and customer dissatisfaction reduction initiatives (Gitlow, et al, 1999:182).

The findings of this study provide a basis for evaluating quality concerns and its causes in low-income housing house construction in the Pietermaritzburg area, thus identifying areas needing improvement and appropriate recommendations in respect thereof. Research limitations had been identified and recommendations have been made for future research.

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APPENDIX 1

SUMMARY OF PROCUREMENT LEGISLATION

(Adapted from the Department of Housing, *User's Guide to standardized procurement documentation, 2002.)*

Table 1: An overview of procurement legislation in South Africa

Specification	Reference to Procurement	Applicability	Comment
State Tender Board Act (Act 86 of 1968)			
	This Act provides for the regulation of the procurement of supplies and services for the disposal of moveable property of, and the hiring or letting of anything or the acquisition or granting of any right for or on behalf of, the state and to that end establishes a State Tender Board and provides for the establishment of a regional tender board.	National and provincial departments	Provincial procurement is governed by provincial legislation, which in the main, are modelled on the State Tender Board Act. The cabinet of the government of South Africa resolved in November 2000, to repeal the national and provincial tender board acts.
Local Government Transitional Act (Act 209 of 1993)			
10G	A municipality is required to award contracts for goods and services in accordance with Section 217 of Act 108 of 1996.	Local sphere of government	
(5)(a) To(c)	The Act requires that the granting of preferences be made public and permits municipalities to dispense with the calling for tenders in the case of an emergency or of a sole supplier or within such limits as may be prescribed by national law.		
10H	Sets out restrictions placed on councillors and officials with respect to any interests that they may have or benefits derived through contracts which are awarded.		
Constitution of the Republic of South Africa (Act 108 of 1996)			
217	Procurement must be conducted in accordance with a "system which is fair, equitable, transparent, competitive and cost effective." An organ of state must implement a procurement policy providing for categories of preference in the allocation of contracts and the protection or advancement of persons, or categories of persons disadvantaged by unfair discrimination in accordance with a framework contained in national legislation	All organs of state	

Public Finance Management Act (Act 1 of 1999)			
38(a) and 51(a) 76(4)	Accounting officers (head of departments / CEOs) and Accounting Authorities (boards / CEOs) are required to ensure that their organisations have in place an appropriate procurement and provisioning system which is fair, equitable, transparent, competitive and cost effective; effective, efficient and transparent systems of financial and risk management and internal control and a system for properly evaluating major capital projects prior to a final decision on a project. The National Treasury may make regulations or issue instruction concerning the determination of a framework for an appropriate procurement and provisioning system.	All organs of state, except in the local sphere of government.	A Municipal Finance Management Bill (MFMB), which mirrors the PFMA, is currently before parliament.
Preferential Procurement Policy Framework Act (Act 5 of 2000)			
All	This Act gives effect to Section 217 of the Construction by providing a framework for the implementation of the procurement policy embedded in the Constitution	All organs of state.	
'Construction Industry Development Board Act (Act 38 of 2000)			
5(1)(a)and 5(3) 5(2) 5(4) 16 and 18 18 and 22	The CIDB is empowered within the construction industry to promote and implement policies, programmes and projects aimed at procurement reform, standardisation and uniformity in procurement documentation, practices and procedures within the framework of the procurement policy of government; and best practices. The CIDB is charged with the establishment and maintenance of a national register of contractors which facilitates public sector procurement and a register of projects. It may also establish a register of suppliers, manufactures or service providers in the construction industry. The CIDB must publish a code of conduct for all construction-related procurement and all participants in the procurement process and may implement programmes aimed at standardisation of procurement documentation, practices and procedures. The Minister of Public Works must prescribe the manner in which public sector contracts may be invited, awarded or managed within the framework of the register and policy on procurement. Only contractors who are registered with the CIDB are permitted to undertake, carry out or complete construction works or a portion thereof. All construction contracts above a prescribed value must be recorded in the register and be subjected to a best practice project assessment.	All organs of state which engage in construction industry related procurement.	The Construction Industry Development Board (CIDB) has only recently been established and must within three years of their establishment establish the registers of contractors and projects and, within a reasonable period thereafter, establish a best practice contractor recognition scheme.

*(*Note : The Construction Industry Development Board Regulations have not been included in the Department's Documents. The Regulations are published under Notice 63 of 2004, government Gazette 26427. These are aimed at ensuring uniformity, transparency and predictability of procurement in construction processes, as discussed in paragraph 4.1.2 of this report.)*

APPENDIX 2

LIST OF STANDARDIZED PROCUREMENT DOCUMENTS : DEPARTMENT OF HOUSING

1. SUMMARY OF MINIMUM STANDARDS FOR PROCUREMENT LOW-INCOME HOUSING (Adapted from Department of Housing *User's Guide to Standardised Procurement Documents)*

These include the minimum standards for:

(1) issuing, receiving and evaluating tenders, including preferencing requirements;

(2) provides standard conditions of tender that are suitable for all methods of evaluation and preferencing in relation to housing;

(3) identifies professional services, engineering and construction works and standards of key outputs, and desired minimum performance standards in respect of each output;

(4) returnable documents and format of submission;

(5) drafting contracts;

(6) performance requirements and measurement;

(7) pricing instructions and schedules

2. SPECIFICATION AND TENDER DOCUMENTATION

Table 1: Documents that relate to the Tender

Number	Document
Part l:Tendering procedures:	
Tl.l	Tender Notice and Invitation to Tender
T1.2	Tender Data
Part 2: Returnable documents:	
T2.1	List of Returnable Documents
T2.2	tender Schedules

Table 2: Documents that relate to the Contract

Number	Document
Part 1: Agreement/ Contract Data	
Cl.l	Form of Offer and Acceptance
C1.2	Contract Data
C1.3	Forms for Adjudicators Appointment
C1.4	Forms of Securities
Part 2: Pricing data	
C2.1	Pricing Instructions
C2.2	Activity Schedule / Bill of Quantities
Part 3: Scope of Work	
C3	Scope of Work
Part 4: Site information	
C4	Site Information

Table 3: Standard Headings and Sequencing of Documents when calling for tenders

Volumes		Contents	
Number	**Description**	**Number**	**Heading**
Volume I	Tendering jrocedures	**Part 1: Tendering procedures**	
		Tl.l	Tender Notice and Invitation to Tender
		T1.2	Tender Data
Volume 2	Tender Returnables	**Part 2: Returnable documents**	
		T2.1	List of Returnable Documents
		Cl.l	Form of Offer and Acceptance
		C1.2	Contract Data (if relevant)
		C2.1	Pricing Instructions
		C2.2	Activity Schedule / Bill of Quantities
		T2.2	Tender Schedules
Volume 3	Contract	**Part 1: Agreement and Contract Data**	
		C1.2	Contract Data (if not included in the above)
		C1.3	Forms of Securities
		C1.4	Forms for Adjudicators Appointment
		Part 2: Pricing data	
		Part 3: Scope of Work	
		C3	Scope of Work
		Part 4: Site information	
		C4	Site Information

Table 4: Descriptions of component documents

Contents Number	Heading	Function and broad outline of contents
TENDER		
Parti: Tenderin» procedures		
T1.l	Tender Notice and Invitation to Tender	Alerts prospective contractors to the nature of the supplies, services or engineering and construction works required by the employer and should contain sufficient information to enable them to respond appropriately.
T1.2	Tender Data	Provides information to tenderers about the procedures that are to be observed during the tendering stage and what documentation they need to submit with their tenders, failing which their tenders may be rejected.
Part 2: Returnable documents		
T2.1	List of Returnable Documents	Ensures that everything the employer requires a tenderer to submit with his tender is included in, or returned with, his tender submission.
T2.2	Tender Schedules	Contains documents that are required for the purpose of evaluating tenders, some of which will be included in the subsequent contract.
CONTRACT		
Part 1: Agreements and contract data		
Cl.l	Agreement, Tender and Acceptance	Establishes the offer and acceptance
C1.2	Contract Data	Establishes the terms that collectively describe the risks, liabilities and obligations of the contracting parties and the agreed procedures for the administration of the contract.
C1.3	Forms for Adjudicators Appointment	Establishes the appointment and terms of reference for adjudicators.
CI.4	Forms of Securities	Provides the securities required by the employer
Part 2: Pricing data		
C2.1	Pricing Instructions	Sets out the way in which items are to be measured and priced.
C2.2	Activity Schedule / Bill of Quantities	Records the contractor's prices for providing supplies / services / engineering and construction works in terms of the contract.
Part 3: Scope of Work		
C3	Scope of Work	Identifies the supplies, services, or engineering and construction works which are to be provided during the execution of the contract and establishes any requirements and constraints relating to the manner in which the contract is to be executed. (Management, resource, construction and material specifications are included under the Scope of Work)
Part 4: Site information (engineering and construction works contracts only)		
C4	Site Information	Describes the site as at the time of tender to enable the tenderer to price his tender and to decide upon his method of working and programming

Table 5: Standardised procurement documents associated with the Project Linked Subsidy Housing Developments

Contents		Enqineerinq and Construction Works Contract						Land acauisition contract	
Number	Heading		Traditional Preplanned Contract						
		Turnkey Contract	Short contract	ECC2	Development	Services contract	Project aqreement	Land purchase	Land availability
STANDARD HEADINGS OF DOCUMENTS THA T RELA TE TO THE TENDER									
Part 1: Tendering procedures									
T1.1	Tender Notice and Invitation to tender	V 1	V	V	V	V	X	V	V
T1.2	Tender Data	V	V	V	V	V	X	V	1 V
T1.3	Standardised conditions offender	V	V	V	V	V	X	L_v	V
Part 2: Returnable documents									
T2.1	List of Returnable Documents	V	V	V	V	M	x	V	V
T2.2	Tender Schedules								
	Certificate for authority of signatory	V	Λ v	V	V	V	X	X	X
	Certificate of attendance at clarification meeting		X	X	X	V	X	X	X
	Record of addenda to tender documents	V			X	X	X	X	X
	Form of intent to provide a performance bond	V	9	V	X	X	X	X	X
	Proposed subcontractors	V	X	~Λ~	X	X	X	X	X
	Quality plan	V	X	X	X	X	X	X	X
	Provision of samples	9	9	9	X	X	X	X	X
	Certificate of attendance at site meeting	V	V	V	V	X	X	X	X
	Basis of Design (Design / build and turnkey contracts)	V	X	X	X	X	X	X	X
	First programme method ands method statement	V	?	V	X	X	X	X	X
	Management plan	V	9	V	X	X	X	X	X
	Health and safety plan	V	9	9	X	X	X	X	X
	Record of addenda to tender documents	V	V	V	V	X	X	X	X
	Preference schedule (direct preference)	9	9	9	V	X	X	X	X
	Preference schedule (direct preference (generic)	X	x	X	X	V	X	X	X
	Preference schedule (direct participation) (generic)	X	x	x	X	V	X	X	X
	Preference schedule (direct participation using the SABS 1914-4 specification)	*>	9	9	X	X	X	X	X
	Preference schedule (direct participation using the SABS 1914-5 specification)	9	9	9	X	X	X	X	X
	Targeted Enterprise Declaration Affidavit (S&ME)	►	9	?	X	X	X	X	X
	Targeted Enterprise Declaration Affidavit (SBE/ WBE/ EE)	?	9	9	V	X	X	X	X

