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ANALYZING THE PERSISTENT NATURE OF QUALITY ISSUES IN LOW-COST HOUSING PROJECTS

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A Research Report submitted to the Faculty of Engineering and Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science (Building)

AUGUST 2018

DECLARATION

I, Zandile Agnes Sibiya, declare that this Research Report is my own, unaided work. It is being submitted for the Degree of MSc in Building (Construction Project Management) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



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Signature

ABSTRACT

The primary objective of this research was to investigate the progressiveness of housing policies and strategies in addressing persistent quality defect challenges experienced in low cost housing projects delivered by the Department of Human Settlements (DHS). As low cost housing projects continue to dominate the South African housing market for low to middle income households and millions spent on rectifications, it was imperative to question why achieving defect-free housing project is such a challenge. Through employing mixed research methods, the researcher found that there has been a noticeable decrease in the frequency of defects due to the introduction of the NHBRC (project and home enrolment) process and the warranty scheme. However, common cases of non-enrolment and late enrolments of housing projects results in non-compliant houses and reinforce the persistence of the defective stock. Furthermore, it was found through the research that a large historical defective stock also remains, which forms the bulk of the defective stock that was accumulated prior to the introduction of the NHBRC warranty scheme and has proved difficult to eradicate due to budgetary constraints. In conclusion, the researcher argues that the delayed rectification of the defective stock and the persistence of quality management challenges continues to threaten the sustainability and viability of the entire Human Settlements programme. It is also clear that the regulatory role of the NHBRC in ensuring and enforcing quality compliance is being hampered by inefficient quality management processes caused by organizational and project management challenges of the DHS, which can be addressed by employing wholesome quality management systems such as TQM.

Keywords: Quality management, Low cost housing, Department of Human Settlements, NHBRC, Quality defects

ACKNOWLEDGEMENTS

To my family, friends, supervisor and research participants, thank you for the support you provided me during the course of working on this research.

To my dear friend and classmate Nonkululeko Mhlanga, thank you for pushing me to be the best I can be.

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ABBREVIATIONS

BQIH:	Building Quality Inspection Index for Houses
CAPA:	Corrective Action and Preventative Action
CESA:	Consulting Engineers of South Africa
CIDB:	Construction Industry Development Board
CONQUAS:	Construction Quality Assessment System
CSIR:	The Council for Scientific and Industrial Research
DHS:	Department of Human Settlements
KZNDHS:	Kwa-Zulu Natal Department of Human Settlements
NDHS:	National Department of Human Settlements
NHBRC:	National Home Building Registration Council
IBT:	Innovative Building Technologies
ISO:	International Organization for Standardization
QMS:	Quality Management Systems
PHSD:	Provincial Human Settlements Department
PSC:	Public Service Commission
RDP:	Reconstruction and Development Programme
SABS:	South African Bureau of Standards
SANS:	South African National Standards
TQM:	Total Quality Management

DEFINITIONS

IBTs:	*Innovative Building Technologies associated with non-standardized construction. Non-standardized construction can be defined as any form of building that utilizes building systems, methods, materials, elements or components, which are not fully covered by existing standards and specifications or codes of practice and which are not described or referred to in "deemed-to-satisfy" rules of the National Building Regulations (NHBRC, 2017d).*
CAPA:	*Corrective Action and Preventative Action, which is a process of correcting flawed processes detected via audits and non-conformance tracking and preventing defects from reoccurring (Rarani, 2013).*
CONQUAS:	*Standard quality assessment system for construction projects launched by CIDB Singapore (NHBRC, 2015b).*
Construction quality:	*The degree to which construction products conform to building standards and design specifications.*
HOMQAS:	*GIS overlay with real time inspection business intelligence utilizing electronic inspections system (NHBRC, 2017a).*
Low cost housing projects:	*Government-subsidized housing programmes, also known as Reconstruction and Development Programmes, introduced by the post-apartheid government to build houses and serviced sites for previously disadvantaged low-middle income citizens.*
NHBRC warranty scheme:	*Warranty Fund that was established to cover consumers against major and defined structural defects for a period of up to five years (NHBRC, 2015).*
Project life-cycle:	*Collective stages that make up the full duration of a project.*
Quality defects:	*Faults in a product, in particular to this research, it means structural faults which renders the house non-conformant in accordance with the prescribed Building standards thereby requiring repairs or reconstruction*
Quality management:	*The systematic application of processes to ensure that the quality of construction works meet the required standard.*

1. CHAPTER 1 - INTRODUCTION

1.1. Outlining the Research Problem

Since 1994, the Department of Human Settlements has provided over 4 million houses and serviced sites through its government-subsidized housing programme, which are commonly known as Reconstruction and Development Programme (RDP) houses or low-cost housing (NDHS, 2017). The issue of quality defects in these housing projects is a well-documented and widely accepted problem as below-standard houses have become common in South Africa for over 20 years. Studies by the CIDB (2011 & 2014) found that client satisfaction of quality was the lowest in the low-cost housing sector. This was further affirmed by the proliferation of common community protests over the quality of houses. Consequently, a number of studies by the PSC, CESA, CIDB, CSIR, NDHS, Public Protector and other researchers were conducted to better understand and address the persistent quality defects encountered in these projects along with studies to determine the cost of rework. RDP houses were often found to be badly build, poorly located on the urban periphery and too small (Tomlinson, 2015). Some of these defects included leaking roofs, surface bed with no foundation, gaps around door/window frames, windows/doors not closing properly, cracks in walls, dampness and mould, lack of toilet doors, lack of ventilation and the use of asbestos cement sheets has also been fairly widespread (for roofs and walls), and health risks. The Ministry of Human Settlements also publicly declared that shoddily-built, sub-standard low-income houses are unacceptable (CSIR, 2010).

The need to provide adequate housing, especially in urban areas, forms one of the critical challenges facing development, especially since it is regarded as a basic need that forms one of the critical human rights (Kotane, 2016). South Africa's low cost housing programme is underpinned by the right to housing which is enshrined in section 26 of the Constitution of the Republic of South Africa (1996), which mandates government to provide 'adequate' housing by taking reasonable legislative and other measures, within its available resources, to achieve the

progressive realization of this right (Tissington, 2011). Limited resources are available for South Africa's housing needs, while housing development pressures emerge in diverse locations (CSIR, 2010). The reality of the housing dilemma in developing countries, including those in Africa, is that not everyone will be able to freely access decent housing.

Goss in CSIR (2010) concludes that South African citizens have a constitutional right to adequate shelter, regardless of whether they live in a low quality area. He further asserts that decision-makers have to look at appropriate investment packages for every type of locality, consisting of suitable housing types as well as supporting services to increase quality of life. The quality of the housing provided by the government is a central part of this housing conundrum. As state-delivered subsidy or low-income houses will continue to dominate the South African landscape in terms of housing provision for lower income households, it is imperative to address the quality issues in low-cost housing project through efficient quality management systems (Zunguzane et.al, 2012: 21).

Achieving quality is a worldwide challenge for the construction industry. The complex nature of construction and the special characteristics of project production lends itself to problems in producing quality in a customer-oriented manner, which often results in quality defects. Causes to these defects are attributed to human factors like unskilled workers or insufficient supervision, material and systems failure, to name a few (Waje and Patil, 2012). Quality assurance systems have been the most common forms of quality principles applied to the low-cost housing projects, including document control, audits, non-conformance tracking, CAPA and Management Review. Furthermore, inspections have been the most dominant measure of addressing quality, which has proved ineffective in ensuring and enforcing the compliance of building legislations (Rarani, 2013: 84). Rarani (2013: iii) also found that low-cost housing inspectors lack training in housing inspection, are not aware of their roles and responsibilities and lack knowledge in building standards and regulations.

It is widely accepted that quality of construction projects should be linked with proper quality management in all the phases of project life cycle (Mallawaarachchi and Senaratne, 2015). Industry experts like CESA and CIDB have argued for the adoption of quality principles throughout the entire project life-cycle. Mkhonto (2014) has also asserted that a failure to emphasize the importance of Quality Management Systems in low-cost housing projects has led to inconsistency and the delivery of sub-standard quality houses.

Over the years, there have been a number of policy interventions and approaches to respond to some of the challenges. The South African National Standards (SANS) 10400:1990 is a document issued by the South African Bureau of Standards which contains the relevant regulations relating to construction of housing. This document formed the basis for the development of the National Home Building Registration Council (NHBRC) home building manual, which provides an acceptable level of safety, health and welfare during the design, construction and use of buildings (Rarani, 2013: 42). Furthermore, the government employed visible efforts to deal with these quality challenges, including the introduction of the NHBRC rectification and enlisting process, and Breaking New Ground which increased the housing subsidy and size of the houses. Over R2 billion has been dedicated to rectifying badly-built 'RDP' houses through a rectification programme which was abandoned in 2015. However, issues of quality still persist.

1.2. Relevance of Research

Allen and Mthi (2016) argue that studies should be conducted to reveal the importance of Quality Management Systems and how they can not only turn around the trajectory of a single organization, but that of the industry as a whole. Quality defects cannot continue to be treated as a recurring challenge that is not addressed, as client dissatisfaction of the quality of work within construction persists. It is unacceptable that the rectification of substandard construction work on many of the low-cost housing projects throughout South Africa has cost over R3 billion.

This has been a costly and wasteful exercise that could have been prevented through holistic application of quality management within the project life-cycle.

Moreover, improving the performance of construction requires the measurement of quality costs and understanding the effectiveness of employing quality management systems (Allen and Mthi, 2016). Key questions need to be raised as to why delivering houses with minimal or zero defects is such a challenge for these projects. The researcher's intention is to positively input into the body of work around the importance of quality management in improving the construction industry, particularly in the low-cost housing sector.

1.3. Research Aims and Objectives

This research is mostly exploratory. The main purpose of such studies is that of formulating a problem for more precise investigation or of developing the working hypotheses from an operational point of view (Kothari, 2004: 35-36). Such studies also offer insights and support Foucault's work on how power is manifested in reality through social actors and multiple perceptions. Hence this research adopts the interpretivism paradigm, based on the belief that reality is constructed by social actors and people's perceptions of it (Wahyuni, 2012). They recognize that individuals with their own varied backgrounds, assumptions and experiences contribute to the on-going construction of reality existing in their broader social context through social interaction (Wahyuni, 2012). Low-cost housing projects are characterized by multiple social actors who display multiple power dynamics, i.e. politicians, officials, beneficiaries, regulatory bodies, housing analysts. Key authors used in this research include Kothari, Mack et.al, Creswell, Thomas, Saunders, Wahyuni, Mallawaarachchi and Senaratne and USC.

Mixed research methods (both quantitative and qualitative methods) were deemed most appropriate for this research study. The study focused on a variety of challenges, hence the mixed

method approach was appropriate since the use of only one of the two methods could provide incomplete answers (Kotane, 2016). Criterion sampling has been used in determining the sample for this study, which allows for the in-depth investigation of a particular case (Patton and Cochran, 2002), i.e. the Department of Human Settlements. Policy and programme planning, and monitoring and evaluation housing programmes are functions of the National Department of Human Settlements (DHS). Inspectors are employed by the PHSDs and more recently in municipalities that have been accredited. Inspectors from Provincial and Municipal departments were selected to complete the questionnaires as they were able to provide insight on the inspection processes and findings on site. Questionnaires and request for information were sent to 3 PHSDs and 1 municipal department. It should be noted that difficulties in making available the current statistics due to unavailability of updated information was found to be common in all the provinces where the information was requested. Only 10 questionnaires were completed from one of the provincial departments. Statistics were collated and analyzed from published NDHS and NHBRC reports, as well as some of the human settlements provincial and municipal departmental reports.

i) Research aims:

The aim of this research was to thoroughly articulate quality management gaps and shortcomings within the low-cost housing sector in South Africa so as to understand the persistent nature of housing quality defects.

ii) Objectives

The objectives of this research were to:

- Provide a clear account of the quality concerns in low-cost housing projects;
- Investigate the factors affecting efficient quality management in the construction industry; and

- Measure the responsiveness of housing policy and programmes to address causes of quality challenges.

1.4. Research Questions

The main research question was:

- How progressive are housing policies and strategies in addressing quality defects challenges experienced in government-subsidized housing projects?

The sub-questions were as follows:

- What interventions have been implemented to address the common causes of housing quality defects?
- How effective has the NHBRC been in addressing housing quality defects?
- What is the frequency of quality defects in recent projects?
- What have been the effects of abandoning the rectification process?
- What lessons have been learnt from the rectification process?

1.5. Assumptions and Limitations

i) Assumptions

- The lack of effective Quality management systems deployment is not the only contributing factor to the quality challenges.
- Quality management principles are used to some extent but they are currently inefficient.

ii) Limitations

Housing quality challenges extend beyond structural failures to issues of accessibility, location, services, which is packaged under the umbrella of sustainable human settlements. However, for purposes of this research, housing quality challenges will refer to structural housing defects caused as a result of structural failures.

1.6. Outline of Study

Chapter 1 has been a brief outline of the context and research problem. The chapter also outlines the research relevance, aims and objectives, limitations and assumptions, and methodology.

The remainder of the chapters are organized as follows:

- Chapters 2 and 3 form the Literature Review, which presents the existing body of knowledge on low cost housing quality, quality defects in the construction industry and the relevance of quality management. Causes of quality issues characterizing South Africa's low-cost housing sector are discussed at great length. There are also a number of studies and research reports about the general challenges within the sector, specifically those focusing on the quality issues. Literature sources used include books from key authors (such as Creswell, Karna, Kothari, Thomas and Saunders), journal papers, conference papers, dissertations, government/organizational reports and websites i.e. DHS, NHBRC, CIDB.
- Chapter 4 is a discussion of the research design and methodology to be applied. This includes a discussion of research philosophies, data collection strategies, sampling, data analysis and ethical considerations.
- Chapter 5 is a discussion and analysis of research findings. This chapter will be an interpretation of the data collected from the case study.

- Chapter 6 is a discussion of the recommendations and conclusions for the research. The chapter will consolidate all the chapters to reflect on the entire research process. This will also include the identification of knowledge and practice gaps/areas for further study.

2. CHAPTER 2 - LITERATURE REVIEW ON QUALITY

This literature review is covered in two chapters, i.e. the first part articulates the relevance of quality management in construction and the second part unpacks the quality issues characterizing South Africa's low-cost housing sector. Literature sources used include journals and conference papers, dissertations, books from key authors, government websites and published government/organizational reports by the NHBRC, DHS, and CIDB. This particular chapter will focus solely on the quality definitions, causes and costs of defects, the relevance and challenges of applying quality management systems.

2.1. Defining Quality in Construction

There are a variety of quality definitions, but the most common trends to defining quality are customer satisfaction, fitness for use and conformance to standards or specifications (KZNHS, 2010: iii; Smallwood, 2012). Asif (year unknown: 9) also highlights two aspects of quality, i.e.

- Quality of design, which measures how closely the characteristics of products and services meet the needs and wants of customers;
- Conformance quality, which refers to the performance of a product or service according to design and produce specifications.

The definition of quality has evolved over the years, since its inception in the 1950s. Three quality "gurus" Deming, Juran and Crosby have been profoundly influential in the development of modern quality management practices, as shown in Table 1 (Lombard, 2006). The development of quality has evolved to move beyond a basic conformance to specifications to a holistic approach that also emphasizes client's needs, organizational culture, measurement of causes and costs of non-conformance.

Table 1: Development of quality management practices

Deming	Juran	Crosby
- Japanese industry in the 1950s - focus on improvement of conformance to specification by reducing variability and uncertainty in the design and manufacturing processes - improved quality led to increased productivity and lowered cost - focus on client's need and organizational prioritizing quality	- Japanese industry in the 1950s - product should be fit-for-use - organizations should fully integrate into their different levels	- costs of quality and non-conformance

(adapted from Lombard, 2006)

ISO 9000 also defines quality as 'the degree to which a set of inherent characteristics fulfils requirements' (CIDB, 2011: 3). These requirements are based on the expectations of the customer/client, which also makes customer satisfaction a key component of how quality is defined and measured. The significance of customer satisfaction and its use for evaluating the quality from the customer's perspective has been emphasized by many authors in construction (Karna, 2004: 68). Karna (2004) further asserts that customer/client satisfaction is an important factor in the development of the construction process and the customer relationship. Value to clients is a very complex and often a subjective issue, but it is recognized that quality of construction is a key component of perceived value to clients (CIDB, 2011).

In construction related activities, a client's requirements are usually translated into a series of specifications that the builder or contractor undertakes to construct through a planning, briefing and design process (CIDB, 2011). Construction works can be defined as "the provision of a combination of goods and services for the development, extension, installation, repair, maintenance, renewal, removal, renovation, alteration, dismantling or demolition of a fixed asset including building and engineering infrastructure" (Lombard, 2006: 8). The construction industry has broad offering of construction works in which quality can be defined. For purposes of this

research, housing quality is the main focus. Mpambane's work in (Rarani, 2013: 14) has identified three areas of housing quality to include:

- Structural quality, which refers primarily to durability of the house;
- Service quality, which is concerned with the kinds of equipment, facilities, and conveniences which the dwelling provides;
- The state of maintenance and caretaking.

As such, quality in the construction industry can be defined as meeting the requirements of the designer, constructor and regulatory agencies as well as the owner (Mallawaarachchi and Senaratne, 2015: 84). Appropriate specifications, and compliance with the specification, are therefore key measures of construction quality, which should be achieved through quality management (CIDB, 2011). Defining and measuring construction quality therefore informs quality management strategies. Quality is obtained if the stated requirements are adequate, and if the completed project conforms to the requirements (Mallawaarachchi and Senaratne, 2015: 84).

2.2. Quality defects

Quality defects are faults in a product, which render the product non-conformant in accordance with the prescribed standards thereby requiring repairs or reconstruction. Defects in construction are a common phenomenon, manifested through structural faults in the built environment. Mpambane in Rarani (2013: 16) highlights the hazards, which result from improper construction, including:

- Unstable or poorly installed foundations that can result in unsafe structures;
- Structures which do not meet minimum weight-bearing requirements or seismic related standards that could collapse;
- Buildings not built to codes that may not withstand the force of winds;
- Improper electrical installations and use of unapproved materials cause injury, deaths, and property loss; and

- Improper plumbing installations also create hazards within a structure and can contaminate water supplies.

Causes of construction defects can be attributed to human factors like unskilled workers or insufficient supervision, material and systems failure (Waje and Patil, 2012). Construction defects would result from defective building material or components-materials (i.e., inferior material such as building bricks, cement, roofing material, poorly manufactured windows), violation of Building Codes at the time of construction, failure to meet professional standards for design at the time plans were approved Design (i.e., faulty RCC roofing design contributes to water intrusion), failure to build according to accepted trade standards for good and workmanlike construction (workmanship: i.e., substandard or shoddy work) and engineering/soil (i.e., structural failures and earth movements) (Waje and Patil, 2012: 16-17).

Lombard (2006: 18-19) also highlights Love et al.'s study into the causality of quality problems in construction. The study identifies three sub-systems as shown in figure 1, which visually depicts the causality of rework in construction in each of these sub-systems. When using this approach, the authors advise that while details of the diagrams may vary from project to project, the fundamental themes should remain similar. This approach emphasizes the importance of an iterative and holistic quality management system.

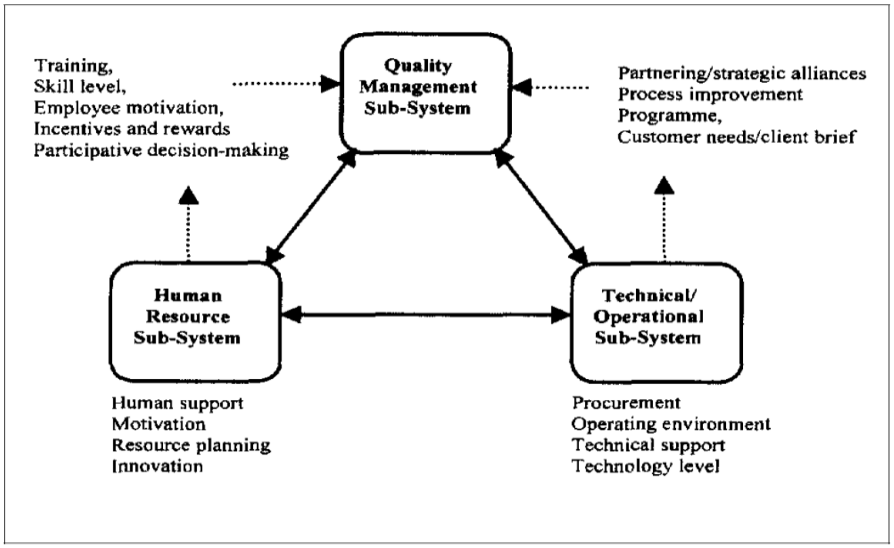


Figure 1: Interaction amongst project sub-systems (Love et.al. in Lombard, 2006:19)

A causal loop diagram shown in figure 2 was also developed as part of the study, which offers several insights into the positive impacts of implementation quality management on both project cost and rework costs, along with impacts of training, skills development and motivation on the number of design errors and changes, project and rework costs, construction errors and poor quality documentation (Lombard, 2006: 19-20).

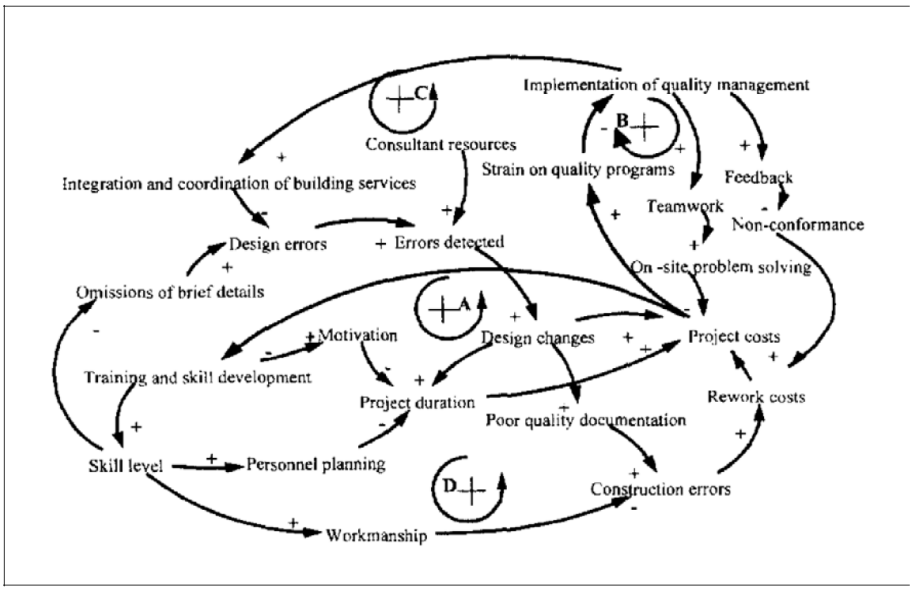


Figure 2: Overall Causal Loop Diagram of the project system (Love et.al. in Lombard, 2006:20)

Lombard (2006: 23) also highlighted a rework fishbone diagram (see figure 3) which found that engineering / design was the single largest contributing factor to rework for the project analyzed. The study was conducted by Fayek et al. (2003) to measure rework during the construction phase of a project and details the various causes of rework.

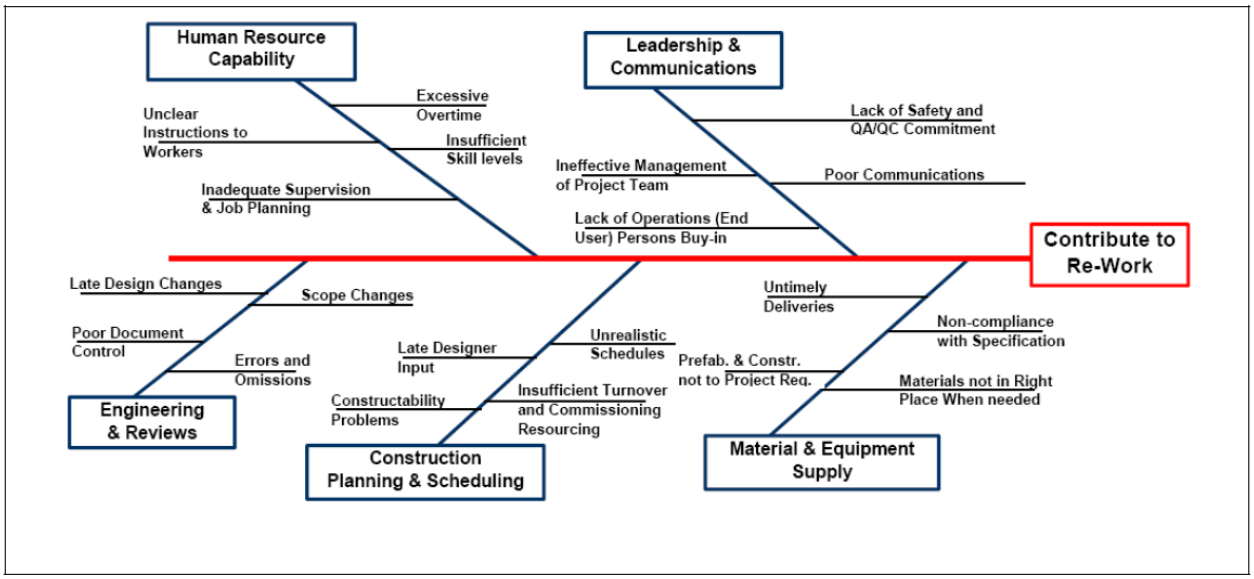


Figure 3: Rework Fishbone Diagram (Lombard, 2006:23)

2.2.1. Quality defects costs

Quality defects often result in repair and reconstruction costs. 6-15% of construction cost is found to be wasted due to rework of defective components detected late during construction and 5% of construction cost is wasted due to rework of defective components detected during maintenance (Mallawaarachchi and Senaratne, 2015: 86). The costs due to failure, appraisal and prevention are three major cost categories that could be directed by poor quality (Mallawaarachchi and Senaratne, 2015: 87).

Rarani (2013: 15-16) identified the following costs as a result of faults in construction:

- Repair in cases where it is possible and replacement with new work in cases where repair is not possible;

- Reconstruction in cases where actual demolition may be necessary;
- Reconstruction following demolition can also interfere with adjacent new work, and lead to problems of damage, dust, access, and creating a good link between old and new work;
- Delay in progress of the project may be one of the less obvious costs but is certainly a real one.

In terms of the traditional prevention-appraisal failure (PAF) approach to cost of quality analysis, non-conformance costs are normally grouped into the following four categories, as detailed by Mallawaarachchi and Senaratne, (2015: 87) and Rarani (2013: 15-16):

- Prevention costs - stopping non-conformance from occurring, including education, training and process study.
- Appraisal costs - stopping non-conforming products being shipped, including checks and grading to ensure specifications have been met. Appraisal costs could incur while performing measuring, evaluating, or auditing to assure the quality conformance. These costs include first time inspection, checking, testing, process or service audits, calibration of measuring and test equipment, supplier surveillance, receipt inspection etc. The prevention costs include the costs related to all activities of preventing defects from occurring and to keep appraisal and failure to a minimum, such as, new product review, quality planning, supplier surveys, process reviews, quality improvement teams, education and training.
- Internal failures - costs incurred due to scrapping or reworking defective product or compensation for delays in delivery. Internal failure cost includes rework, crap, re-inspection, re-testing, redesign, material review, etc; whilst external failure cost includes processing customer complaints, customer returns, warranty claims and repair costs, product liability and product recalls.
- External failures: costs incurred after delivery of a product to the customer ± costs of repairs, returns, dealing with complaints and compensation (ideally, this should also include loss of future business through customer dissatisfaction).