Notes: **V** Standardised document in suite to be used
X No document required
? Standardised document in suite may be used if appropriate / necessary

Contents		Enqineerinq and Construction Works Contract						Land acquisition contract	
Number	Heading		Traditional Preplanned Contract						
		Turnkey Contract	Short contract	ECC2	Development	Services contract	Project aqreement	Land purchase	Land availability
STANDARD HEADINGS OF DOCUMENTS THAT RELATE TO THE CONTRACT									
Part 1: Agreement and Contract Data									
C1.1	Form of offer and acceptance	V	V	V	V	V	V	V	V
C1.2	Contract Data	ECC2	ECSCl	ECC2	ECSCl	PSC2	ECC2	Purpose written	Purpose written
CI.3	Forms for Adjudicators Appointment	V	V	V	V	V	V	X	X
C1.4	Form of securities	V	9	V	X	X	X	X	X
Part 2: Pricing Data									
C2.1	Pricing instructions	V	V	V	V	V	V	V	V
C3.2	Pricing schedules	V	V	V	V	V	V	V	V
Part 3: Scope of work									
C3	Scope of work	V	V	V	V	V	V	X	X
	Specification for Beneficiary and Housing Subsidy Administration	X	X	X	X	X	V	X	X
	Specification for Construction and management requirements pertaining to the NHBRC Warranty Scheme	9	≥	9	X	X	V	X	X
	Schedule of Actual Cost	X	X	X	X	X	V	X	X
	Programme for Housing Development	X	X	X	X	X	V	X	X
	Draw Down Forecast	X	X	X	X	X	V	X	X
Part 4: Site Information									
C4	Site Information	V	V	V	V	V	V	X	X
	Annexure for I^and acquisition agreement	9	X	X	X	X	V	X	X
	Annexure for Municipality's undertakings to supply and install bulk connector services and take over installed services.	9	X	X	X	X	V	X	X
	Annexure for NHBRC Project Enrolment Certificate	9	X	X	X	X	V	X	X
	Annexure for Phase 1 geotechnical investigation report.	9	X	X	X	X	<	X	X
	Annexure for Environmental impact assessment report	9	X	X	X	X	V	X	X
	Annexure for Social Compact Agreement	9	X	X	X	X	V	X	X

Notes: **V** Standardised document in suite to be used
X no document required
? Standardised document in suite may be used if appropriate / necessary
ECC2 = N EC Engineering and Construction Contract 2"J Edn 1995
ECSC1= NEC Engineering and Construction Short Contract 1st Edn 1999
PSC2 NEC Professional Services Contract 2"J Edition June 1998

APPENDIX 3

SUMMARY OF STANDARDS SOUTH AFRICA (SANS) PROCUREMENT SPECIFICATIONS

Table **1** : SANS Procurement Specifications

SANS Number	Description
*294	*Construction procurement processes, methods and systems*
*10403	*Formatting and compiling of construction procurement documents*
*10306	*Implementing preferential procurement policies using targeting procurement procedures*
*1914	Family of standards for targeted procurement
*10120	*Code of practice for use with standard specifications for civil engineering construction and contract documents*

*Note : The National Housing documents have not been updated to reflect this standard.

APPENDIX 4

SUMMARY OF GEOTECHNICAL REQUIREMENTS INVESTIGATION

Adapted from the Department of Housing Standard Procurement Specifications, also obtainable from the NHBRC website at http://nhbrc.org.za/SubsidySector/TechnicalDocuments.htm, as accessed on 20 September 2005 and 28 August 2006).

1. GEOTECHNICAL INVESTIGATION ACTIVITIES FOR GOVERNMENT FUNDED LOW-INCOME HOUSING PROJECTS

The specifications outline the following activities:

(1) Evaluation of the geology and hydrogeology of the site.
(2) Examination of existing geotechnical information pertaining to the site.
(3) Excavating or boring in soil or rock.
(4) In-situ assessment of geotechnical properties of materials.
(5) Recovery of samples of soil or rock for examination, identification, recording, testing or display.
(6) Testing of soil or rock samples to quantify properties relevant to the purpose of the investigation.
(7) Evaluation of geotechnical properties of tested soils
(8) Reporting of the results

2. SUMMARY OF CONTENT OF GEOTECHNICAL SPECIFICATION FOR GOVERNMENT FUNDED LOW-INCOME HOUSING PROJECTS

(Adopted from the Department of Housing's Standard Procurement Documents)

The specifications contain:

(1) minimum qualification and experience of the professional conducting the reports in the various types of geotechnical investigations
(2) objectives and key outputs for each stage of the investigations;
(3) classification of risks of doline and specified size sink hole forming
(4) classification of risk characterization and anticipated number of ground-movement;
(5) minimum requirements for the entire process (objectives, inputs, processes and outputs) of the geotechnical investigations, including the following:
(6) consultation with relevant organizations
(7) data input, collection and analysis requirements
(8) geotechnical classification and scale of favourability of the site;
(9) field work and testing; and
(10) very detailed reporting requirements, including standard headings, content, presentation, special precautionary measures, and attachments (such as maps), specifically aimed at obtaining risks and precautionary measures for excavation, sanitation and founding conditions and soil suitability.

APPENDIX 5

SUMMARY ENVIRONMENTAL ASSESSMENT SPECIFICATIONS
(Adapted from the Department of Housing Standard Procurement Specifications, also obtainable from the NHBRC website at http://nhbrc.org.za/SubsidySector/TechnicalDocuments.htm, as accessed on 20 September 2005 and 28 August 2006).

The specification contains :

(1) objectives for each stage of the environmental impact assessment;
(2) key outputs;
(3) qualification criteria of professionals engaging in the process;
(4) Minimum requirements for each stage of the process (pre feasibility scan, scoping, impact report and management plan phases);
(5) Reporting requirements in respect of inputs, processes and outputs; and
(6) Application requirements, including investigations, motivation, consultation, recommendation and feedback.

APPENDIX 6

SUMMARY OF STANDARDS AND SPECIFICATION FOR ENGINEERING SERVICES

1. **Department of Housing norms and standards**

Table 1 : Department of Housing minimum norms and standards for engineering services

Type of service	**Minimum Level**
Water	Single standpipe per erf (metered)
Sanitation	Ventilated Pit Latrine per erf
Roads	Access to each erf with graded or gravel paved roads
Strom Water	Lined open channels
Street lighting	High mast security lighting for residential purposes where this is feasible and practicable, on condition that such lighting is not funded by CMIP or funding available form other sources

2. **SANS specifications**

Table 2 : SANS Civil Engineering Design and Construction Specifications

SANS Number	Description
1200	*Civil engineering construction standards*
	Design of buried pipelines
*0102'	*Pipe materials*
*010252=	*Water supply and drainage for buildings*
* 10299'	*Development, maintenance and management of ground water resources*

^Note These standards have not been updated in the Department of Housing Documents.

SANS 010252 - *Water supply and drainage for buildings,* has legal status as it was proclaimed in the Government Gazette No. 22355, 8 June 2001 - Regulation Notice R509. (www.stansa.co.za/watersuply.aspx)

SANS 10299 - *Development, maintenance and management of ground water resources,* was developed specifically to address South African needs to establish a framework in which ground water should be managed, specifically with regard to the location, siting, design, construction, drilling, rehabilitation and decommissioning of boreholes and associated pumps. (www.stansa.co.2a/TOWARDSBETTERGRONDWATERUSE.aspx

3. **CSIR**

CSIR "Guidelines for human settlement planning and design - The Red Book"

These are not standards in the true sense as it is not designed to be enforceable absolute limits, but have informed the Department of Housing's specification for engineering design and construction. The guidelines are performance based suggestions for professionals involved in human settlement planning and design. It is aimed at ensuring quality town planning layouts and engineering designs, taking cognizance of planning and transport nodes, land use planning, minimum property sizes, distances, open space types, quantities, transport matters (including access), sanitation and water designs, etc.(CSIR, 2000:2-5).

APPENDIX 7

HOUSE CONSTRUCTON SPECIFICATION : DEPARTMENT OF HOUSING

(Adapted from the Department of Housing Standard Procurement Specifications, also obtainable from the NHBRC website at http://nhbrc.org.za/SubsidySector/TechnicalDocuments.htm, as accessed on 20 September 2005 and 28 August 2006).

(1) Acoustics (privacy, reduce noise penetration and annoying emission);
(2) Condensation (applicable to the Southern Cape Condensation Area);
(3) Construction accuracy (dimensions and limits);
(4) Energy efficiency;
(5) Fire safety (ease of escape, mitigation of spread, suppression and rescue elements);
(6) Functionality (in terms of spaces, uses, ease of access, indoor visual environment, natural ventilation and accident safety);
(7) Internal wall finishing;
(8) Minimum measurements/dimensions/distances;
(9) Permissible deviations (concrete work; masonry and reinforcement in masonry; drainage; structural timber members; pre-cast concrete elements before and after erection);
(10) Sanitation;
(11) Solar radiation;
(12) Storm water disposal;
(13) Structural durability;
(14) Structural safety;
(15) Structural serviceability performance (e.g. design life minimum of 50 years for structural system and non-accessible components, 25 years for repairable/replaceable components such as roofing material);
(16) Tests (general; performance; structural safety; serviceability and durability; and rain penetration test for roofs and walls respectively;
(17) Thermal Performance;
(18) Water penetration (rain and other moisture elements); and
(19) Water saving measures.