It is evident that causes of quality defects extends beyond technical standards non-conformance to include other factors like human resources, organizational support, procurement policies and processes and equipment. These factors are interconnected and occur throughout the project life-cycle. Quality management is an important element to ensuring the success of a project as it focuses on eliminating defects and variations and seeks to avoid waste of time, materials, and financial resources due to rework (Zunguzane et.al, 2012: 20). Mallawaarachchi and Senaratne (2015: 84) further state that great expenditures of time, money and resources, both human and material, are wasted each year because of inefficient or nonexistent quality management procedures.

2.3. 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, which should be certified by a third party as conforming to an acceptable standard, such as the International Standards Organization (KZNDHS, 2010). Project quality management, as defined in the PMBOK Guide, "includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken," (Project Management Institute cited in Khoza and Kabir, 2014: 33). The author of this research understands quality management (QM) in construction projects to mean the systematic application of processes to ensure that the quality of construction works at the required standard is achieved so as to obtain customers' satisfaction.

2.3.1. Common QMS approaches

There are various useful QM approaches that are commonly adopted. The implementation of quality management in construction projects requires the concepts of quality planning (identification of quality standards), quality assurance (evaluation of overall project performance) and quality control (monitoring of specific project results) (Mane and Patil, 2015).

Each approach is further divided into 3 stages, including inputs, tools and techniques, and outputs. Quality assurance (QA) and quality control (QC) are mostly used in construction (Mallawaarachchi and Senaratne, 2015: 86).

Quality planning is identifying what quality standards are relevant to the project and determining how to meet them through a quality management plan (ETU, 2007). Quality Assurance is evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards (ETU, 2007). Quality assurance is the process of auditing the quality requirements and the results from quality control measurements to ensure appropriate quality standards and operational definitions are used throughout the project (Rarani, 2013: 17). QA also involves establishing project related policies, procedures, standards, training, guidelines, and system necessary to produce quality (Mallawaarachchi and Senaratne, 2015). These policies and processes include:

- Inputs – quality management plan, quality metrics, quality checklists, process improvement plan, work performance information, approved change requests, quality control measurements (Rarani, 2013).
- Tools and techniques – quality audits, process analysis, cause and effect diagram, control charts, flowcharting, histogram, pareto chart, run chart, scatter diagram, statistical, inspection and defect repair review (Rarani, 2013).
- Outputs – organizational process assets updates, change requests, recommended corrective actions, project management plan updates, project document updates (Rarani, 2013).

Quality control is the monitoring of specific project results to determine if they comply with relevant quality standards and identifying ways to remove causes of poor performance (ETU, 2007). The quality control procedure in construction projects is based on tender documents, specifications and working drawings meaning that the pre-tender stage quality and standards of the work should be properly maintained (Mallawaarachchi and Senaratne, 2015). Quality Control

(QC) is the specific implementation of the QA program and related activities which reduces the possibility of changes and mistakes, if implemented effectively (Mallawaarachchi and Senaratne, 2015).

2.3.2. Quality improvement

As articulated in KZNDHS (2010:39), Quality Improvement includes confirming the need for quality improvement, identifying quality projects, organizing project teams, problem solving, and change management and should further include detailed improvement programmes for effective implementation. The forms in which quality improvement may take are as follows:

- Reducing defects and cost due to non-conformance;
- Improving responsiveness for cycle time in processing customer complaints, repairs or service;
- Improve products and enhancing the value of homes; and
- Improving productivity and effectiveness in all operations and business processes (Mkhonto, 2014: 32).

2.3.3. Total Quality Management

Total Quality Management (TQM) is based on a philosophy that quality affects all levels of the organization. It is defined as “a system of activities to achieve customer satisfaction, empower employees and increase revenue, all at lower costs” (KZNDHS, 2010: 42). Botha (2012: 12) also describes Total Quality, for any company, as the culture and attitude of the company’s employees to continuously provide their clients with products and services to satisfy their needs. The basic elements of TQM include leadership and management commitment, training, communication, teamwork, customer satisfaction, measurements, continuous improvement, process improvement, employee empowerment, supplier involvement (Harrington et. al, 2012).

Mkhonto (2014) concludes that TQM has been recommended as a strategy for achieving an improvement in the effectiveness, flexibility and competitiveness of a construction related

enterprise. The benefits of applying TQM in the construction industry are reduced construction cycle time, increased measurement of performance, better control of processes resulting in consistency throughout the life-cycle, and improvements in customer perceptions of the company (Harrington et. al, 2012).

Table 2: Differences between the traditional view of quality and total quality

Traditional view of quality	Total Quality
Productivity and quality are in conflict	Lasting productivity gains are made only as a result of quality improvements.
Only defined as meeting customer expectations.	Quality means satisfying customer needs and exceeding customer expectations.
Quality is measured by establishing an acceptable level of non-conformance, and measuring against that benchmark.	Quality is measured by establishing high-performance benchmarks for customer satisfaction, and continuing improving performance.
Quality is inspected into the product.	Quality is determined by product and process design, and achieved by effective control techniques.
Defects are an expected part of producing a product.	Defects are to be prevented using effective control systems.
Quality is a separate function.	Quality should be fully integrated throughout the organization.
Employees are blamed for poor quality.	At least 85% of quality problems are management's fault.
Supplier relationships are short term and cost driven.	Supplier relationships are long term and quality orientated.

Source: Botha, 2012

It has been widely argued that quality management should form part of every stage of the project life cycle. The implementation of typical QMS approaches, e.g. quality control and quality assurance as the most common, has often been disjointed and lacking multilevel organizational integration. Total quality calls for a complete multilevel integration of quality management in organizations [see Table 2]. The approach also challenges the traditional view that quality defects are a common phenomenon. Instead it argues that defects need to be prevented through the use of effective control systems throughout the project life cycle.

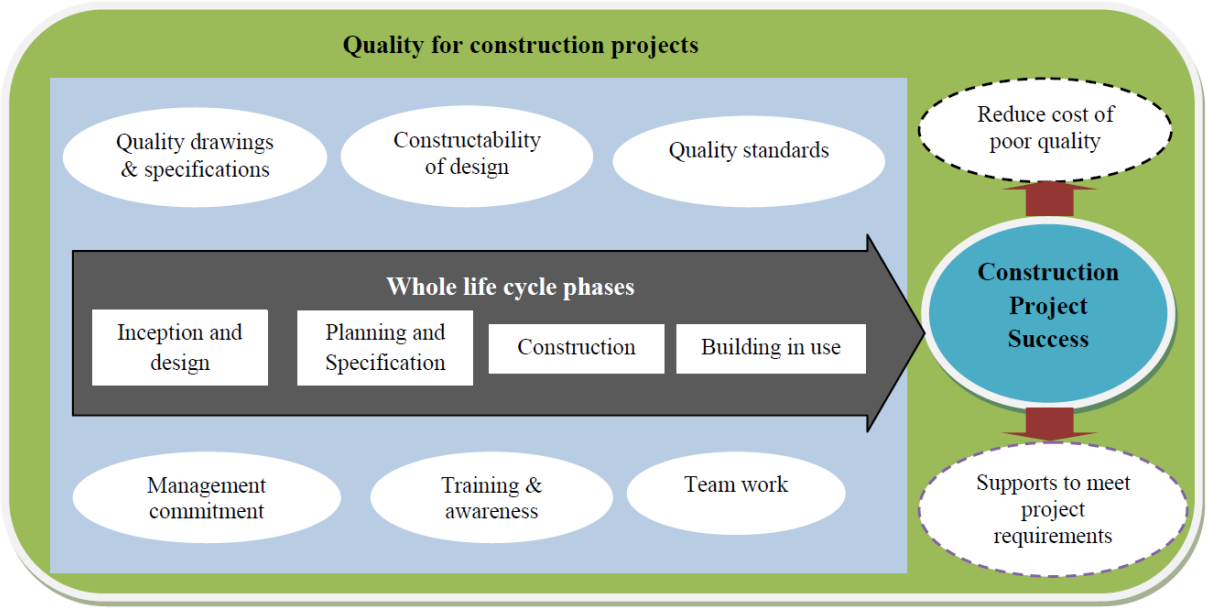


Figure 4: Framework of quality for construction project success
Source: Mallawaarachchi and Senaratne (2015: 87)

A clear understanding of quality requirements and strategies for each project phase is crucial to ensure that quality management forms part of the whole project life cycle, from inception and design to building use. Quality management should therefore take a holistic view of the entire project value chain (Lombard, 2006). Mallawaarachchi and Senaratne (2015) developed a framework of quality for construction projects [figure 4], which identifies and highlights construction project success requirements for the integration of quality reduction strategies and organizational commitment throughout the whole life cycle of the project. This should be coupled with management commitment, capacity and training, and team work.

2.4. Relevance of Quality Management

Quality often lags behind time and cost. Quality management increases productivity, price flexibility, competitive position, demand, profit, customer satisfaction, healthy supply chain relationships, jobs and job security while reducing rework and customer dissatisfaction and associated costs (KZNDHS, 2010). Quality management should be prioritized as a critical part of

ensuring the success of construction projects (KZNDHS, 2010; Mkhonto, 2014). Therefore quality should be viewed as equally important to time and cost, to lower the risks of higher costs and extended project time-frames. Bowen et al. (2002) argues that the majority of project management control systems highlight time and cost, and overlook the relative importance of quality. Therefore, for a successful project, the three parameters of time, cost and quality management should be embraced (Bowen et.al, 2002).

Bowen et.al (2002: page 2) further argues that in order to achieve successful project quality management three separate drivers to quality management must be managed, namely:

- Integration of the project team so as to have a single objective and a common culture;
- A customer focus for the team thereby facilitating the provision of products and services that will meet the client's needs;
- A process of continuous improvement in the management of the construction project.

When these three components are successfully integrated, the project will begin to realize significant, measurable and observable improvements in the attainment of the client's objectives (Bowen et al., 2002).

Whilst it is evident that nature of construction and the special characteristics of project production are complex (Karna, 2009), the construction industry needs to move towards the prioritization of quality management. Quality defects cannot continue to be treated as a recurring challenge, meanwhile client dissatisfaction of the quality of work within construction persists.

3. CHAPTER 3 - LOW COST HOUSING LANDSCAPE

Achieving quality is a worldwide challenge for the construction industry. This is also evident in South Africa, where the quality of low-cost housing has been a long-standing issue for over 20 years. The Ministry of Human Settlements has publicly declared that shoddily-built, sub-standard low-income houses are unacceptable (CSIR, 2010). The chapter is a discussion on South Africa's existing literature on low-cost housing policy, quality management approaches used and the nature and causes of housing defects.

3.1. Low-cost Housing Policy

The dual pressures of a growing urban population and pervasive poverty mean that African governments, including South Africa, face a growing challenge of providing shelter for the poor (Croese et. al, 2016). Government is tasked with the provision of housing for the poor, within budgetary constraints, persisting informal settlements and housing backlog (Tissington, 2011; Tomlinson, 2016). Access to and affordability to good-quality decent housing remains a major issue in South Africa.

The housing policy is underpinned by the right to housing which is enshrined in section 26 of the Constitution of the Republic of South Africa (1996), which mandates government to provide 'adequate' housing by taking reasonable legislative and other measures, within its available resources, to achieve the progressive realization of this right (Tissington, 2011). Table 3 summarizes the major developments in South Africa's housing landscape. Not all of them will be discussed at length but only those that are critical to providing the broader context for housing policy development and some of the policy interventions to quality issues.

Table 3: Summary of Housing Legislation and Policy

Summary of Low-cost Housing policy development in South Africa	
1992	National Housing Forum established
1994	Housing backlog in South Africa estimated to be 1,2 million
	The Reconstruction and Development Programme (RDP) adopted
	National (Botshabelo) Housing Accord signed
	Housing White Paper released
1995	National Housing Subsidy Scheme introduced
	Establishment of the Mortgage Indemnity Fund (MIF)
	Home Builders Registration Council (NHBRC) founded
	National Urban Reconstruction and Housing Agency (NURCHA) set up
1996	National Housing Finance Corporation (NHFC) established
	Rural Housing Loan Fund (RHLF) comes into being
	Constitution of the Republic of South Africa finalised
	Adoption of the Habitat Agenda at the second United Nations Conference on Housing and Urban Development
1997	National Housing Act promulgated
1998	Government pioneers the People's Housing Process (PHP)
	Prevention of Illegal Eviction from and Unlawful Occupation of Land Act passed
	National Home Builders Registration Council (NHBRC) established
1999	The Rental Housing Act passed
	Social Housing Foundation established
	National minimum norms and standards introduced
2000	Housing Code launched
	Home Loan and Mortgage Disclosure Act introduced
2001	The Housing Amendment Act No 4 prevents beneficiaries from selling RDP homes within first eight years of purchase
	Launch of the Urban Renewal Programme (URP)
2002	Community Reinvestment Bill tabled in Parliament and withdrawn
	Housing Consumers Protection Measures Act takes effect
	Beneficiaries earning more than R1 500 required to pay portion of RDP house cost
2004	Breaking New Ground launched
	Upgrading of Informal Settlements Programme (UISP) launched
2005	Social Housing Act introduced
2009	Housing Development Agency (HDA) established
	Revised Housing Code published
	MTSF 2009-2014
	Department of Housing renamed to Department of Human Settlements
2010	Minister Sexwale signs performance agreement on Outcome 8 targets
	Inauguration of the Social Housing Regulatory Authority (SHRA)
	Estate Agency Affairs Board (EAAB) falls under the Department

Adapted from NDHS, 2014

South Africa's housing policy has been in existence for over 20 years, rooted in the results of intense negotiations of the National Housing Forum (NHF) in 1992 to negotiate a new non-racial housing policy and strategy to provide redress for the black population that was deprived from adequate housing under apartheid (Khan and Thurman, 2001; Tomlinson, 2015; Croese et. al, 2016). These debates focused around issues such as whether housing should be provided by the private or the public sector, what standard of housing should be provided i.e. a completed four-room house or "progressive" (incremental) housing, and how rapidly the housing backlog should be eliminated. The result was a new "housing subsidy scheme" through which qualifying households were to have access on a "progressive" basis to:

- a permanent residential structure with secure tenure, ensuring internal and external privacy and providing adequate protection against the elements; and
- Potable water, adequate sanitary facilities, and a domestic energy supply (Tomlinson, 2015).