APPENDIX 8

SUMMARY OF CONTENT : CODE OF APPLICATION OF THE NATIONAL BUILDING REGULATIONS (SABS 0400:1990)

(a) Administration
(b) Structural Design
(c) Dimensions (Plans, room heights, floor area)Public Safety
(d) Demolition work
(e) Site operations
(f) Excavations
(g) Foundations
(h) Floors
(i) Walls
(j) Roofs
(k) Stairways
(1) Glazing
(m) Lighting and ventilation
(n) Drainage
(o) Non-water borne means of sanitary disposal
(p) Storm water disposal
(q) Facilities for disable persons
(r) Fire protection
(s) Refuse disposal
(t) Space heating
(u) Fire installation

APPENDIX 9

SUMMARY OF SANS BUILDING CONSTRUCTION SPECIFICATIONS APPLICABLE TO LOW-INCOME HOUSING

Table 1 : SANS building Construction Related Specifications

SANS Number	Description
0400	*Code of Practice for the application of the National Building Regulations*
542	*Specification for concrete roofing tiles*
0155	*Code of practice for accuracy in buildings* (Method of measurement and accuracy of dimensions for setting out and completing structures with permissible deviations, as prescribed)
0160	*Code of Practice for general procedures and loadings to be adopted in the design of buildings* (stability of structures when exposed to wind)
0177	*Fire proofing*
1263	*Glazing* (including areas requiring safety glazing, but this is less likely in low-income housing projects)
*11600:1993/ ISO 11600:1993	*Building construction - sealants - classification and requirements*
10409:2000	*Design, selection and installation of geomembranes* facilitates the correct use and installation of plastics to act as a barrier for waterproofing (e.g. foundation slabs and roofs) www.stansa.co.za/SANS 10409. aspx
*10145:2000	*Concrete masonry construction* (Covers construction of walls with precast concrete masonry units)
*1783-2:2005	*Sawn softwood timber Part 2:Stress graded structural timber and timber for frame wall construction*

Note : *These standards have not been updated in the National Department of Housing Documents.*

APPENDIX 10

UNIVERSITY OF
KWAZULU-NATAL

RESEARCH OFFICE (GOVAN MBEKI CENTRE)
WESTVILLE CAMPUS
TELEPHONE NO.: 031 -2603587
EMAIL : ximbap@ukzn.ac.za

23 AUGUST 2006

MRS. MM MILNE (9020479470)
MANAGEMENT STUDIES

Dear Mrs. Milne

ETHICAL CLEARANCE APPROVAL NUMBER: HSS/06212A

I wish to confirm that ethical clearance has been granted for the following project:

> **"An investigation into quality concerns in house construction in government subsidized low income housing projects in the Pietermaritzburg Area"**

Yours faithfully

MS.PHUMELELEXIMBA
RESEARCH OFFICE

PS: The following general condition is applicable to all projects that have been granted ethical clearance:

THE RELEVANT AUTHORITIES SHOULD BE CONTACTED IN ORDER TO OBTAIN THE NECESSARY APPROVAL SHOULD THE RESEARCH INVOLVE UTILIZATION OF SPACE AND/OR FACILITIES AT OTHER INSTITUTIONS/ORGANISATIONS. WHERE QUESTIONNAIRES ARE USED IN THE PROJECT, THE RESEARCHER SHOULD ENSURE THAT THE QUESTIONNAIRE INCLUDES A SECTION AT THE END WHICH SHOULD BE COMPLETED BY THE PARTICIPANT (PRIOR TO THE COMPLETION OF THE QUESTIONNAIRE) INDICATING THAT HE/SHE WAS INFORMED OF THE NATURE AND PURPOSE OF THE PROJECT AND THAT THE INFORMATION GIVEN WILL BE KEPT CONFIDENTIAL.

cc. Faculty Office (Post-Graduate Studies)
cc. Supervisor (Mr. M Poulter)

Founding Campusei: •• Edgewood "*• Howard College ••* Medical School ™ Pietermaritzburg "-"" Westvllle

APPENDIX 11

EXTRACT OF SPREAD SHEET FOR DATA COLLECTION : PHASE 1

Key: NO DEFECT TYPE DETECTED=0; DEFECT TYPE DETECTED=1

PROJECT DETAILS		INSPECTION DATES			TIMEFRAMES (Calendar days)			STAGE (Completed during 1April200 5to31 December 2005)		
PROJECT NAME	SITE NUMBER	SLAB	WALL PLATE	COMPLETION	Slab to wall	Wall to completion	Total	SLAB	WALL PLATE	COMPLETION
	8473	4/26/05	7/19/05	8/30/05	84	42	126			
	8474	4/26/05	7/12/05	7/26/05	77	14	91			
	8475	4/26/05	5/31/05	7/19/05	35	49	84			
	8476	4/26/05	5/17/05	7/26/05	21 _,	70	91			
	8477	4/26/05	5/17/05	7/19/05	21	63	84			
	8478	4/26/05	7/26/05	8/30/05	91	35	126			
	8534	5/31/05	6/14/05	8/16/05	14	63	77			
	8542	5/10/05	6/14/05	8/16/05	35	63	98			
	8543	5/31/05	6/14/05	8/16/05	14	63	77			
	8544	5/10/05	6/14/05	8/16/05	35	63	98			
	8545	5/10/05	6/14/05	8/16/05	35	63	98			

TIME FRAME ANALYSIS			Slab to wall	Wall to completion	Total
UNITS V TIMEFRAME STATISTICS					
AVERAGE	3/30/05	8/11/05	172	135	307
MODE	7/12/05	7/19/05	0	0	84
Frequency	1086	4/28/01	98	69	137
MEDIAN	04/19/05	8/11/05	146	101	316
MIN	2/11/04	2/2/05	0	0	0
MAX	12/20/05	12/20/05	655	510	779
DIFFERENCE	678	321.00	655	510	779
Units/day	2.00	2.00			
Units/month (30 days)	60.13	60.13			
DIFFRENCE between first slab and last subsequent stage				1030.00 days	
Units/day				1.32	
Units/month (30 days)				39.58	

Completion time frames							
90 day period (3 months)							
Days	**91-180**	**181-270**	**271-360**	**361-450**	**451-540**	**541-630**	**>630**
Units	293	154	175	294.00	165	106	16
Units/day (90 days)	3.26	1.71	1.94	3.27	1.83	1.18	0.18
Units/month (30 days)	7.67	51.33	58.33	98.00	55.00	35.33	5.33
180 day_period (6 months)							
Days	**0-180**		**181-360**		**>361**		
Units	432		329		475		

PROJECT NAME	*POTENTIAL FAILURE*																
	MAJOR STRUCTURAL													OTHER		INADEQUATE SERVICES	
	Construction			Material/s													
				Foundation				Wall			Roof						
Site number	**Foundation and Slab**	**Wall to plate**	**Roof)**	Lintels	Concrete	to o en	DPC	oo	Mortar mix	Lintels (window , door, partitions	Sheeting	Beams and Purlins	**Incomplete/not readv**	**Access/Keys**	Water	Sanitation	Access
															1		
															1		
															1		
															1		
															1		
															1		
	1														i_1 _		
															1		

PROJECT DETAILS PROJECT NAME	CLEARANCE	*FINISHING*																	REINSPECTIONS	Duplications	Errors per unit
		PLUMBING								OTHER FINISHES											
		Workmanship					Material			Workmanship						Material					
Site Number	Site clearance	Toilet (Incl, Pipes and Rodding eyes)	Outlet and Gully	Pipes (Water, inci, taps)	Basin	Shower	**Jafi**	**Gully**	**Water tank**	Block work (	"3 eg oo	Plaster	Fitting windows, glass and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	Door			
												1			1						3
												1			1						2
																					1
													1					1			3
						1					1	1									3
											1	1									3
																					1
																					1
																					2
															1						1

APPENDIX 12

SUMMARY OF DEFAULT CATEGORIES AND DESCRIPTIONS

MAIN CATEGORY	SUBCATEGORY	INSPECTION STAGE/ DEFECTIVE UNIT	COMMENTS
A : MAJOR STRUCTURAL ISSUES These will cause the stage to be failed by the inspector	(1) Workmanship (Construction)	Foundation and Slab	Includes leveling, waterproofing, major cracks, pad and lintels, etc.
		Wall Plate	Includes: block work; mortar mix; lintels; plumpness of building, windows and door; brick force, brick courses (building height), etc.
		Completion	Structural design, pitch, ties, beam spacing, and fixture (screw spacing, etc), overhang and overlap, etc)
	(2) Materials (quality)	Foundation and Slab	Lintels, concrete, blocks and DPC (Plastic membrane for waterproofing)
		Wall Plate	Blocks, mortar mix, lintels (windows, doors and partitions, where applicable).
		Completion	Sheeting type, thickness and rust free, beams and purlins to specification and SABS/SANS compliant
B: INCOMPLETE WORK These will cause the inspector to fail the unit as it is not habitable, or cannot be accessed for inspection.	(1) Inadequate services	Water, Sanitation, Access	These should be completed before the house is occupied, but needs to be available to ensure that the plumbing and water supply is in working order, and that the property is accessible.
	(2) Other	Incomplete/ not ready	Includes outstanding pre-certification by engineer/building professional.
		Access/Keys	Where keys are not available, or the unit could not be accessed for final inspections,
C: FINISHING	(1) Clearance		Used in records to describe both site preparation, and clearing materials after construction.
	(2) Plumbing		
	(a) Workmanship	Toilet	Entire system, including pipes and rodding eyes
		Outlet and gulley	Fitting, leaks, gradient of fall, and positioning over the gulley and condition of gulley
		Pipes	For water, and including taps
		Basin	Fitting
		Shower	System and all fittings
	(b) Materials (quality)	Tap	
		Gully	
		Water tank	
	(3) Other finishes		
	(a) Workmanship	Block work	
		Fillings	
		Plaster	(and/or bag washing, where applicable)
		Fitting windows, glass and door frames	
		Glazing	
		Screed	(Topping of slab)
	(b) Materials (quality)	Window and/or door frames	
		Plaster/Cement/Bag wash material	
		Door	
		Glazing	

APPENDIX 13

EXAMPLES OF POOR QUALITY IN LOW-INCOME HOUSING

Figure 1 : Poor mortar mix, inadequate cement.

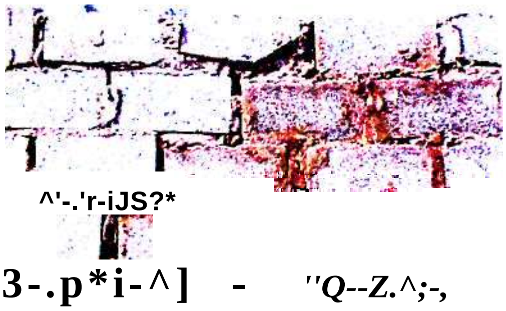


Figure 2 : Poor block work resulting in re-work.

Figure 3 : Poor founding conditions resulting in cracks.

Figure 4 : Severe cracking, with daylight shining through.

Figure 5 : Structural cracks from window to roof.

Figure 6 : Structural cracks from roof beam to window.

Figure 7 : Structural crack starting from roof.

Figure 8 : Foundations being underpinned as a result of poor founding. Also note block-work had to be redone.

Figure 9: Roof screw not done properly.

Figure 10: Poor sealing of holes, as is evident from reflection of light on the beam.

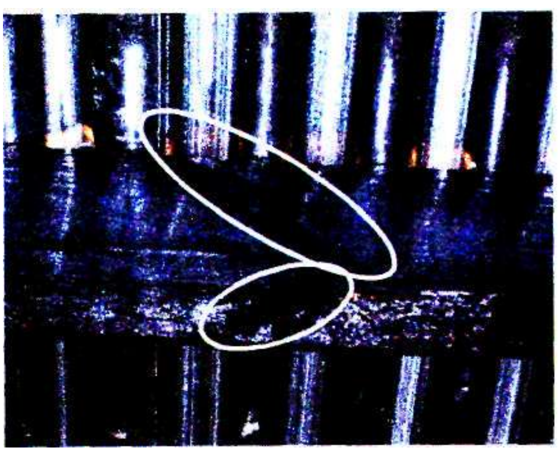


Figure 11 : Poor quality timber used.

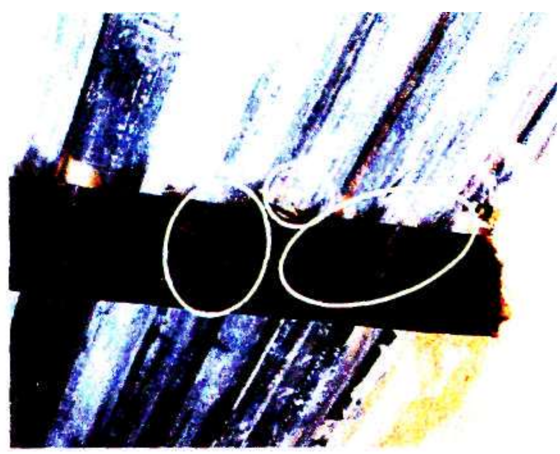


Figure 12: Poor material (knotty timber), nailing roof screws, poor and holes not sealed.

Steals

Figure 13 : Roof ties fitted retrospectively

Figure 14 : Poor beam filling, roof ties fitted retrospectively, and holes not sealed.

Figure 15 : Poor service maintenance.

Figure 16 : Poor service maintenance.

Figure 17 : Poor service maintenance.

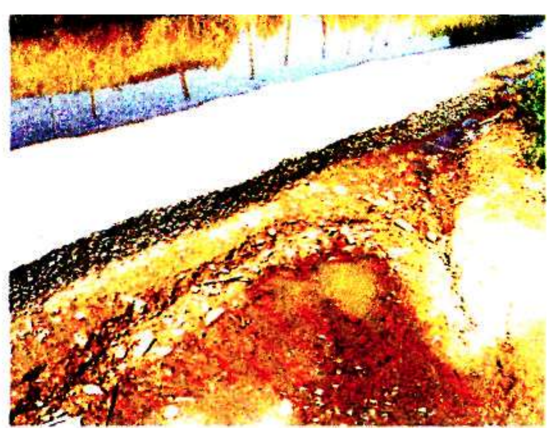


Figure 18 : Poor service maintenance.

Figure 1: An informal wattle and daub structure.

Figure 2 : Platform excavation for foundation.

Figure 3 : Platform preparation.

Figure 4 : Preparation for constructing foundation.

Figure 5 : Preparation for foundation continued.

Figure 6 : Damp proofing and steel reinforcement of foundation.

Figure 7 : Pouring cement for foundation and slab.

Figure 8 : Slab completed, ant poison applied and clearance commencing.

Figure 9 : Setting profiles to construct walls.

Figure 10 : Mixing mortar for wall construction.

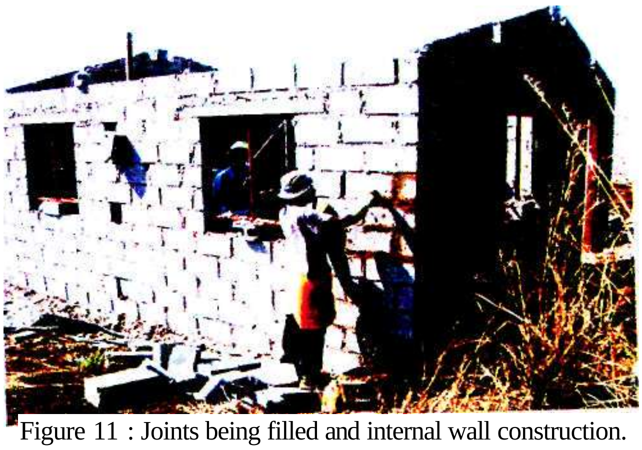


Figure 11 : Joints being filled and internal wall construction.

Figure 12 : Unit completed to plate level.


Figure 13 : Roofing of structure commencing.


Figure 14 : Completed unit ready for occupation.


Figure 15 : Unit handed over to occupant.

APPENDIX 15

Dear Potential Participant

PARTICIPATION IN RESEARCH : AN INVESTIGATION INTO QUALITY CONCERNS IN HOUSE CONSTRUCTION IN GOVERNMENT-SUBSIDISED LOW-INCOME HOUSING PROJECTS IN THE PIETERMARITZBURG AREA

This attached questionnaire aims at informing a MBA study through the University of KwaZulu-Natal. The study is an investigation into issues that affect quality in Government-subsidised low-income housing house construction in the Pietermaritzburg area. The study is informed by the theoretical framework of total quality management (TQM).

The purpose of this study is to identify issues that affect quality in the construction of houses through the South African Government's low-income housing subsidy scheme in the Pietermaritzburg area, and to determine how quality management can assist in improving house construction in an environment limited by budget constraints.

Research Objectives

The research is aimed at the following objectives:

(8) To identify house construction quality concerns in Government-subsidised low-income housing projects in the Pietermaritzburg area.

(9) To identify the causes of house construction quality problems in the low-income housing delivery environment within the Pietermaritzburg area, from the perspective of the developers, municipality and Department of Housing : KwaZulu-Natal.

(10) To identify how house construction quality issues are currently being addressed.

Identification for the need of the research

The need for this research was identified through numerous references regarding quality concerns in low-income housing. This matter has been raised in numerous political speeches at National and Provincial level. These concerns were also raised at the KwaZulu-Natal Housing Summit held on 23 and 24 March 2005. The report on the summit highlights the Department of Housing's role in ensuring quality that is acceptable to the beneficiaries. In discussion at the summit the need for the quality of housing to be reviewed, the need for improved value of this type of asset, review of the house design, and quantity vis-a-vis quality aspects, were recorded. A resolution was taken to "beef up the inspectorate component" of the Department of Housing, to assist in addressing the quality. Resolutions were also taken that required the Department to develop performance indicators, standardize reporting and monitoring templates, and quality specifications for various housing options. This research would assist in informing these efforts.

Benefits of participation

- Assist in identifying common trends in housing quality issues which you are involved in.
- Quantify the extent of quality defaults.
- Inform quality management strategies of your organization/component.
- Provide information on gaps in quality management in the context of low-income housing.

What is required from participants?

Participants are required to complete the attached questionnaire, which will take approximately 30 minutes to 1 hour to complete. All responses should be done in the contexts of low-income housing.
There are no financial, legal or personnel implications to your or your organization. Thee names of all respondents will remain anonymous. The research report will refer to respondents in the context of the category (Department of Housing, Municipality, Private Developer/ Implementing Agent, etc.), and each respondent will be referred to in numerical terms (e.g. Municipality/Local Government: Respondent 1).

The questionnaire is structured in three sections:

> **Section 1** : The objective of this section is to establish possible causes of quality concerns in the Pietermaritzburg area, from the perspectives of the Department of Housing (DoH) officials, developers, and the municipality, respectively.
>
> **Section 2** : The objective of this section is to establish which systems are in place and to review the efficiency of these.
>
> **Section 3** : Provision is made here to list any additional concerns, comments and/or suggestions regarding quality management in the contexts of Government subsidised low-income housing.

Kindly provide contact details (your name, organization, contact number, and/or e-mail) at the bottom of the questionnaire. These details will be used for purposes of obtaining clarity, should the need arise. Please note that the names of all respondents will remain anonymous.

Kindly submit your responses to Mrs. Martie Milne at 199 Pietermaritz Street, Room 1/07 or via e-mail at milnem(£»hse.kzntl.gov.za, before 10 June 2006.

Participants may be contacted for purposes of obtaining clarity. The research summary should be completed by 14 July 2006.

Information management

Questionnaires will be filed in a secure filing facility, until final acceptance of the dissertation, and then destroyed thereafter.
Data findings will be stored electronically, until final acceptance of the dissertation, and then destroyed thereafter.

Confidentiality and anonymity
Please note that information will be dealt with discretely and anonymity will be ensured as explained above. Kindly indicate where information is sensitive in nature and how you wish this to be included/excluded from the research report by providing a brief explanation on the questionnaire, or by contacting the research investigator (see contact details below).

Non-participation
Please note that a decision not to participate will not result in any form of disadvantage or prejudice. Participation is voluntary and that subjects are free to withdraw from the study at any stage and for any reason.

Declaration
Kindly complete the declaration section below and return to the research investigator at 199 Pietermaritz Street, Room 1/07 or via fax (033-8452086), before 7 June, 2006

Contact details

The **research investigator** is Mrs M Milne, a MBA student, registered with the University of KwaZulu-Natal. Should you have any queries regarding this questionnaire, kindly contact Mrs. Martie Milne on 0827715217, or via e-mail: milnem@hse.kzntl.gov.za.