The default policy position was to adopt a 'mass' supply approach to rapidly eliminate the housing backlog, through the Reconstruction and Development Programme (RDP) that was launched in 1994. The Housing White Paper complemented the RDP in 1994 by introducing the National Housing Subsidy Scheme (NHSS) which was a once-off capital subsidy provided to low-income households earning below R3 500 a month (NDHS, 2014). Housing provision after 1994 included the roll-out of freehold title RDP housing developments located on the periphery of towns and cities and later shifted to an advancement of access to rental housing as a national priority, through the development of Institutional Subsidy Programme, Social Housing Programme and Community Residential Unit (CRU) Programme (Le Roux, 2011; SERI, 2013).

In the first 5 years, houses were built in great haste and left much to be desired in terms of quality. Shoddy workmanship was common, as builders cut corners to make profits. Structural defects were rife (NDHS, 2014). Hence the need for an introduction of the National Home

Builders Registration Council (NHBRC) in 1998, to regulate and monitor quality in the construction industry. The NHBRC was mandated to protect the interests of housing consumers and to ensure compliance by contractors with regulated building industry standards, in accordance with the provisions of the Housing Consumers Protections Measures Act (Act No. 95 of 1998). All builders in the country were compelled to register with the organization to be in business. The NHBRC certified builders who meet regulated industry criteria for technical, construction and financial capabilities. Secondly, to enforce correct building practices, the NHBRC dispatched home inspectors to building sites, long before houses are handed over to expectant homeowners (NDHS, 2014). Some of the initial RDP houses built were either rebuilt or rectified through the National Rectification Project spearheaded by the NHBRC.

The year 2000 saw the introduction of the Housing Code, which had been mandated in the Housing Act but had taken some time to develop. The Code clearly set out the underlying policy principles, guidelines, norms and standards that had to be applied to the National Housing Programmes. The introduction of Breaking New Ground (BNG) in 2004 was a fundamental change to low-cost housing provision. With it came the increase in the size of the houses coupled by an increased subsidy and the introduction of the Upgrading of Informal Settlements Programme. BNG rejected the idea of small RDP houses on poorly located land and instead proposed the delivery of “sustainable human settlements”. The importance of building durable, quality homes came to the fore and formed a large part of the NHBRC’s mandate. There was also an introduction of municipal accreditation, to delegate to municipalities the responsibility of housing provision, along with the provincial and national government (NDHS, 2014).

2004 also saw the introduction of housing as an asset as part of Breaking New Ground, through a new housing vision that ensured that property could be accessed by all as an asset for wealth creation and empowerment (CAHF, 2010). Notably, a house is not an end in itself but a social asset and a means to something greater, namely social and economic transformation, equality, human development and fulfilment (Tissington, 2010). Finmark Trust, in an aim to explore the

extent to which a subsidy house is a financial asset in the hands of the subsidy beneficiary, further developed the concept of the housing asset triangle which saw a housing asset as having three components: social, financial and economic/productive, as illustrated in the housing asset triangle shown in figure 5 (CAHF, 2010).



Figure 5: Housing Asset Triangle
Source: CAHF, 2010

In its reports, they found that houses provided through the national subsidy programme comprised a significant portion of South Africa's property market and could benefit the overall market if operated effectively (Ros et.al, 2011). The findings affirmed that subsidy housing can be effective as a social and economic asset. Families can create a home for themselves, parents can leave some form of inheritance for their kids and beneficiaries can use their homes to earn an income. However, the findings have suggested that using housing as a financial asset has proved challenging. Some beneficiaries have not received title deeds and subsidy homes cannot be sold within the first 8 years of occupancy. Furthermore, improvements to subsidy housing were still low and coupled with low levels of mortgage finance, mainly because beneficiaries were poor (Ros et.al, 2011). It was clear though that the creation of these homes should extend beyond just building shelters in remote places that are far from places of work and social amenities. The

impact of shoddy quality of the houses impacts the viability of the house as an asset which will positively benefit its beneficiaries and the housing market at large. As an end product, housing quality should be good enough to compete with others in the housing market.

As a response to the challenges at the time, the Housing Code was revised in 2009. In 1999 the National Norms and Standards for the Construction of Stand Alone Residential Dwellings were introduced by the Minister of Housing in terms of section 3(2)(a) of the Housing Act. These provided minimum technical specifications including environmentally efficient design proposals (Tissington, 2011). The norms and standards were revised in 2007 and contained in the 2009 Housing Code. Each house now had to have a minimum gross floor area of 40 m^2, two bedrooms, separate bathroom with a toilet, a shower and hand basin, combined living area and kitchen with wash basin and ready board electrical installation, if electricity is available in the project area.

Table 4: Housing delivery statistics 1994-2014

HSDG ONLY	Province	EC	FS	GP	KZN	LP	MP	NC	NW	WC	SA total
20 Year	Serviced Sites	135 182	30 566	256 307	88 217	66 001	46 631	27 630	106 126	146 883	**903 543**
Delivery	Houses/Units	309 364	224 341	681 753	516 373	224 028	211 835	63 485	269 310	334 786	**2 835 275**
	Total	**444 546**	**254 907**	**938 060**	**604 590**	**290 029**	**258 466**	**91 115**	**375 436**	**481 669**	**3 738 818**

Source: DHS, 2015

At the end of 2014, approximately 3.7 million housing units and service sites had been built all around South Africa, as indicated in Table 4. The delivery of these houses and service sites have definitely improved the lives of its beneficiaries, allowing 12,5 million people to access accommodation and a fixed asset and more than 10 739 communities in 968 towns and cities benefitting from the government housing programme (NDHS, 2014). The housing market, especially the affordable and gap market, had grown fivefold with the post-1994 government housing programme constituting about 24% of the total formal housing stock in the country (NDHS, 2014). In 2017, over 4 million housing opportunities have been provided in South Africa (NDHS, 2017). By 2015, the value of the state-subsidized housing market was estimated at R300 billion compared to R100 billion in 1994 (National Treasury, 2015).

While great strides have been achieved with the programmes, there have been major issues. Dissatisfaction with the quality of the houses has been clearly articulated by the government, beneficiaries and housing analysts. These houses were often badly build, poorly located on the urban periphery and too small (Tomlinson, 2015). The housing programmes were also characterized with issues of severe capacity problems and the inability to draw from resources located in the traditional housing and property markets which are required to deal with critical issues of the unlocking of well-located land in urban areas for residential development, delivering quality and good standard houses, connection of bulk infrastructure and services to new housing developments, access to interim services and upgrading for millions of households living in informal settlements, and lack of decent, affordable rental housing for low-income and poor individuals and households in well-located urban areas (Tissington, 2011; Tomlinson, 2016).

There have also been ongoing debates about what adequate and good-quality housing means. Tomlinson (2015: 6) has argued that "communities and housing actors generally agree that houses are often badly built, poorly located, and too small…Beneficiaries were dissatisfied with how little input they could make into the delivery process. They often said that they could build bigger and better houses for themselves if they were simply given direct access to the housing subsidy". Many commentaries also have alluded to the limited financial and human resources by the state, which has been further exacerbated by the citizens' belief that they deserve free houses, as an interpretation to the Section 26 of the constitution, which states that everyone has a 'right to housing'. Unfortunately though, in practice, the state cannot provide free housing to everyone. And with growing populations and poverty levels, the need for housing will surely maintain its increasing trends. It is clear that the creation of good quality homes has proved challenging for the government of South Africa. Tissington (2010: 77) argued that 'serious consideration should be given to setting up a formal monitoring and evaluation system that subjects all housing projects to an ongoing impact assessment in order to inform policy'. Eight years later, this assertion is still relevant in informing the low-cost housing dilemma.

3.2. Low-cost Housing Development Projects

3.2.1. Department of Human Settlements

The Constitution assigns housing as a concurrent function of national and provincial government. The Housing Act (1997) outlines the responsibilities of national, provincial and local government for housing delivery (National Treasury, 2015).

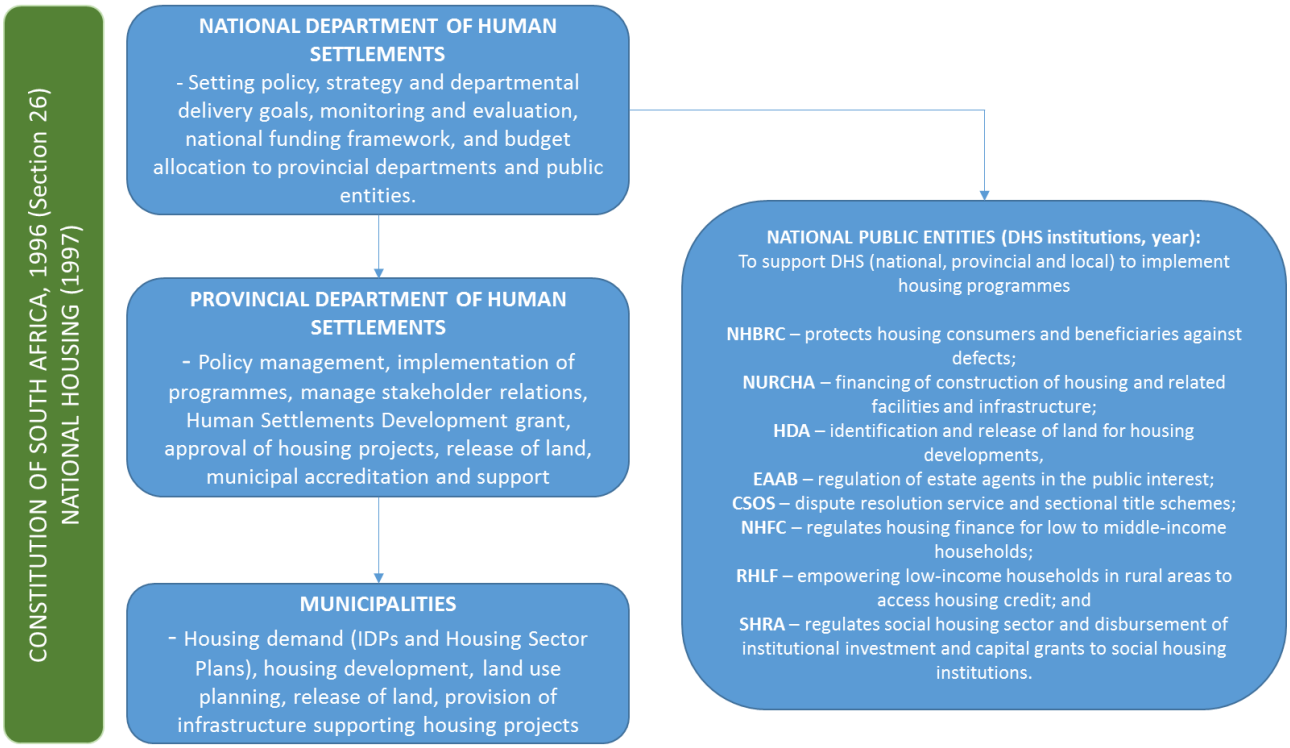


Figure 6: Department of Human Settlement organizational structure

Government is expanding the role of municipalities in human settlement development, as they are crucial to the creating an enabling environment for housing development in their areas of jurisdiction. This is also necessary to integrate housing and infrastructure planning and delivery at local level (National Treasury, 2015). There are three levels of accreditation. Level 1 identifies the foundational roles of a municipality (such as drafting high-level housing strategy and managing beneficiaries) and allows it to budget for human settlements expenditure (National

Treasury, 2015: 4). Level 2 allows a municipality to manage programmes and administer subsidies (excluding individual and relocation subsidies) whilst level 3 assigns the full housing function to a municipality, giving it authority for financial administration and disbursement of subsidies (National Treasury, 2015: 4). Provinces have assigned Level 2 accreditation to Johannesburg, eThekwini, Tshwane, Cape Town, Nelson Mandela Bay, Ekurhuleni and two district municipalities. To date, no municipality has received Level 3 accreditation (National Treasury, 2015).

3.2.2. Planning, Designing and Construction of Housing developments

The Department of Human Settlement's housing process is divided into 2 disciplines, namely Human Settlement Programme Cycle and Human Settlements Development process. The Human Settlements Development process is divided into the following phases:

1. Project Application/pre-feasibility - securing government commitment and feasibility funding
2. Feasibility – land legal investigations, securing land ownership, confirmation of bulk capacity and pre-planning funding
3. Pre-planning – securing development approvals i.e. town planning and environmental authorization, land surveying, engineering designs, NHBRC registration, house plans and implementation funding.
4. Implementation – contracting and procurement, construction, transfers of properties and close out
5. Post construction – re-sale and transfers of subsidized housing, payment of rates and services, installation of public services and facilities
6. Evaluation and Monitoring – compliance monitoring and value for money valuation, and impact analysis.

The following serves as a summary of the challenges identified in the Human Settlement Development Programme Cycle (uMhlaba Consulting group, 2013: 14):

- Lack of clarity on actual demand for housing;
- Weak match between identified housing demand and land identification needs in areas to address this need;
- Housing identification and prioritization not adequately matched to economic and other strategic opportunities in the country, province and municipality, leading to housing projects often being approved in areas of decline and lack of economic activity;
- Lack of proactive comprehensive integrated planning for housing – no long term cohesive, integrated strategic approach that guides funding prioritization and allocation from the various sector departments on which housing delivery depends;
- Lack of integration of Human Settlement priorities in other sector plans' prioritization (e.g. land access, bulk infrastructure, social facilities and economic development);
- Lack of sense of urgency from municipalities in responding to the information required and requested for the project;
- HSP review process lagging behind IDP processes – no opportunity for integration;
- Fragmented planning processes at Provincial and at municipal level – not aligned;
- Limited capacity at Provincial level (shortage of staff) for effective monitoring of implementation of MHSPs.

A number of challenges were also identified in the human settlement development process as experienced in the different stages. Quality management challenges and interventions were only highlighted during the implementation stage. The challenges highlighted by Umhlaba Consulting Group (2013: 19) include:

- Lack of experience of emerging contractor in business management (including tendering, costing, business / financial management) leading to quality, cash flow and other problems causing delays in implementation or stalled projects;
- Low skill levels resulting in slow progress poor workmanship - resulting in rectification / over expenditure / wasteful expenditure;

- Lack of accountability for non-performance of contractors results in slow response to interventions to rectify performance;
- NHBRC enrolment – requirements not met.

Lack of overall management systems to manage project feasibility assessment, pre-planning, readiness and implementation was highlighted as one of the general issues (Umhlaba Consulting Group, 2013). Interventions proposed to address these challenges included mentoring of improvement management systems, emerging contractors, exploring bridge finance options and penalties clauses in contracts (Umhlaba Consulting Group, 2013). A shortcoming of this analysis is that there is clearly a missed opportunity to understand the value of highlighting quality management challenges in the entire project life-cycle.

3.3. Quality Management of Low-cost housing projects

3.3.1. South African housing quality standards

South Africa also has a well-developed set of technical standards that can be used to describe the standards of materials and workmanship for construction works. These include a range of South African National Standards (SANS) and ISO standards, such as the SANS 1200 and 2001 series of Construction Standards, SANS 1921 series of construction and management requirements for works contracts, SANS 10155 code of practice for accuracy in buildings, as well as numerous standards relating to products and processes, such as SANS 10107 for the installation of ceramic tiles and SANS 10070 for the installation of plastic flooring, etc (CIDB, 2011: 12).

The SANS and ISO standards are managed by the South African Bureau of Standards (SABS), and the SANS standards have largely been developed by industry task teams which have included the CSIR, volunteer support from the learned societies (including the South African Institution of Civil Engineering, SAICE), and trade associations (CIDB, 2011: 12).

The three primary pieces of legislation governing the design and construction of homes are:

1) National Building Regulations and Building Standards Act of 1977 (Act No. 103 of 1977).
2) Housing Consumers Protection Measure Act of 1998 (Act No. 95 of 1998).
3) Occupational Health and Safety Act of 1993 (Act No. 85 of 1993) (NHBRC, 2014).

The South African Bureau of Standards (SABS) is a member of ISO, and is the ISO representative in SA (Botha, 2012). The International Organization for Standardization (ISO) developed the ISO 9000 series of quality management standards in the pursuit of harmonizing quality standards and reducing barriers to international trade, which have become one of the most ubiquitous international standards, having been adopted in more than 75 countries without editorial change (Lombard, 2006). The following volumes are applicable to a QMS (the year of latest revision is shown after the specification number):

- ISO 9000: 2005 – Vocabulary Standards
- ISO 9001: 2008 – Requirements
- ISO 9004: 2009 – Guidelines for improvement
- ISO 19011: 2002 – Auditing Standards (for external audits) (Botha, 2012: 14).

The SABS is the originator of Quality Standards in SA – the SANS series. The ISO Standards process was adopted by the SABS, who published it under the SANS banner and is typically known in SA with the prefix SANS (Botha, 2012). SANS 10400:1990 is a document issued by the South African Bureau of Standards which contains the relevant regulations relating to construction. These formed the basis for the development of the National Home Building Registration Council (NHBRC) home building manual, which provides an acceptable level of safety, health and welfare during the design, construction and use of buildings (Rarani, 2013: 42). The manual entails details

of home building legislation, design requirements, NHBRC warranty scheme, and technical requirements for compliance.

The old NHBRC Home Building manual has now been replaced by the new SANS special edition SANS Collection for Home Builders which provides the industry with an objective standard, which is taken from SANS 10-400 and ensures that all participants are using a uniform standard (figure 7).

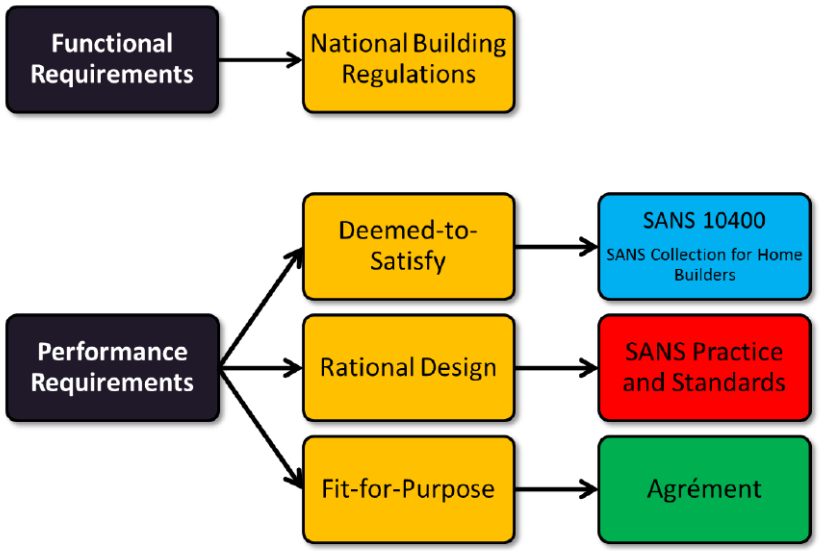


Figure 7: NHBRC technical standards (Source: NHBRC, 2017a)

3.3.2. Quality management approaches adopted

Quality assurance systems are the most common forms of quality principles applied to the low-cost housing projects, including document control, audits, non-conformance tracking, CAPA and Management Review. Wentzel (2010) lists 5 quality assurance systems currently implemented in the low-cost housing sector, which are:

- Document Control: To ensure employees have the correct procedures and that the procedures are properly maintained.
- Audits: To verify that quality procedures are being followed.

- Non-conformance Tracking: To monitor and track quality issues and that defects are kept from customers.
- CAPA (corrective action and preventative action): To correct flawed processes (i.e. quality procedures) when detected via audits and non-conformance tracking and to prevent defects from reoccurring.
- Management Review: Reviewing quality systems data (performance) (quality metrics) to determine if the quality system is working and if it is not, taking the appropriate action to improve the system.

Inspections have been the most dominant measure of ensuring quality. Housing inspectors have been an essential part of quality assurance, thorough independently checking that the project and processes are in place for quality planning and quality control (Rarani, 2013). Quality assurance should be carried out by a third party to be classified independent, hence housing inspectors have been from the provincial government and the NHBRC (Rarani, 2013).

3.3.3. Low-cost Housing quality defects

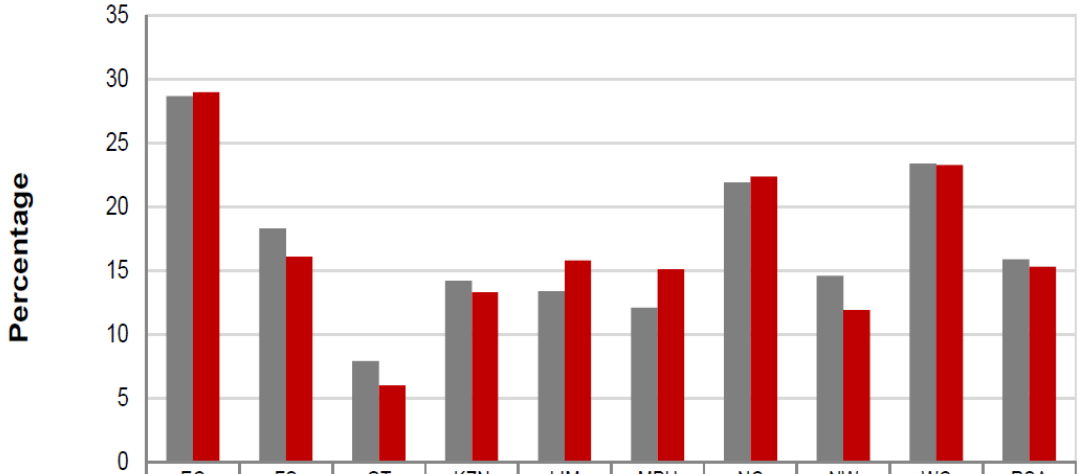
Inadequate housing quality in the South African context extends beyond the structural durability of the structure to include location, accessibility, overcrowding, size of the house, services available, and lack of basic urban design amenities, and inadequate supply of services (Zunguzane et.al, 2012: 20). This is commonly referred to as Sustainable Human Settlements. However, for purposes of this research, inadequate housing quality refers to structural defects. According to the NHBRC manual (2014), a defect adversely affects the strength, stability, durability and serviceability of the housing unit. The images below show some of the structural quality defects of the houses. Other structural defects include leaking roofs, surface bed with no foundation, gaps around door/window frames, windows/doors not closing properly, dampness and mould, lack of toilet doors, lack of ventilation; and the use of asbestos cement sheets has also been fairly widespread (for roofs and walls), and health risks.



Figure 8: Images showing housing defects
Source: NHBRC, 2011; Mkhonto, 2014; KZNDHS, 2010

Since 2002, any structural defects in low-income houses have been covered by a warranty scheme managed by the National Home Builders Registration Council (NHBRC), which provinces need to register subsidy projects to (National Treasury, 2015). The enrolment process is divided into two phases, i.e. Project enrolment (phase 1), which includes a geotechnical investigation with a focus on soil classification and ground conditions and home enrolment (phase 2), which includes the township layout plan, house drawings and specifications (National Treasury, 2015). Provinces that do not enrol houses place a strain on provincial rectification budgets as the warranty will not cover structural defects in these houses and are in breach of the Housing Consumers Protection Measures Act (1998) (National Treasury, 2015).

The 2013 General Household Survey by Statistics South Africa (Stats SA) also reported on the perceived quality of dwellings, focusing on strength of walls and roofs (National Treasury, 2015). Over 15% of houses built were defective for the whole country, as shown in figure 9.



	EC	FS	GT	KZN	LIM	MPU	NC	NW	WC	RSA
Walls weak or very weak	28.7	18.3	7.9	14.2	13.4	12.1	21.9	14.6	23.4	15.9
Roof weak or very weak	29	16.1	6	13.3	15.8	15.1	22.4	11.9	23.3	15.3

Figure 9: 2013 Survey of the observed quality of low-cost houses
Source: National Treasury, 2015: 8

Investigations and audits by the Department of Human Settlements in 2009 showed that it would cost South Africa R1.3-billion, or 10% of its 2009/10 year's budget, to rectify badly built Reconstruction and Development Programme (RDP) houses (CIDB, 2011). As a result, 40 000 defective RDP houses were rebuilt at a cost over R1 billion (Ramalisa and Mayne, 2012). An NHBRC forensic investigation in 2011 also estimated the rectification costs to be around R400 million to re-instate structural integrity and with NHBRC minimum technical requirements and the NBRs on around 41 000 houses investigated' (CIDB, 2011). The national department also spent more than R2bn on fixing badly-built RDP houses, but in 2015 it terminated the rectification programme, saying beneficiaries must fix their own houses as part of their maintenance obligation (Tomlinson, 2015). But very much more rectification still remains to be done – in 2011 the director general of human settlements, Thabane Zulu, put the rectification bill at R58bn – while many of the problems lie beyond the capacity of beneficiaries to address. Rectification work still continues throughout South African municipalities.

3.3.3.1. Causes of quality defects

A number of studies by the PSC, , CIDB, CESA, CSIR, NDHS, Public Protector and other researchers have been conducted to better understand why quality defects of low-cost housing continues to be a challenge. The consistent reasons were weak capacity of the state, inefficient quality management systems, the non-compliancy of emerging contractors and inefficient state subsidies (PSC, 2003; CIDB, 2011; NDHS, 2014).

The Public Service Commission published a report in 2003, on the evaluation of the National Housing Subsidy Scheme. Some of the findings pertaining to quality include:

- The small amount of funds available for top-structure after services were put in, and the requirements for a minimum house size contributed to problems with housing quality. Contractors were compelled to use cheaper materials and pay low labor rates in order to complete the construction, which sometimes led to the abandoning of the project.

- The subsidy amount has not been sufficient for both an adequate house and an adequately serviced and well-located plot.
- Quality standards for houses and infrastructure have been compromised by a number of factors including inadequate funds, poor training and/or monitoring of contractors.
- Norms and standards for housing need to be flexible and appropriate, and should not make housing unaffordable for the poor. Promoting energy efficient and environmentally sustainable housing is also essential. (PSC, 2003).

In a study conducted by the CIDB (2011) on the South African Construction Industry, it was found that client dissatisfaction was highest in the residential building sector. The CIDB findings also ranked the Low- and middle-income residential construction sectors as the lowest in terms of quality achieved (typically ranked poor to average quality). The low-income sector ranked the lowest, as compared to all other sectors. A similar study was conducted in 2014, based on client satisfaction, quality in construction and defects, also came to the same conclusion, as shown in Table 5. It was found that the state of quality in the low-income was very poor.