The **research supervisor** is Mr Mike Poulter, University of KwaZulu-Natal, Pietermaritzburg. He may be contacted at 033-2605736 or e-mail at Poulter@ukzn.ac.za.

Should you require further information, kindly contact the research investigator or research supervisor, alternatively, the Programme Director, Prof. D. Vigar- Ellis, at the University of KwaZulu-Natal, Pietermaritzburg Campus, School of Business.

Your inputs into this research are greatly appreciated.

Yours faithfully

Martie Milne
MBA Student (902479470)

DECLARATION

PARTICIPATION IN RESEARCH : AN INVESTIGATION INTO QUALITY CONCERNS IN HOUSE CONSTRUCTION IN GOVERNMENT-SUBSIDISED LOW-INCOME HOUSING PROJECTS IN THE PIETERMARITZBURG AREA

I……………………………………………………………………………(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT DATE

Note : Enquiries may be directed to the research supervisor, Mr. Mike Poulter at the University of KwaZulu-Natal (Pietermaritzburg) at 033-2605736 or e-mail at Poulter@ukzn.ac.za.

QUESTIONNAIRE

SECTION 1 : POSSIBLE CAUSES OF QUALITY CONCERNS							
Kindly indicate the extent to which you agree with the following statements:		0 = Strongly disagree 1 = Disagree 2 = Slightly agree 3 = Agree 4 = Strongly agree					
		Not sure	0	1	2	3	4
1.	Quality concerns exist in low-income housing in Pietermaritzburg						
2.	Most defects in the area relate to structural issues.						
3.	Most defects relate to finishing.						
4.	Defects are caused mainly through the availability of resources, in terms of						
(a)	- Finance						
(b)	- Skilled labour						
(c)	- The following major materials:						
	Cement						
	Sand						
	Stone						
	Steel						
	Timber						
	Water						
5.	Defects are caused mainly by poor quality material.						
6.	Materials are SABS or Agrement compliant. *(Agrement is a South African Organization responsible for the certification of non-standardized building methods)*						
7.	Material and product samples are regularly tested against SABS or Agrement requirements.						
8.	Defects are caused mainly through poor workmanship						
9.	Poor workmanship is caused by (please mark those you feel are relevant):						
(a)	- Inappropriate recruitment processes.						
ibL^	- Poor training.						
lep	- Lack of financial support for training						
(d)	- High work speed requirement						
(e)	- Pressure relating to high volume and short time frames.						
(f)	- Lack of supervision.						
(g)	- Lack of performance management.						
(h)	- Lack of reward systems.						
(0	- Lack of proper quality management systems						
0)	- Lack of staff involvement in problem solving.						
(k)	- Lack of inspection during production processes.						
(1)	- Lack of team work.						
(m)	- Lack of leadership.						
(n)	- Lack of competently skilled resources.						
(o)	- Lack of commitment to quality.						

		Not sure	0	1	2	3	4
(p)	- Lack of quality awareness.						
(q)	- Lack of experience.						
(r)	- Lack of quality responsibility ownership.						
(s)	- High volume production within shortest possible timeframes.						
(t)	- Lack of discipline						
10.	Quality defect rates are within acceptable tolerances.						
11.	Quality defects result in major rework and/or re-inspections.						
12.	Quality defects impact on cashflow.						
13.	Product warranties are in place.						
14.	Claims against warranties are measured.						
15.	The average yield of 40 units per month (completed and passed for payment) is acceptable.						
16.	Construction stages (foundation and slab : wall plate : completion) are programmed and monitored.						
17.	Delivery rates between timeframes are acceptable.						
18,	Product specifications and timeframes are stipulated in the contract.						
197^	Timeframes, costs and product specifications are adhered to at all times.						
20.	Variations to the contract are negotiated with all stakeholders and are formalised.						
21.	Quality concerns are addressed at site meetings						
22.	Repetitive quality problems are included in organisational strategies.						
23	Other possible quality causes (please list some here and rate the impact on quality, based on the assumption that the impact would be significant, as per the example in italics, below)						
	***Example .-Possible cause** .Poor maintenance of equipment (score on the extent to which you agree that this would have a significant impact)*					X	

SECTION 2 : QUALITY MANAGEMENT SYSTEMS AND EFF1[CIENCIES							
1.1	Your organization has a quality management system	Not sure	0	1	2	3	4
1.2	In your organization, quality management involves all internal components.						
1.3	In your organization, quality management involves all external role players						
1.4	Quality concerns are defined by:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f)	- None of the above.						
(g)	- Some of the above (Please indicate which ones by marking these with [*].)						
1.5	The responsibility for quality lies with:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality.						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f)	- None of the above.						
(g)	- Some of the above. (Please indicate which ones by marking these with [*].)						
2.1	Your organization undertakes regular company wide quality assessments (at least once a year).						
2.2	Your organization follows ISO 9000 quality standards.						
2.3 (a)	Quality management in your organization is customer focused.						
(b)	Quality management is practiced with effective leadership.						
(c)	Quality management follows a process approach. *(A process approach includes planning, controlling and improving primary process)*						
(d)	Quality management supports a systems approach to management.						
(e)	Quality management focuses on continuous improvement.						
(f)	Quality management includes a factual approach to decision making.						
(g)	Quality management is aimed at mutual beneficial supplier relationships.						
(h)	Quality management is practiced with effective leadership.						

		Not sure	0	1	2	3	4
3.1	Different approaches are followed for quality problems that occur less often and/or are less severe, than those that happen often and/ or have a major impact on delivery.						
3.2	A diagnostic approach is followed in solving quality management problems. *(A diagnostic approach allows for decisions to be made on facts)*						
4.1	Quality is benchmarked against competitors. *(Benchmarking is the comparison of your product or service to best practices in the field or industry).*						
4.2	Quality management in your organization recognizes a range of different customers with different needs.						
4.3	A quality management policy is in place.						
5.1	Quality control includes a quality score card						
5.2	Final inspections are the responsibility of:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality.						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f>	- None of the above.						
(g)	- Some of the above. (Please indicate which ones by marking these with [*]).						
5.3	Inspections are carried out by:						
(a)	- Primarily the customer.						
(b)	- Primarily the developer.						
(c)	- Primarily the municipality.						
(d)	- Primarily the Department of Housing.						
(e)	- All of the above.						
(f)	- None of the above.						
(g)	- Some of the above. (Please indicate which ones by marking these with [*].)						
5.4	All stakeholders are aware of the criteria used in inspection processes.						
5.5	Inspection processes are based on prior knowledge of product quality, similarity within the lot and allowable risk.						
5.6	The following is typical of inspections :						
(a)	- No inspection.						
(b)	- Small samples.						
(c)	- Large samples.						

		Not sure	0	1	2	3	4
(d)	- 100% inspection.						
(e)	- Snags are done prior to final inspections.						
(0	- Snags are addressed properly and within the given time.						
6.1	Quality is part of the strategic management process to ensure long term customer satisfaction goals.						
~62	In your organization:						
(a)	Quality management is lead and supported by top management.						
(b)	Proper infrastructure (including plans, goals, organisational mechanisms and resources, performance measurement and rewards) exist at all levels to implement a quality management system.						
(c)	Role players are not skeptic about the need for new quality management programmes.						
(d)	Management relies ***principally on strong motivational technique to encourage improvement,*** once statistical strong evidence has been used to convince all of the seriousness of the problem.						
(e)	An incremental approach is followed is solving quality **problems** *(i.e. prioritization of quality problems to address, as opposed to trying to resolve all problems simultaneously).*						
(0	Different techniques are used to achieve quality goals (Please refer to Appendix 1 for typical tools and kindly indicate the 5 most frequently used in your organization).						
(g)	Sufficient time and resources are available to address quality, and the need to change priorities as a result thereof is supported by management).						
6.3	Quality strategies are implemented throughout all line function activities.						
7.1	Quality is part of the organization's vision.						
7.2	Decision making styles (command, consultative and consensus/agreement) are adapted to suit the situation at hand).						
7.3	Management creates an environment that encourages learning from mistakes to encourage improvement.						
7.4	Employees participate in quality related decision and take ownership of work related thereto.						
7.5	Individual and team performance is measured regularly and are provided with feedback on progress.						
7.6	Management base decisions on facts and scientific instruments.						

		Not sure	0	1	2	3	4
7.7	Staff are encouraged to share ideas, feelings and needs freely, in an open and trusting manner without fear of punishment.						
7.8	Managers act as role models for ethical practices.						
8.1	Customer needs are well understood.						
8.2	Customer needs defined based on proper market research.						
8.3	Customer satisfaction is measured in terms of product features and freedom from deficiencies.						
8.4	Customer satisfaction surveys inform product development.						
9.1	Suppliers are evaluated regularly against quality defaults.						
9.2	Supplier quality problems are resolved through partnerships.						
9.3	Certified suppliers are used.						
9.4	Suppliers understand all specification and standards clearly, and these are stated in quantitative terms.						
9.5	All role players understand **what** they should be doing. *(Please rate each of the role players listed in (a) to (e) below).*						
(a)	- Implementing agent, project manager or developer						
(b)	- Suppliers						
(c)	- Department of Housing						
(d)	- Municipality						
(e)	- Community						
9.6	All role players know **how to** undertake their functions. *(Please rate each of the role players listed in (a) to (e) below).*						
(a)	- Implementing agent, project manager or developer.						
(b)	- Suppliers.						
(c)	- Department of Housing.						
(d)	- Municipality.						
(e)	- Community.						
9.7	All stakeholders have suitable, controllable processes to meet specifications. *(Please rate each of the role players listed in (a) to (e) below).*						
(a)	- Implementing agent, project manager or developer.						
(b)	- Suppliers .						
(c)	- Department of Housing.						
(d)	- Municipality.						
(e)	- Community.						
10.	Statistical process control systems are used to measure and analyse all processes .						