Table 5: State of quality per sector

Scale: 1 = very poor; 3 = average; 5 = very good		
Sector	**Overall Mean**	**Rank**
Commercial	**3.5**	**2**
Industrial	**3.5**	**3**
Infrastructure	**3.3**	**4**
Residential:		
Low-income	**1.9**	**6**
Middle-income	**2.9**	**5**
Upper-income	**3.9**	**1**

Source: CIDB, 2014: 15

The studies also identified a number of barriers to achieving quality in the general construction industry, which include:

- design related factors: inadequate details and inadequate specifications, and poor design coordination;

- procurement related factors: including emphasis on time and budget, shortened project periods, lack of pre-qualification, competitive tendering and awarding of contracts primarily on price;
- construction related factors: including skills shortages and insufficient workforce training, lack of management commitment, and lack of strict quality control; and
- more recently – corruption.

Poor site management, lack of contractor quality expertise and corruption ranked as the three most common barriers to construction quality. It is worth mentioning though that the CIDB (2011 & 2014) further highlights a lack of control and monitoring of standards in respect of housing projects due to the limited number of project managers and technical staff in provincial and local government. The CIDB (2014) also alludes to department structure and monitoring systems as an issue. Prior to 2006, the absence of a Chief Directorate dedicated to monitoring the technical aspects of housing delivery, combined with the lack of a monitoring system, impacted negatively on the quality of housing (CIDB, 2014). Officials also cited the lack of a Department dedicated to housing as being problematic and hampering their performance. The issue of monitoring and evaluation was also noted in the PSC (2003) report, stating that monitoring and evaluation of housing delivery through the HSS appears to be seriously lacking within the provincial departments i.e. monitoring of projects typically took place by means of developers' reports and physical inspections by the departments' project managers.

Ramalisa and Mayne (2012) also identified a number of causes, including lack of technical management capacity, bribery and corruption, delayed payment, inexperienced officials and consultants, appointment of unqualified firms, few work opportunities (unspent budget), poorly defined scope of works and services, lower margins, poor procurement practices (deviations), lack of infrastructure maintenance and inappropriate construction procurement models. Gabula (2012) also argued that there are severe shortages of project management skills facing the RDP housing projects, including contractors using unskilled labor, misuse of funds, fraudulent claims,

contractors asking for additional money or having left site. The overall scope of projects had no plan and no clear definition, poor project management and there was a lack of strategies to improve the quality of projects (Gabula, 2012). In addition, millions of rands were spent by government on repairs for defective workmanship and the practice whereby contractors are employing local communities, whether skilled or not (Gabula, 2012).

Findings by the Public Protector from an investigation into over 5000 complaints into the delivery of RDP houses showed that there were planning inadequacies and procurement irregularities (including corruption and fraud) leading to defective houses among many inadequacies (Madonsela, 2013). Corruption undermined the achievement of a quality outcome resulting in projects which are unnecessary, unreliable, dangerous, and over-priced (Ramalisa and Mayne, 2012). It also resulted in tendering uncertainty, wasted tender expenses, increased project costs, economic damage, and reduced project opportunities (Ramalisa and Mayne, 2012). Key observations relating to procurement included alleged poor or no quality assurance leading to shoddily built houses to be demolished and rebuild at state expense, defective houses (including after rectification) and lack of standardization of houses. Mkhonto (2014: 2) also asserted that "failure to emphasize the importance of Quality Management Systems in low-cost housing projects has led to inconsistency and the delivery of sub-standard quality houses".

More recently, Khubisa (2017) also relayed stories of fuming beneficiaries in Waterloo Phase 5 (Durban North) whose houses are falling apart after just a few years of being built. It was further reported in the article that some of the houses will need demolished and that there was not sufficient budget by the Municipality to fix the defects.



Image 1: Cracks in one of the houses in Waterloo Phase 5 (Source: Khubisa, 2017)

Lali (2017) also relayed stories of beneficiaries from the Kuyasa community based in Khayelitsha and their unhappiness over their defective houses which have cracks and mould. The department has also communicated that houses built before 2002 can be fixed under the emergency housing program if it can be proven that the defects are not as result of the neglect and bad maintenance by the owner (Lali, 2017).

In summary, research has shown that quality management is indeed a challenge for low-cost housing projects, owing to a number of issues including poorly defined scope of works and services, lack of monitoring and evaluation of standards, inefficient state subsidies, limited funding/inadequate funds or lack of sufficient finance, the use of inexperienced and emerging subcontractors, corruption and fraud, procurement irregularities, limited capacity of provincial and local project managers, poor quality assurance, lack of management commitment toward quality achievement, and substandard quality of workmanship (Zunguzane et al, 2012; Ramalisa and Mayne, 2012; Mkhonto, 2014; Gabula, 2012; CIDB, 2011; Ramalisa and Mayne, 2012;

Madonsela, 2013). Moreover, communities continue to be disgruntled and dissatisfied with the quality of houses provided to date.

3.3.4. Recommendations to address quality challenges

Issues of quality date back to the inception of the RDP programme in 1994. It is critical to therefore find out what quality management strategies have been employed thus far to deal with the shortcomings mentioned below, in order to understand why they still persist. Lombard (2006) argues that methods and best practices for managing and improving the quality of construction and specifically the engineering aspects thereof should be identified and implemented to avoid quality problems in construction will persisting at great cost to the economy, the companies involved and the taxpayer. It has also been strongly recommended that quality principles should be used throughout the project life cycle (Ramalisa and Mayne, 2012; Mkhonto, 2014). Notably, there are certain unique aspects to the South African construction environment that may warrant unique approaches to quality management. These aspects include Black Economic Empowerment requirements and shortages of specific skilled workers such as engineers and artisans (Lombard, 2006).

Lombard (2006: 12) suggests that quality system implementation should be driven by a drive to improve service quality rather than a mechanistic implementation of ISO processes and requirements. Furthermore, quality systems such as ISO 9000 should be implemented, but with a specific focus on improving client satisfaction through improved business processes (Lombard, 2006). Gabula (2012) supports this notion, arguing that the structure of the organization, and with its project management culture have a profound effect on the ability of the project management discipline to thrive and develop. As such, the development of an organization fitted-strategy, a project management supportive organizational culture and customized project management methodology consider a careful selection of systems appropriate for an organization's array of projects needed to be done and they must be compatible with the existing financial and administrative systems of the organization (Gabula, 2012: 29).

i) Procurement

Supply chain management (SCM) is the other critical requirement for construction quality (Barret in Lombard, 2006). The National Treasury recommends that lowest cost-based selection method be used in procurement. The service provider scoring the highest point is awarded, derived from a combination of price and BBBEE scoring. The KwaZulu Natal High Court, case no 10878/2009 ruled that Quality score cannot be combined with Price & Preference. This method and subsequent court ruling relegated functionality/ quality to a pre-qualification criteria, using a minimum threshold (Ramalisa and Mayne, 2012).

Ramalisa and Mayne (2012) argued that acceptance of the lowest price denies opportunity to assess value, which leads to poor quality outcomes, high construction costs, low development, less optimization, poor performance and lower expertise. Ramalisa and Mayne (2012: 92) further recommended the following:

- Procurement - Inclusion of Quality is essential (Quality Based Selection) - CIDB Procurement Method 4 (Financial Offer plus Quality plus preference – Price + Quality + BBBEE), which is the CIDB method 4;
- Value-added services (Value, Financial Offer, Quality) – scope of works, tender documentation, evaluation of tenders:
    - Requires careful descriptions in Scope of Services, Scope of Work
    - Score quality in evaluation of tenders (thresholds and minimum quality points).

ii) Design

The quality of designs in the scope of works has been consistently identified as a cause for quality defects. Enhancing the quality of drawings and specifications could be done at the early stages to better inform the quality in design and construction phases and, ultimately the quality of constructed facility (Mallawaarachchi and Senaratne, 2015).

iii) Skills development

Capacitation and skills development is quite critical to addressing the identified skills shortages. Shortages of skills has been identified across the project life cycle, including the use of emerging and inexperienced sub-contractors, lack of technical expertise of project managers and officials, inexperienced inspectors and shortage of engineering skills. Project managers should be capacitated in system optimization, project management tools like QMS, human relations and organizational development, as compulsory training (Gabula, 2012). Also, management competence at the municipal level is critical to the overall objective (National Treasury, 2015: 11). Rarani (2013) also recommended that standard continuous training and education should be provided for low-cost housing inspectors to improve the level of knowledge of building standards and regulations by low-cost housing inspectors and review the roles and responsibilities of low-cost housing inspectors and establish awareness of them among the affected parties.

iv) Customer satisfaction

To achieve customer satisfaction, Aigbavboa and Thwala (2013: 255) have asserted that meaningful consultation should be held with individuals and communities affected to facilitate the active participation of all relevant stakeholders in housing development and to improve the overall housing delivery and the satisfaction of the housing subsidy beneficiaries. Thorough needs analysis of the beneficiaries of a proposed housing subsidy development, to understand their needs and expectations prior to the construction of the houses. The development of a customer satisfaction scorecard has been proposed (Ramalisa and Mayne, 2012), which should be informed by the needs analysis, coupled with policies and standards for housing development. This will strengthen the relationship between community housing quality needs (user) and government's policies and processes (implementing agent).

v) Performance monitoring

Performance monitoring, which is performed through quality assurance, should be reformed through the implementation of QMS like ISO 9001:2008 or of similar levels. Organizations with QMS will be in control of all its key processes. Gabula (2012) proposed that a strategic project measurement system should be created, whilst Ramalisa and Mayne (2012) argues that clients should establish a formal performance review. Quality accreditation ensures that quality systems, documents and procedures are in place, but does not guarantee the quality of the work performed (Rarani, 2013). Hence, it is important that quality should be a holistic process that is an integral part of day-to-day activities for quality systems to positively affect product quality (Rarani, 2013).

3.4. Summary of Literature Review

In Summary, both chapters have highlighted that Quality Management is effective when applied throughout the entire project life cycle, whilst promoting a process of continuous improvement in the management of the project. This has unfortunately been a challenge for the South African low-cost housing projects, which face a myriad of issues including procurement processes that prioritize time and cost over quality, capacity constraints of the implementing agent i.e. dhs project managers, disjointed quality management practices that place over-emphasis on quality assurance through the use of inspectors, user (customer) dissatisfaction with the quality of the houses, procurement irregularities and corruption, the use of inferior materials, design related issues, technical skills shortages of engineers and artisans, lack of sufficient levels of monitoring and evaluation, and the use of emerging and inexperienced subcontractors, which is a requirement of the BBBEE policy.

Furthermore, the nature in which causes of quality defects occur is that they are interlinked. This is critical to understand the importance of applying a wholesome approach to effectively address these challenges. By extension, this means that no one factor can solely be the cause. Lastly,

quality defects can be avoided through effective quality management, as argued in the TQM ideology. The literature reviewed also showed that extensive work has gone into determining the effects and costs of defects, i.e. rework. The implementation of quality management positively impacts on both project cost and rework costs. Rework is costly and counter-productive.

4. CHAPTER 4 - RESEARCH DESIGN AND METHODOLOGY

Research refers to a search for knowledge through objective and systematic method of finding solution to a problem (Kothari, 2004). Research is needed to add to the body of knowledge of a particular subject, through new developments and/or to support new viewpoints. The purpose of research is to discover answers to questions through the application of scientific procedures (Kothari, 2004). This particular research aims to answer the following question:

- How progressive are housing policies and strategies in addressing quality defects challenges experienced in government-subsidized housing projects?

Answering this question will require the design of a systematic process to the solution and to embark on a process of conceptualizing research design. Creswell (2009) refers to research design as the plan or proposal to conduct research, involving the intersection of philosophy, strategies of inquiry, and specific methods. Key authors used in this research include Kothari, Mack et.al, Creswell, Karna, Thomas, Saunders, Wahyuni, Mallawaarachchi and Senaratne and USC.

4.1. Research design

Research design refers to the overall strategy that a researcher chooses to integrate the different components of the study in a coherent and logical way...it constitutes the blueprint for the collection, measurement, and analysis of data (USC, 2016). Research design is therefore a general plan of how the research question will be answered. The process of research design integrates a number of factors, including research philosophies, approaches, strategies, time-horizons, choices, techniques and methods (Saunders, 2012). Figure 9 shows the different elements in research design, making up a Framework for Design.

The length and complexity of describing research designs in a study can vary considerably, but any well-developed design will achieve the following:

1. Identify the research problem clearly and justify its selection, particularly in relation to any valid alternative designs that could have been used;
2. Review and synthesize previously published literature associated with the problem;
3. Clearly and explicitly specify hypotheses [i.e., research questions] central to the research problem;
4. Effectively describe the data which will be necessary for an adequate testing of the hypotheses and explain how such data will be obtained; and
5. Describe the methods of analysis to be applied to the data in determining whether or not the hypotheses are true or false (USC, 2016).

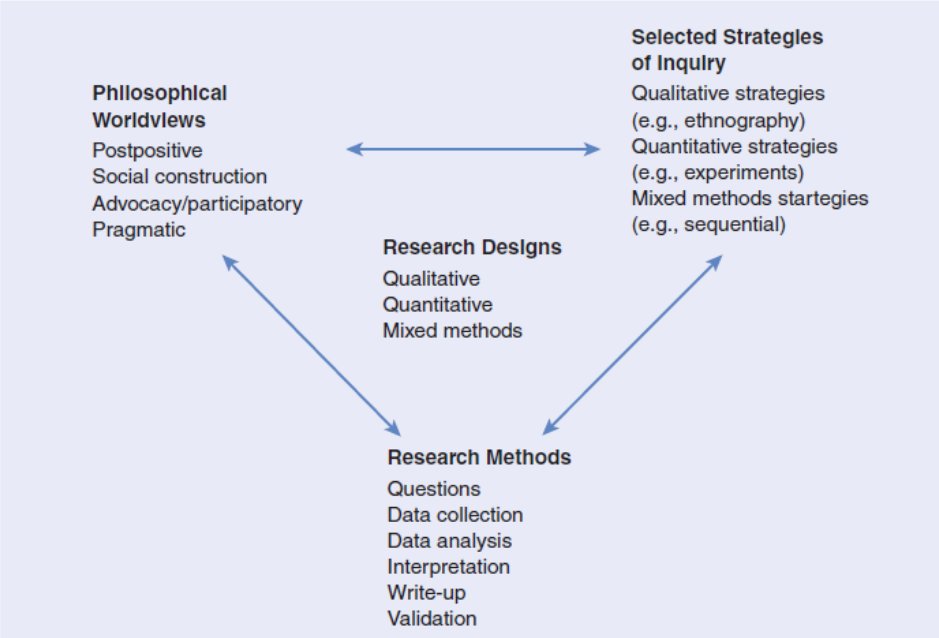


Figure 9: A Framework for Design- The Interconnection of Worldviews, Strategies of Inquiry, and Research Methods (Creswell, 2009: 5)

This research is mostly exploratory. Exploratory research studies are also termed as formulative research studies, with a main purpose of formulating a problem for more precise investigation or of developing the working hypotheses from an operational point of view (Kothari, 2004: 35-36).

4.1.1. Research paradigms/philosophies

Philosophical worldviews are concerned with how the researcher views the world, which have also been referred to as paradigms, epistemologies, ontologies, or broadly conceived research methodologies (Creswell, 2009). Ontology refers to the nature of knowledge whilst epistemology is the beliefs on the way to generate, understand and use the knowledge that are deemed to be acceptable and valid (Creswell, 2009; Wahyuni, 2012). The types of beliefs held by individual researchers will often lead to embracing a qualitative, quantitative, or mixed methods approach in their research (Creswell, 2009).

Creswell (2009) gives definitions for the different paradigms, which are also summarised by Wahyuni (2012) in Table 6. Objectivism recognises that social phenomena and their meanings exist separately to social actors. Positivism generates hypotheses (or research questions) that can be tested and allows explanations that are measured against accepted knowledge of the world we live in (Creswell (2009). Realism is similar to positivism in its processes and belief that social reality and the researcher are independent of each other and so will not create biased results (Creswell, 2009). In realism, scientific methods are perfect. Interpretivism refers to approaches emphasizing the meaningful nature of people's participation in social and cultural life (Creswell, 2009).

Table 6: Fundamental Beliefs of Research Paradigms in Social Sciences

	Research Paradigms			
Fundamental Beliefs	*Positivism (Naïve realism)*	*Postpositivism (Critical Realism)*	*Interpretivism (Constructivism)*	*Pragmatism*
Ontology: the position on the nature of reality	External, objective and independent of social actors	Objective. Exist independently of human thoughts and beliefs or knowledge of their existence, but is interpreted through social conditioning (critical realist)	Socially constructed, subjective, may change, multiple	External, multiple, view chosen to best achieve an answer to the research question
Epistemology: the view on what constitutes acceptable knowledge	Only observable phenomena can provide credible data, facts. Focus on causality and law-like generalisations, reducing phenomena to simplest elements	Only observable phenomena can provide credible data, facts. Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, the reality behind these details, subjective meanings and motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data
Axiology: the role of values in research and the researcher's stance	Value-free and etic Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Value-laden and etic Research is value laden; the researcher is biased by world views, cultural experiences and upbringing	Value-bond and emic Research is value bond, the researcher is part of what is being researched, cannot be separated and so will be subjective	Value-bond and etic-emic Values play a large role in interpreting the results, the researcher adopting both objective and subjective points of view
Research Methodology: the model behind the research process	Quantitative	Quantitative or qualitative	Qualitative	Quantitative and qualitative (mixed or multi-method design)
Based on Saunders et al.(2009, p.119),Guba and Lincoln (2005), and Hallebone and Priest (2009)				

Source: Wahyuni, 2012:70

This research adopts the interpretivism paradigm, based on the belief that reality is constructed by social actors and people's perceptions of it. They recognize that individuals with their own varied backgrounds, assumptions and experiences contribute to the on-going construction of reality existing in their broader social context through social interaction (Wahyuni, 2012). The interpretivism paradigm was used to understand the context of the study group. Low-cost

housing projects are characterized by a variety of social actors who continue to shape the implementation of quality principles, i.e. politicians, officials, housing analysts, beneficiaries, etc. Beneficiaries are demanding houses from government, due to the apartheid legacy of the country and promises made by the ruling party. Politicians want to deliver as many houses as possible, to garner support and votes from citizens. In chasing targets, efficient quality management are compromised in the process. Budgets determined by political leadership and cycles are implementation cycles and targets for officials. Officials are blamed for delivering defective houses, amongst political pressures and inconsistent leadership. Housing analysts are critical of the DHS programme, owing to the low quality of the houses delivered.

4.1.2. Strategies of Inquiry

Strategies of inquiry are types of qualitative, quantitative, and mixed methods designs or models that provide specific direction for procedures in a research design. Others have called them approaches to inquiry or research methodologies (Creswell, 2009). Table 7 summarises the characteristics of the strategies. Mixed research methodologies were used in this research, through the application of concurrent mixed methods procedures. These procedures combined both qualitative and quantitative methods.

Table 7: Strategies of Inquiry

Quantitative	Qualitative	Mixed Methods
• Experimental designs • Non-experimental designs, such as surveys	• Narrative research • Phenomenology • Ethnographies • Grounded theory studies • Case study	• Sequential • Concurrent • Transformative

Source: Creswell, 2009: 12

Mixed methods research is an approach to inquiry that combines or associates both qualitative and quantitative forms which involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both approaches in a study (Creswell, 2009).

Sequential mixed methods procedures are those in which the researcher seeks to elaborate on or expand on the findings of one method with another method whilst transformative mixed methods procedures are those in which the researcher uses a theoretical lens as an overarching perspective within a design that contains both quantitative and qualitative data (Creswell, 2009). In particular to this research, concurrent mixed methods procedures were adopted. These are methods where the researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem (Creswell, 2009). Through this approach, the researcher was able to collect both the statistics and causes of quality defects to answer the research questions. Furthermore, the questionnaires were designed to also deduce both qualitative and quantitative information. In this design, the investigator was able to collect both forms of data at the same time for integration and analysis.

Quantitative researchers try to recognize and isolate specific variables contained within the study framework, seek correlation, relationships and causality, and attempt to control the environment in which the data is collected to avoid the risk of variables, other than the one being studied, accounting for the relationships identified (USC, 2016). Survey research provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population. It includes cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection, with the intent of generalizing from a sample to a population (Creswell, 2009).

Qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry (USC, 2016). The researcher engages the situation, makes sense of the multiple interpretations, as multiple realities exist in any given context as both the researcher and the participants construct their own realities (Thomas, 2010). There are a number of qualitative strategies to be followed, including ethnography, grounded theory, case studies, phenomenology research and narrative research, which are detailed as follows (Creswell, 2009):

- Ethnography is a strategy of inquiry in which the researcher studies an intact cultural group in a natural setting over a prolonged period of time by collecting, primarily, observational and interview data.
- Grounded theory is a strategy of inquiry in which the researcher derives a general, abstract theory of a process, action, or interaction grounded in the views of participants.
- Case studies are a strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one or more individuals. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time.
- Phenomenological research is a strategy of inquiry in which the researcher identifies the essence of human experiences about a phenomenon as described by participants.
- Narrative research is a strategy of inquiry in which the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives.

A case study of the Department of Human Settlements was the chosen qualitative strategy for this research, in particular the project management unit where the mandate of quality management resides. Statistics and reports were also collated from the different spheres of this department and the NHBRC, which provides a supportive and regulatory role to the department in terms of quality, which is a mixture of qualitative and quantitative strategies.

4.1.3. Research Methods

Research methods involve the forms of data collection, analysis, and interpretation that researchers propose for their studies. Researchers collect data on an instrument or test or gather information on a behavioural checklist (Creswell, 2009). Table 8 summarises the different research methods. Methodology refers to a discussion of the underlying reasoning why particular methods were used (USC, 2016).

Table 8: Quantitative, Mixed and Qualitative Methods

Quantitative Methods →	Mixed Methods ←	Qualitative Methods
• Pre-determined • Instrument based questions • Performance data, attitude data, observational data, and census data • Statistical analysis • Statistical interpretation	• Both pre-determined and emerging methods • Both open- and closed-ended questions • Multiple forms of data drawing on all possibilities • Statistical and text analysis • Across databases interpretation	• Emerging methods • Open-ended questions • Interview data, observation data, document data, and audio-visual data • Text and image analysis • Themes, patterns interpretation

Source: Creswell, 2009: 15

The advantage of using qualitative methods is that they generate rich, detailed data that leave the participants' perspectives intact and provide multiple contexts for understanding the phenomenon under study (USC, 2016). Some qualitative research methods include:

- Semi-structured interviews, also known as the non-standardised or qualitative interview, is a hybrid type of interview which lies in between a structured interviews and an in-depth interviews (Creswell, 2009).
- Participant observation is appropriate for collecting data on naturally occurring behaviours in their usual contexts (Mack et.al, 2005).
- In-depth interviews are optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored (Mack et.al, 2005).
- Focus groups are effective in eliciting data on the cultural norms of a group and in generating broad overviews of issues of concern to the cultural groups or subgroups represented (Mack et.al, 2005).
- Questionnaires - consists of a set of questions presented to a respondent for answers. Questionnaires could either be close-ended, open-ended or a combination of both.

Quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques (USC, 2016).

Mixed research methods (both quantitative and qualitative methods) were deemed most appropriate for this research study. The study focused on a variety of challenges and information, hence the mixed method approach was appropriate, since the use of only one of the two methods could provide incomplete answers. Qualitative methods used included interviews and government reports. Questionnaires and statistics were used as the quantitative methods.

4.1.4. Research Ethics

Ethical and legal considerations also form a critical role in research design. In line with designing research to be useful, it should also be designed to be ethical (Harwell, 2011). Researchers themselves should be responsible for protecting the interests of participants in their studies (Harwell, 2011). One starting point in considering ethical concerns is the four principles of Tom Beauchamp and Jim Childress (cited in Patton and Cochran, 2002), namely:

- Autonomy; respect the rights of the individual
- Beneficence; doing good
- Non-maleficence; not doing harm
- Justice; particularly equity.

Moreover, two key ethical issues that should be considered in any project are, as highlighted by (Patton and Cochran, 2002):

- Consent (Verbal/Written) - everyone who participates in your study should have freely consented to participation, without being coerced or unfairly pressurised. This

means they should be well-informed about what participation entails, and reassured that declining will not affect any services they receive.

- Confidentiality - It is essential to protect the identity of the person from whom you gather information.

Ethical considerations noted for this particular study was that consent needs to be requested from participants, and they will be given an option to decline participation in the study. Information was and will continue to be kept confidential and no harm was brought to participants.

4.1.5. Sampling

It is important to select a sample in a systematic way so as to ensure that the community/users/external actors see it as a credible and indicative sample (Patton and Cochran, 2002). The table below are the different kinds of sampling methods, which will help determine the participants of the study.

Table 9: Types of sampling methods

Types of sampling methods		
Type of sampling	**Purpose**	**Example**
Intensity sampling	To provide rich information from a few select cases that manifest the phenomenon intensely but are not extreme cases	Interviewing survivors of date rape to learn more about how coerced sex affects women's sexuality
Deviant case sampling	To learn from highly unusual manifestations of the phenomenon in question	Interviewing men who do not beat their wives in a culture where wife abuse is culturally accepted
Stratified purposeful sampling	To illustrate characteristics of particular subgroups of interest; to facilitate comparisons	Interviewing different types of service provider (police, social workers, doctors, clergy) to compare their attitudes toward and treatment of abuse victims
Snowball or chain sampling (locate one or two key individuals, and then ask them to name other likely informants)	To facilitate the identification of hard-to-find cases	Finding commercial sex workers to interview about experiences of childhood sexual abuse by getting cases referred through friendship networks
Maximum variation sampling (purposely select a wide range of variation on dimensions of interest)	To document diverse variations; can help to identify common patterns that cut across variations	Researching variations in norms about the acceptibility of wife beating by conducting focus groups: young urban women, old urban women, young rural men, old rural men, women who have been abused, women who have not experienced abuse
Convenience sampling (Select whoever is easiest, closest, etc.)	To save time, money and effort. Information collected generally has very low credibility	Forming focus groups based on who is available that day at the local community centre, rather than according to clear criteria
Criterion sampling	To investigate in depth a particular "type" of case; identify all sources of variation	Specifically interviewing only abused women who have left their partners within the last year in order to better understand the variety of factors that spur women to leave

Source: Patton and Cochran, 2002

Criterion sampling has been used in determining the sample for this study. Criterion sampling is a sampling method which allows for the in-depth investigation of a particular type of case (Patton and Cochran, 2002). Policy and programme planning, and monitoring and evaluation housing programmes are functions of the National Department of Human Settlements (DHS). The NDHS are in an ideal position to properly and holistically monitor the progress of interventions to address quality defects, which should inform policy. Hence participants identified included:

- Inspectors from the Department of Human Settlements, who advised on the implementation of quality principles in projects and its challenges thereof. They also advised on what quality management strategies are employed by the Department and extent of their implemented. Attention was also be paid to how these strategies can be more effective. DHS organizational reports and statistics were also collated to track the progress of houses delivered and defects thereof.
- The NHBRC, which is mandated by government to ensure that quality housing is built. NHBRC organizational reports and statistics were collated to track the progress of rectifying housing quality defects and the warranty scheme.

4.1.6. Data Analysis

Data analysis involves the drawing of inferences from raw data. Data analysis can involve multi-methods that are applied sequentially (Wahyuni, 2012). Performing data analysis on qualitative data basically involves dismantling, segmenting and reassembling data to form meaningful findings in order to draw inferences (Wahyuni, 2012).