		Not sure	0	1	2	3	4
11.	Rate the extent to which the administration and support activities in 11.1 to 1 .3 are measured in terms of quality.						
11.1	**Finance** *(Rate the extent to which items (a) to (d) are measured by your organization).*						
(a)	- monetary value of invoices paid late.						
(b)	- average number of days to issuing of invoices.						
(c)	-% of invoices returned due to errors.						
(d)	-monetary value of unrecoverable accounts receivable.						
11.2	**Personnel** *(rate the extent to which items (a) to (d) are measured by your organization).*						
(a)	-% resumes (cv's) received that result in interviews						
(b)	-number of candidates interviewed before an offer is made and accepted.						
(c)	-average number of days from request for personnel to initial employment date.						
(d)	-% certified/qualified workers in critical activities.						
11.3	**Information technology** *(rate the extent to which items (a) to (e) are measured by your organization)..*						
(a)	-% **System uptime** *(i.e. when systems can he used).*						
(b)	- Mean (average) time between failures.						
(c)	- Mean (average) time to restore services.						
(d)	- Turnaround time for reports *(how long it takes to get reports out of the system).*						
(e)	- Software/programming errors.						
12.	A quality information system is in place and includes the following items listed in (a) to (1) below:						
(a)	- Key Performance Indicators.						
(b)	- Action Plan for Improvement						
(c)	- Progress on action plan						
(d)	- Evaluation and feedback mechanism.						
(e)	- Customer satisfaction data.						
(f)	- Product design, specification and standards information.						
(g)	- Material, equipment and supplier test results .						
(h)	- Work in progress.						
(i)	- Complaints.						
(i)	- Management control.						
(k)	- Delivery cycle timeframe projections, actual and variation.						
(1)	- Variation data and problem solving process management data.						
13.	A quality audit and assurance programme is in place. *(A Quality audit is an independent review conducted to compare some* ***actual*** *aspects of quality performance with the* ***required*** *standard of performance.. Quality assurance is a process of providing evidence to establish whether quality requirements will be met.*						

SECTION 3 : COMMENTS, CONCERNS AND SUGGESTIONS

Kindly submit any concerns, suggestions and comments with regard to low-income housing in the space below. (A separate sheet may be attached if necessary)

CONTACT DETAILS

Name:	
Organization:	
Component:	
Position:	
Contact Number:	
E-mail	

Thank you for your time and participation.

RESEARCH QUESTIONNAIRE Appendix 1

The questionnaire is structured two sections:

> **Section A** : The objective of this section is to establish broad quality management tools and techniques used in your organization.
>
> **Section B** : The objective of this section is to collect data on participants' perception of the supply chain management status of their organizations.

Detailed explanations of each tool have been provided at the back of the questionnaire, together with an example to illustrate how items should be selected.

Kindly provide contact details (your name, organization, contact number, and/or e-mail) at the bottom of the questionnaire. These details will be used for purposes of obtaining clarity, should the need arise. Please note that the names of all respondents will remain anonymous.

Kindly submit your responses to Mrs. Martie Milne at 199 Pietermaritz Street, Room 1/07 or via e-mail at mi lnemCojhse. kzntl. go v. za, before 10 July 2006.

SECTION A

QUALITY MANAGEMENT TOOLS

Various authors discuss a range of different tools and techniques, those most commonly referred to in the literature are briefly outlined in the section below. Kindly mark the 5 most commonly used by your organization. Please note that detailed explanationsare attached at the back of the questionnaire.

(Note, the quota of 5 includes selections from subcategories. Where sub-subcategories are provided, please make your selection from these, should it be applicable). An example is attached, in which the "respondent's" selection is highlighted)

1. **Process analysis**

2. **Quality management systemsfe.g. ISO 9000)**

3. **Statistical method**

   3.1 Run charts
   3.2 Control charts
   3.3 Pareto analysis
   3.4 Histograms
   3.5 Cause and effect diagrams
   3.6 Stratification data
   3.7 Check sheets
   3.8 Scatter diagrams

4. **Qualitative methods**

   5.1 Quality circles
   5.2 Job design
   5.3 Organisational structure
   5.4 Supplier relationships and -development
   5.5 Specifications and Standardisation

5. **Other Management Methods**

   5.1 Six sigma
   5.2 Deming wheel
   5.3 Bench marking
   5.4 Gantt charts

SECTION B : SUPPLY CHAIN MANAGEMENT STATUS

Organizations achieve different levels of mastering world class supply chain management as summarised in Figure 9 below. Kindly peruse Figure 9 and rate the placement of your organization in terms of World class status, by encircling the "World Class Supply Chain Scale" at the bottom.

Figure 9. The Progression to World Class Supply Chain Management

Clerical	Mechanical	Proactive	World Class
			Strategic sourcing
			Monitoring supply environment
			Understand key supply industries
		Coordinate procurement system	Develop and implement commodity strategies
			Commodity teams
		Involved in development of requirements	Supply base by design
		Fulfil social responsibilities	Time-based competition
	Transactional focus	Plan for recurring requirements	Manage risk
		Develop Suppliers	Leverage supplier technology
Process paperwork		Near defect free materials and services	Virtually defect free materials and services
	Not involved in key source selections	Active in source selection	Integrated supply strategy
Confirm actions of others	React to requisitions	Long term contracts	Develop and manage alliances and networks
Emphasis : Convenience	Emphasis: Purchase price	Emphasis : cost, quality, timeliness	Emphasis : total cost
Relationships : Personal	Relationships: Transactional/adversarial	Relationships : Transactional and collaborative	Relationships: Transactional, collaborative, and alliance
Bottom-line impact : Overhead	Bottom-line impact: Revenue neutral	Bottom-line impact: Profit	Bottom-line impact: Increase shareholder value
Reporting : very low level	Reporting low level	Reporting : Upper management	Reporting: Member executive group
Data: Not available	Data: Used to expedite	Data Facilitates sourcing and pricing	Data: Facilitates strategic planning
	Computers process paperwork	e-Commerce	e-Commerce II

1	2	3	4	5	6	7	8	9	10

World Class Supply Chain Scale

CONTACT DETAILS

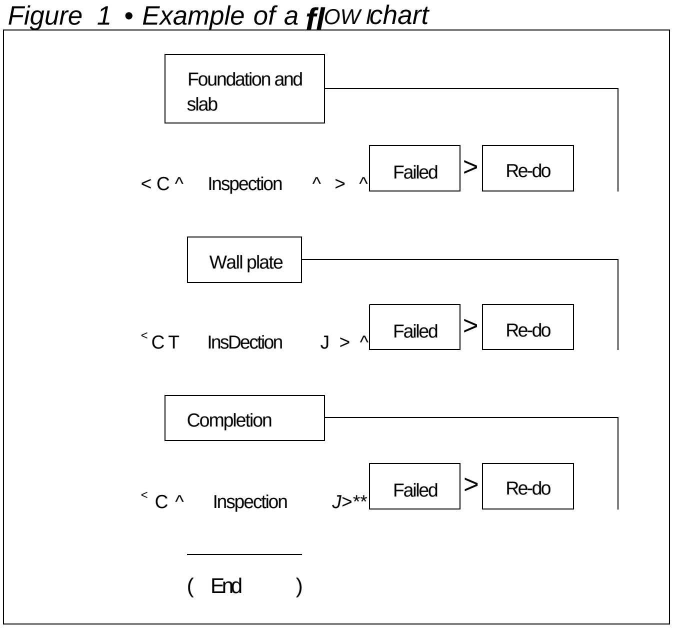
Name:	
Organization:	
Component:	
Position:	
Contact Number:	

EXPLANATIONS OF QUALITY MANAGEMENT TOOLS AND RELATING TO SECTION A

6. Process analysis

Process analysis outlines systems and helps to identify process and quality problems Flow charts (Figure 1, below) provide a visual representation of all the steps in a process, links between them, source of inputs and resultant outputs.

Figure 1 • Example of a flow chart



7. Quality management systems

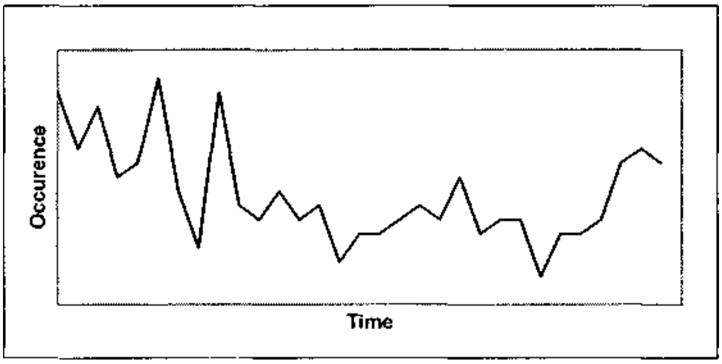
A quality management system is a systematic approach that yields a formal record of an organization's quality management method and provides a basis for measuring and monitoring quality performance. The system is certified by a third party as conforming to an acceptable standard, such as the International Standards Organization, e.g. ISO 9000 and 14000.

8. Statistical method

Various tools are available to collect and analyse data. A number of computerized software programmes are available

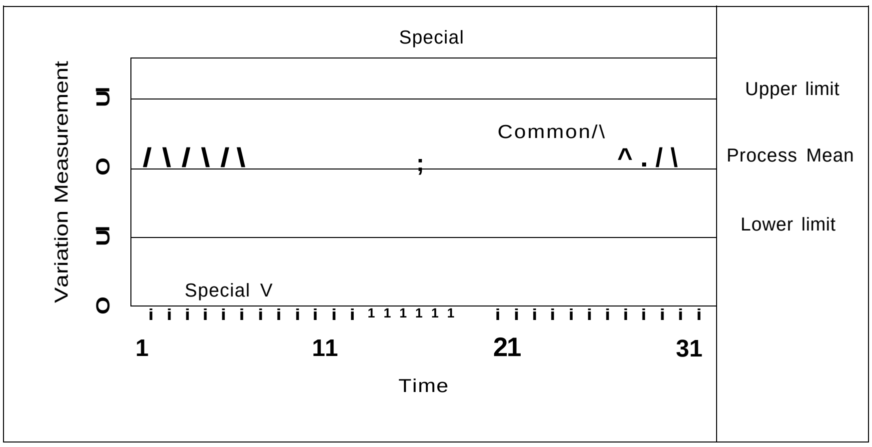
3.1 Run charts (Figure 2 below) provide graphic representation of occurrences over time to indicate trends, cycles and other changes over time.

<u>Figure 2 Run chart</u>



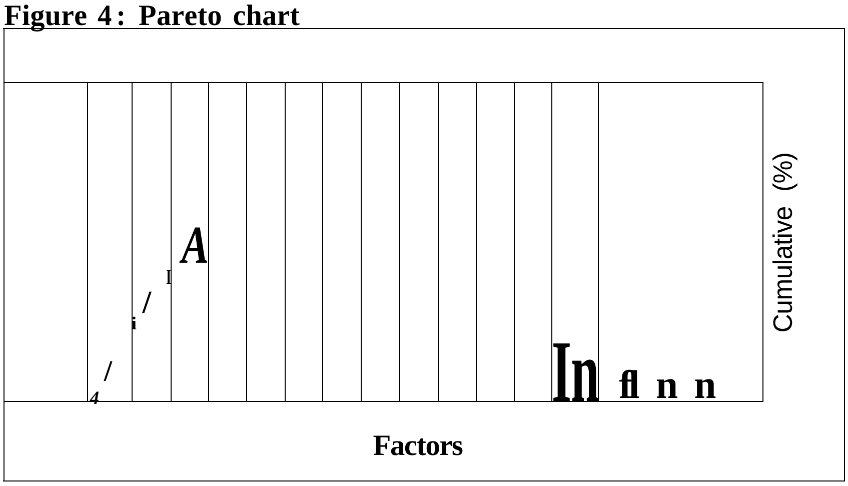
3.2 Control charts (Figure 3, below) are used to indicate variation that exceed set limits to identify "special causes" needing intervention to reduce variation.

<u>Figure 3 : Sample control chart</u>



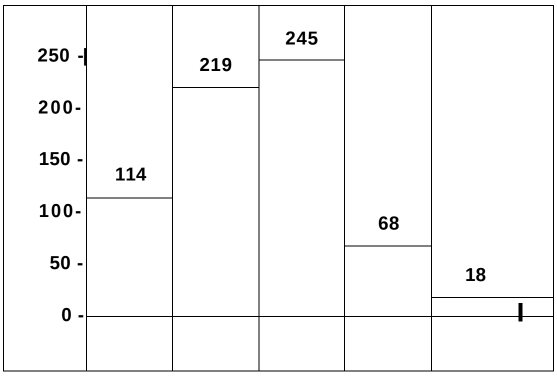
3.3 A Pareto analysis is used to identify the most critical problems to be addressed for maximum impact. The resultant charts (Figure 4, below), provide a graphic representation of factors in descending order of the frequency of occurrences to identify the starting point for problem solving, monitor progress and identifying basic causes.

Figure 4: Pareto chart



3.4 Histograms (bar charts) are used to display the frequency distribution of an occurrence through the use of bar charts. It highlights the centre and amount of variation in a sample.

<u>Figure 5 : The histogram</u>



3.5 Cause and effect diagrams (Figure 6.1) are used to identify root causes of problems and indicate resultant effects. With adaptation the model can be used to indicate the potential consequences of proposed actions, see Figure 6.2.

<u>Figure 6.1 : Ishikawa or fishbone diagram</u>

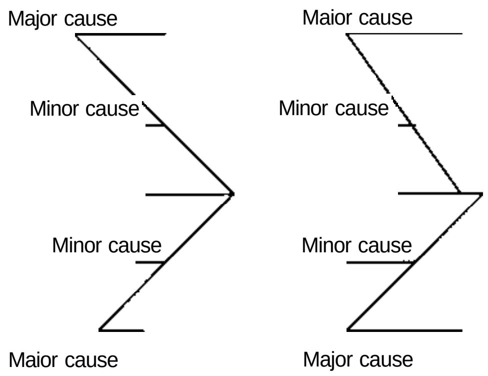
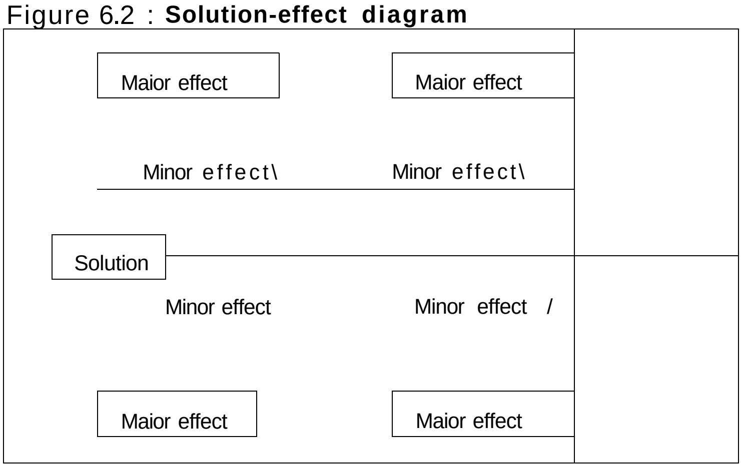
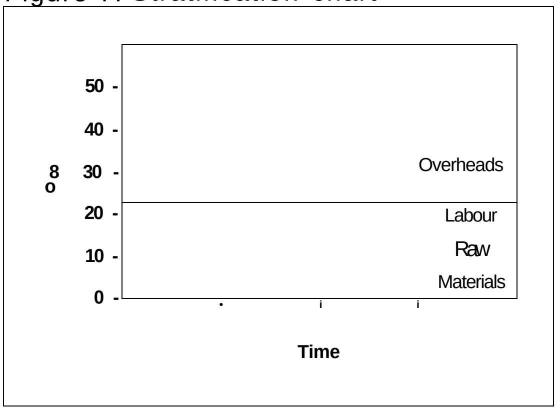


Figure 6.2 : **Solution-effect diagram**



3.6 Stratification data is presented in stratification charts (Figure 7). Bands of information are presented as cumulative totals of each type of occurrence to indicate which element is incurring the greatest costs or greatest number of faults. These can be used to indicate the relative importance of contributing factors to a process or problem and are typically easier to construct than Pareto's.

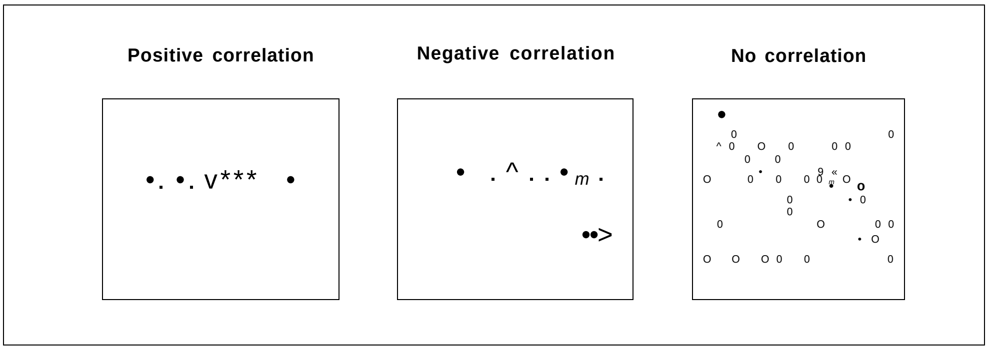
Figure 7: Stratification chart



3.7 Check sheets provide a simple method for collecting data on the occurrence of defects or values, in a wide range of areas. It is used to collect numerical values of nonconforming aspects for Pareto analysis and/or histograms.

3.8 Scatter diagrams are used in combination with statistical methods to determine whether there is a relationship between two variables. Points are plotted on a graph to ascertain whether there is a pattern in the distribution that would allow a line of best fit to be drawn with the same number of points on each side.

Figure 8 : Scatter diagrams



9. <u>Qualitative methods</u>

4.1 Quality circles

Quality circles (workforce teams) comprise of groups of people within each department who meet regularly to address quality problems within their particular components.

4.2 Job design

People need to know the job requirements and how it should be executed, they should be suitable to the job, be trained and skilled (thus also indicating the importance of proper selection and recruitment, and should be authorized to make decisions. Delegation empowers people and is a motivational tool that could stimulate innovation (which is critical to continuous improvement), and illustrates management's trust in its employees Continuous feedback on performance through effective appraisal and rewards is a key element in improving work quality.

4.3 Organisational structure

Recent trends indicate a shift from function based to processed based organization where quality management is assigned to all functional departments, focusing on internal and external customers. Decisions are delegated to lower levels and suppliers and customers are partners in quality improvement. Upper management leads quality and is responsible for quality strategy development and implementation support. Middle management is responsible strategy execution; and the workforce for implementation and providing knowledge and experience type inputs.

4.4 Supplier relationships and -development

The use of partnerships is a growing trend in attending to quality. These partnerships can be facilitated through joint economic and technological planning (and cooperation in execution of contracts.

4.5 Specifications and Standardisation

"Specifications and standardisations are related topics in supply chain management".

"Specifications are targets and tolerances determined by designers of products and services. Targets are ideal values for which production is to strive; tolerances are specified because designers recognize the impossibility of meeting meet targets all of the time in manufacturing. The degree of conformance to specifications, within the prescribed tolerance of deviation, is a means of defining quality.

Standardisation is defined by the International Standards Organization defines it as "documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products and services are fit for their purposes".

10. <u>Other Management Methods</u>

5.5 Six sigma

Six sigma combines managerial and statistical techniques process variation reduction. Six sigma status means that a small amount of variation (denoted by a sigma) exceeds specification limits. Six standard deviations are recorded between the process mean and upper and lower limits. The closer the number of variations to six, the better. The approach aims to identify, remedy and prevent future defects, as does total quality management discussed earlier, thus from this perspective is a means through which total quality can be achieved.

It comprises five phases, summarised as follows:

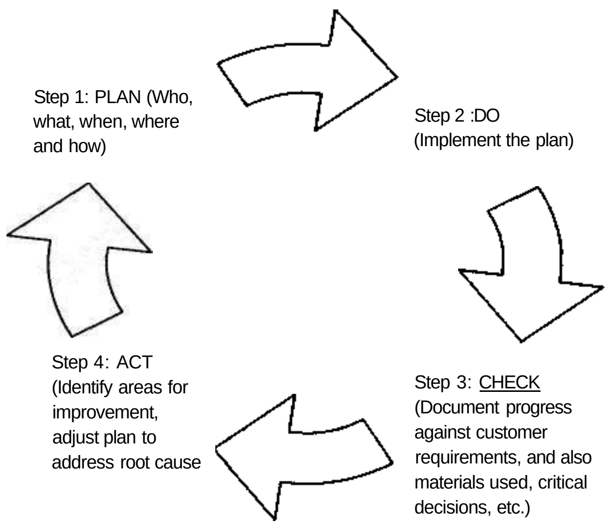
Phase 1- Definition phase: Identify and define projects and -teams
Phase 2- Measurement phase: Identify key parameters and process characteristics; data collection needs; and measures current process capabilities.
Phase 3- Analysis phase: Collect and analyse past and current performance data to identify causes for variation, including the development and testing of theories (hypothesis) on cause and effect relationships of variations identified.
Phase 4- Improvement phase: Design a remedy to address causes of variation; test and prove effectiveness; develop and implement change management plan.
Phase 5- Control phase: Ensure design and implementation of activities for maintenance and improvement of processes

5.6 Deming wheel

This is a management concept advocated by Deming (a quality management theorist) to satisfy customer requirements by using a continuous cycle of **plan, do, check** and **action** (see Figure 9, below).

Plan - Identify causes of a problem and obtain data to detect the causes of error.
Do - Quality team to address problem.
Check - Investigate whether improvement was successful.
Action - Accept new quality level if improvement was successful, or repeat the cycle.

<u>Figure 9 : Deming Wheel</u>



5.7 Bench marking

Benchmarking is a continuous, systematic process for evaluating the products, services and work processes of organizations that are recognized as representing best practices for the purpose of organisational improvement. It is the measurement of an organization's performance against best practices, determining how these are achieved and using this information for superior performance.

5.8 Gantt charts

Commonly used in project management or to illustrate steps and timeframes for activities, as illustrated in Figure 10, below.

Figure 10 : Example of a Gantt Chart

Task		**Time rame**				
No.	**Description**	**1**	**2**	**3**	**4**	**5**
1	Activity 1					
2	Activity 2	— •				
3	Activity 3					
4	Activity 4					
5	Activity 5					

APPENDIX 16

DATA FOR UMSHWATI LOW-INCOME UNITS USING THE SAME LIMITATIONS APPLIED IN THIS STUDY

Table 1 : Defective Units v Defect Free Units

DEFECTS ANALYSIS	Frequency	% of Sample		Slab	Wall	Completion
Total number of sites	411	100.00	Total (per defect type)	236	283	403.00
			% Number Defects	31.81	**38**	54.31
Totally Defect free	126	30.66	% of Sample	57	**69**	98.05
Total number defects	**218**	53.04				
Total Re-inspections	**73**	17.76				
Total no. Inspections (Apr-Dec 2005)	922					

Table 2 : Defect types : Issues leading to potential failure of the inspection

	MAJOR STRUCTURAL												OTHER		INADEQUATE SERVICES			
	Construction			Materia l/s														
				Foundation				Wall			Roof							
	U. 3 c co ndSl	Wall to plate	aa oof	i ntels	o oncrete	m ocks	a Q o	CQ ocks	s ortar mix	/ ntels (window , do partitions	co leeting (thic tness c d rust free	CQ eams and R	* complete/notreay	^ ccess/Kevs	s /ater	CO anitation	^ ccess
Total (per defect type)	15.00	-	-	16.00	-		12.00	-	-	2.00	-	1.00	-	6.00	1.00	8.00	1.00
% Number Defects	2.02	-	-	2.16	·		1.62	-		0.27	-	0.13	·	0.81	0.13	1.08	0.13
% of Sample	3.65	-	-	3.89	-	-	2.92	-	-	0.49	-	0.24	-	1.46	0.24	1.95	0.24

DESCRIPTIVE STATISTICS																	
Mean	1	-	-	1	-		1	-	-	1	-	1	-	1	1	1	1
Standard Error	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Median	1	-	-	1	-		1	-	-	1	-	1		1	1	1	1
Mode	1	-		1	-	-	1	-	-	1	-	0	-	1	0	1	0
Standard Deviation	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Sample Variance	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Kurtosis	0	-	-	0	-	-	0	-	-	0	-	0	-	0	0	0	0
Skewness	0	-	•	0	-	-	0	-	-	0	-	0		0	0	0	0
Range	0	-		0	-	-	0	-	:	0	-	0	-	0	0	0	0
Minimum	1	-	-	1	-	-	1	-	-	1	-		-	1		1	
Maximum	1	-	-	1	-	-	1	-	-	1	-			1		1	
Sum	15	-	-	16	-	-	12	-	-	2	-		-	6		8	
Count	15	-	j	16	-		12	-	-	2	-		-	6		8	
Largest(1)	1	-	-	1	-	-	1	-	-	1	-			1		1	
Smallest(1)	1	-	-	1	-	-	1	-	-	1	-		-	1		1	
Confidence Level(95.0%)	0	-		0	-		0	-	-	0		0		0	0	0	0

Table 3 : Defects relating to finishing : Plumbing

	CLEARANCE	***FINISHING: PLUMBING***										
		Workmanship					**Material**					
	Site clearance	Toilet (Incl. Pipes and Rodding eyes)	Outlet and Gully	Pipes (Water, incl. taps)	Basin	Shower	**Tap**	**Gully**	**Water tank**	REINSPECTIONS	Duplications	Errors per unit
Total (per defect type)	0	5.00	1.00	25.00	38.00	0	27.00	1.00	24.00			
% Number Defects	0	0.67	0.13	3.37	5.12	0	3.64	0.13	3.23	9.84	3.23	59.30
% of Sample	0	1.22	0.24	6.08	9.25	0	6.57	0.24	5.84	17.76	5.84	107.06
DESCRIPTIVE STATISTICS												
Mean	-	1	1	1	1	-	1	1	1	1	1	1.0706
Standard Error	-	0	8E-15	0	0	-	0	8E-15	0	0	0	0.0501
Median	-	1	1	1	**1**	-	1	1	1	1	1	1
Mode	-	1	0	1	1	-	1	0	1	1	1	0
Standard Deviation	-	0	0	0	0	-	0	0	0	0	0	1.0157
Sample Variance	-	0	0	0	0	-	0	0	0	0	0	1.0316
Kurtosis	-	0	0	0	0	-	0	0	0	0	0	-0.139
Skewness	-	0	0	0	0	-	0	0	0	0	0	0.7002
Range		0	0	0	0	-	0	0	0	0	0	4
Minimum	-	1		1	1	-	1		1	1	1	0
Maximum	-	1		1	1	-	1		1	1	1	4
Sum	-	5		25	38	-	27		24	73	24	440
Count	-	5		25	38	-	27		24	73	24	411
Largest(1)	-	1		1	1	-	1		1	1	1	4
Smallest(1)	.	1		1	**1**	-	1		1	1	1	0
Confidence Level(95.0%)	-	0	0	0	0	-	0	0	0	0	0	0.0985

Table 4 : Defects relating to finishing : Other

	FINISHING : OTHER FINISHES										
	Workmanship						Material				
	Block work	Cork/Fill/Grout	Plaster	Fitting windows, glass and door frames	Glazing	Screed	Window and/or door frames	Plaster/Cemcrete/Bagwash	REINSPECTIONS	Duplications	Errors per unit
Total (per defect type)	0	0	1.00	0	0	34.00	19.00	17.00	73.00	24.00	
% Number Defects	0	0	0.13	0	0	4.58	2.56	2.29	9.84	3.23	59.30
% of Sample	0	0	0.24	0	0	8.27	4.62	4.14	17.76	5.84	107.06
DESCRIPTIVE STATISTICS											
Mean	-	-	**1**	-	-	1	1	1	1	1	1.0706
Standard Error	-	-	8E-15	-	-	0	0	0	0	0	0.0501
Median	-	-	1	-	-	1	1	1	1	1	1
Mode	-	-	0	-	-	1	1	1	1	1	0
Standard Deviation	-	-	0	-	-	0	0	0	0	0	1.0157
Sample Variance	-	-	0	-	-	0	0	0	0	0	1.0316
Kurtosis	-	-	0	-	-	0	0	0	0	0	-0.139
Skewness	-	-	0	-	-	0	0	0	0	0	0.7002
Range	-	-	0	-	-	0	0	0	0	0	4
Minimum	-	-		-	-	1	1	1	1	1	0
Maximum	-	-		-	-	1	1	1	1	1	4
Sum	-	-		-	-	34	19	17	73	24	440
Count	-	-		-	-	34	19	17	73	24	411
Largest(1)	-	-		-	-	1	1	1	1	1	4
Smallest(1)	-	-		-	-	1	1	1	1	1	0
Confidence Level(95.0%)	·	·	0	·	—	0	0	0	0	0	0.0985

Table 5 : Time Frames

UMSHWATI SLUMS CLEARANCE	INSPECTION DATES			TIMEFRAMES (Calendar days)			INSPECTION STAGE (Completed during 1 April 2005 to 31 December 2005)		
	SLAB	WALL PLATE	COMPLETION	Slab to wall	Wall to completion	Total	SLAB	WALL PLATE	COMPLETION
UNITS V TIMEFRAME STATISTICS									
AVERAGE	4/27/05	5/15/05	9/27/05	17	135	153	-	-	-
MODE	2/3/05	6/22/05	9/22/05	0	112	112	-	-	-
Frequency	63	318	7/16/00	98	166	115	-	-	-
MEDIAN	04/28/05	05/19/05	9/29/05	8	126	143	-	-	-
MIN	1/10/05	1/10/05	5/26/05	0	0	0	-	-	-
MAX	11/24/05	11/24/05	10/21/06	182	464	625	-	-	-
DIFFERENCE	318.00	318.00	513.00	182	464	625	-	-	-
Units/day	1.29	1.29	1.25	-	-	-	-	-	-
Units/month (30 days)	38.77	38.77	37.45	-	-	-	-	-	-
DIFFERENCE between first slab and last subsequent stage	318		649.00	days					
Units/day	1.29	-	0.63		-	-	-	-	-
Units/month (30 days)	38.77	-	19.00	-	-	-	-	-	-

Overall completion date analysis

90 day period (3 months)

Days	0-90	91-180	181-270	271-360	361-450	451-540	541-630	>630	.	.	.
Units	139	293	154	175	294.00	165	106	16	-	-	-
Units/day (90 days)	1.54	3.26	1.71	1.94	3.27	1.83	1.18	0.18	-	-	-
Units/month (30 days)	46.33	97.67	51.33	58.33	98.00	55.00	35.33	5.33	-	-	-

180 day period (6 months)

Days	0-180	181-360	>361
Units	432	329	475

	Slab	Wall	Roof
Total (per defect type)	236	283	403.00
% Number Defects	31.81	38.14	54.31
% of Sample	57	69	98.05