Qualitative data analysis is defined as "working with the data, organising them, breaking them into manageable units, coding them, synthesising them, and searching for patterns" (Thomas, 2010). Qualitative contents analysis concentrates on portraying reality by discovering meanings from the textual data (Wahyuni, 2012). Quantitative data can also be analysed through content analysis. Quantitative researchers transform qualitative information into numerical numbers. They establish a set of categories and then count the number of instances that utterances fall into each category. The characteristics of categories need to be defined clearly in order to allow other researcher to draw similar results from the texts, e.g. annual reports (Wahyuni, 2012).

The research data was analysed through content analysis, which is a procedure for the categorisation of verbal or behavioural data, for purposes of classification, summarisation and

tabulation[1]. Content analysis involves coding and classifying data, also referred to as categorising and indexing and the aim of context analysis is to make sense of the data collected and to highlight the important messages, features or findings.

The content can be analysed on two levels:

- Basic level or the manifest level: a descriptive account of the data i.e. this is what was said, but no comments or theories as to why or how;
- Higher level or latent level of analysis: a more interpretive analysis that is concerned with the response as well as what may have been inferred or implied.

Defining and clearly articulating the research methodology has been important to steer the research study in a systematic process of data collection and analysis. Answering the research question was guided by a research framework that recognizes that while Quality Management Systems are borne of a concise and procedural science, the context is marred with a myriad of social constructs defined by the multiple actors involved. The next chapter will be a discussion of findings that have been gathered through the research methodology.

[1] http://libweb.surrey.ac.uk/library/skills/Introduction%20to%20Research%20and%20Managing%20Information%20Leicester/page_75.htm

5. CHAPTER 5 – ANALYSIS OF RESEARCH FINDINGS

5.1. Introduction of research findings

The aim of this research is to thoroughly articulate quality management gaps and shortcomings within the low-cost housing sector in South Africa so to understand the persistent nature of housing quality defects. The primary objectives are to understand the:

- Progressiveness of housing policies and strategies in addressing quality defects challenges experienced in low cost housing projects;
- Interventions implemented to address the common causes of housing quality defects;
- Effectiveness of the NHBRC been in addressing housing quality defects;
- Frequency of quality defects in recent projects; and
- Effectiveness of the rectification process and the lessons thereof.

5.2. Presentation of findings

The research findings are based on the following qualitative and quantitative data:

- Questionnaires completed by DHS provincial inspectors - Inspectors are employed by the PHSDs and more recently in municipalities that have been accredited. Inspectors from Provincial and Municipal departments were selected to complete the questionnaires as they would be able to provide insight on the inspection processes and findings on site. Questionnaires and request for information were sent to 3 PHSDs and 1 municipal department. It should be noted that difficulties in making available the current statistics due to unavailability of updated information was found to be common in all the provinces where the information was requested. Only 10 questionnaires were completed from one of the provincial departments. Statistics were collated and analyzed from published NDHS and NHBRC reports, as well as some of the human settlements provincial and municipal departmental reports.
- DHS and NHBRC Annual Performance plans;
- Presentations by the DHS, CIDB and NHBRC;

- DHS and NHBRC Annual Reports;
- DHS and NHBRC statistics; and
- Manuals, quality management plans and quality checklists of the DHS.

5.2.1. DHS Quality Management practices

Provincial Human Settlements departments act as developers of the houses and serviced sites, where there is no accredited municipality to perform this task. Provincial Human Settlements Departments (PHSD) are normally divided into 4 programmes, i.e.

- Programme 1: Administration
- Programme 2: Housing Needs, Planning and Research
- Programme 3: Housing Development
- Programme 4: Housing Asset Management, Property Management

It is within the housing development programme that quality management approaches are employed. The most common form of quality management employed at DHS are quality management plans, quality checklists and inspections. The NHBRC is also at the heart of the quality management process for the department.

5.2.1.1. Quality planning

A Quality Management Plan (QMP) is required at the prefeasibility stage and is submitted by the developer/municipality with the application for project approval and be included in the project agreement. A quality management plan (QMP) must be adopted by establishing the correct project brief & scope and flow through all phases of the project until final close-out.

Checklist for a Quality Management Plan

			Yes	No
1	Scope of project			
2	Budget			
3	Project Specification			
4	Materials:	Bill of quantities, product and specification Procurement plan		
5	Procedures:	Inspections Checklists Quality control testing on building materials Quality control testing review of results Tracking of deficiencies and timely corrective measures Quality control report		
6	Organizational structure:	Identify top management Financial capacity of company Credit rating CIDB grading NHBRC registration/status Personal liability cover Indemnity Insurance Overview of implementation strategy Joint venture: partners and their roles and responsibilities		
7	Resources:	Financial Human Equipment		
8	Time-frames:	Development programme		
9	Communication strategy:	Roles and responsibilities What will be reported and to whom Frequency of meeting and standard agenda items Who will maintain the record of meetings How will the minutes of the meeting be circulated		
10	Reporting:	Quality audits: What will be audited, when and by whom Identify corrective action that will be undertaken and by whom		
11	Risk Management:	Risk management plan Revised plan		
12	Scope Management:	Product specification Delivery time frame Authority to change specification Nature of change Record keeping		

Figure 10: Quality Management checklist (Source: KZNDHS, 2011)

i) NHBRC projects and home enrolments

The National Home Builders Registration Council (NHBRC) is a regulatory body of the home building industry. The NHBRC enrolment process, which was discussed in the literature review, offers consumers several benefits, including:

- Builder compliance with NHBRC's Home Builders Manual, which sets minimum quality standards.
- NHBRC quality inspections during construction.
- Major structural warranty cover for up to five years from date of occupation.
- NHBRC mediation between consumer and builder.
- Recourse through our complaints, arbitration and remedial processes (NHBRC, 2015).

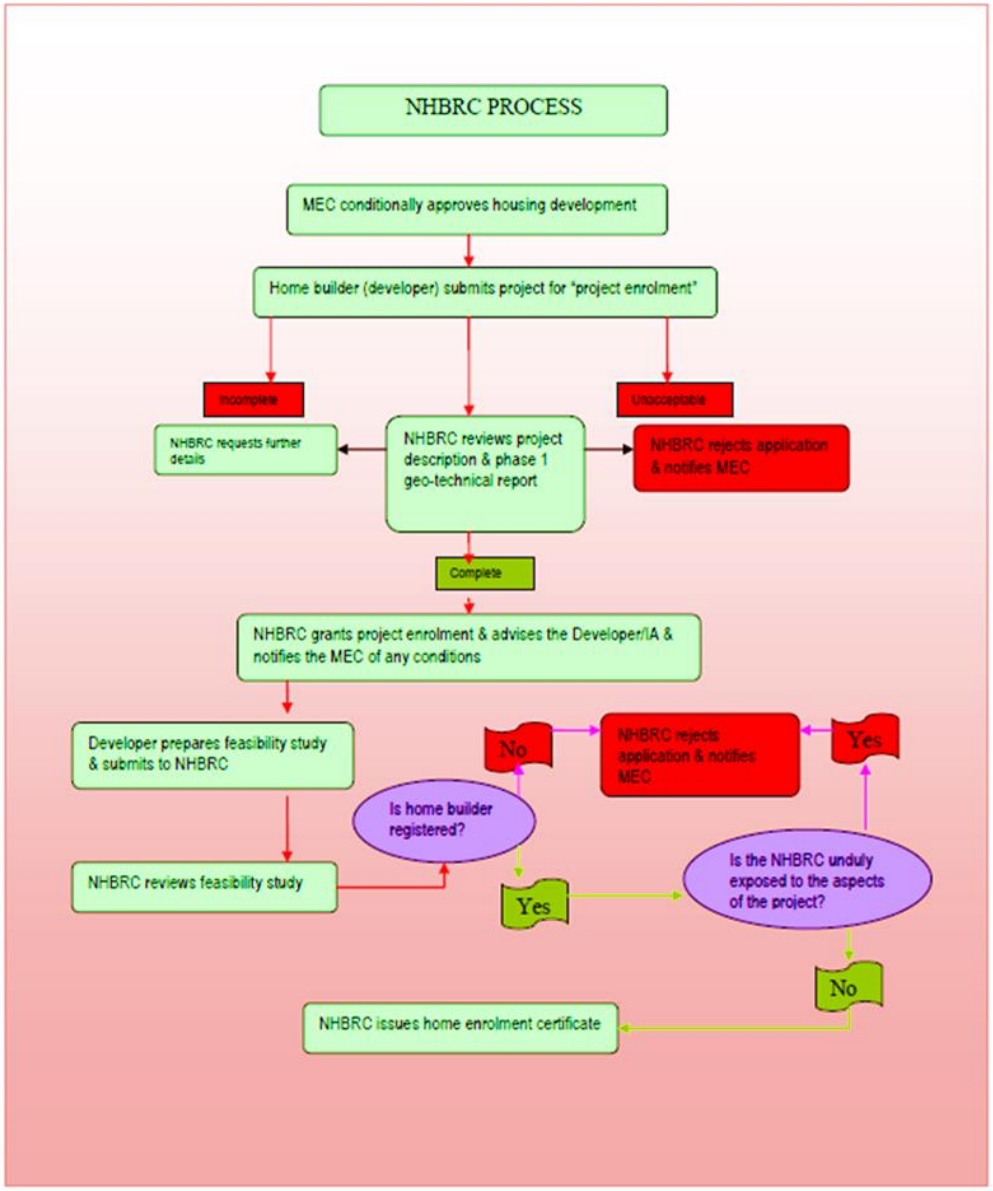


Figure 11: NHBRC enrolment process (NHBRC, 2015)

An enrolled home is provided with warranty cover by the NHBRC for a period of 5 years from date of occupation which allows the NHBRC to pursue and ensure that the builder rectifies:

1. Minor defects identified by the housing consumer within the first three-months of occupation
2. Roof leaks identified by the housing consumer within one-year from date of occupation
3. Major structural defects identified by the housing consumer within five-years from date of occupation

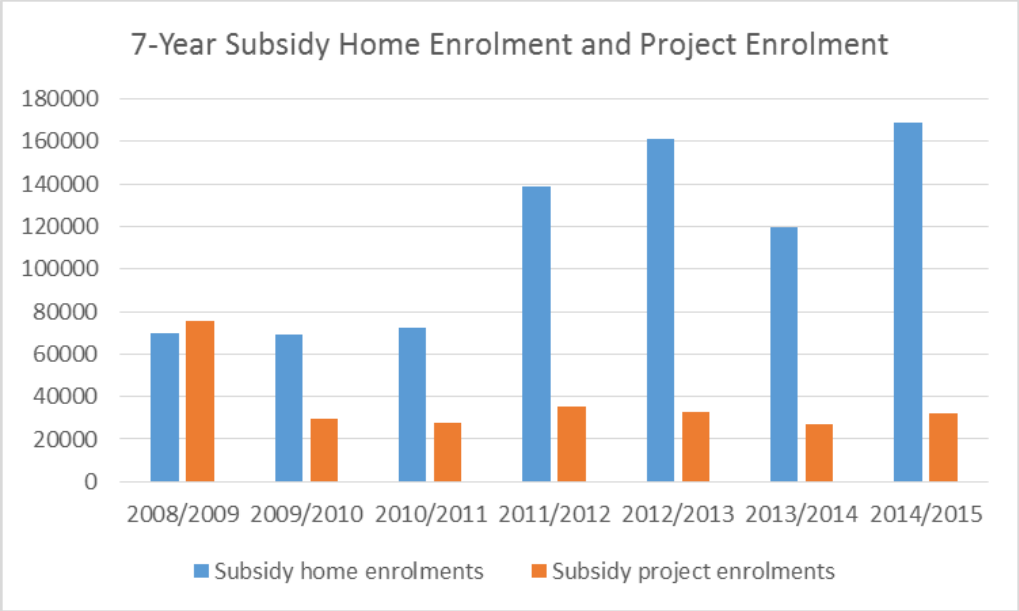


Figure 12: 7 year subsidy home and project enrolment (Source: NHBRC, 2015)

The NHBRC inspects all enrolled homes at key stages of construction. The objective of inspections is to protect housing consumers against poor workmanship during construction. In the situation where the inspector identifies a deviation from the NHBRC Home Building Manual, a non-compliance will be issued to the home builder. The home builder will be given reasonable time frames within which to rectify the non-compliance. If the builder is unable or unwilling to rectify, the NHBRC will stop construction and institute its builder disciplinary process (NHBRC, 2015).

5.2.1.2. Quality assurance

Inspections are the most common form of quality assurance employed by the Department of Human Settlements and the NHBRC, its national entity.

i) Inspections by DHS

The project management units within the provincial departments have inspectors and monitors employed to ensure that inspections are carried out. Inspection manuals and templates are available to assist with the inspection process. Figure 13 outlines the inspection checklist that is prescribed, particularly in KZN. This is a similar format used by other provinces, which focus on structural elements of the houses. Regular inspections are conducted on each project to compile an audit.

DEPARTMENT OF HOUSING: KWAZULU-NATAL
Inspection Form for Construction: P5

Project Name:_____ **Site No:** _____
Project Number:_____

Milestone	Date	Checklist	Quality		Comments
			Passed	Failed	
Site Preparation and Excavation for foundations		Area cleared of veg. matter, debris or refuse, etc.			
		Stormwater drainage.			
		Excavation. Measurements.			
		Compaction and leveling of the filling.			
		Setting out accuracy.Checking of measurements.			
Foundations/Floor Slab		Level and measurements of the formwork.			
		DPC			
		Steel Mesh/Reinforcements. Splicing and lappings,			
		Cover to steel reinforcement			
		Concrete grade			
		Compaction of the concrete.			
		Finishing of the surface			
		Curing of the concrete.			
Masonry Walls		Placement of the DPC			
		Vertical plumb.			
		Angle in the corners.			
		Wall thickness (external and internal).			
		Brickforce			
		Bagging/face finishing.			
		Roof anchors. Depht of embedment and positioning.			
		Door and Widows frames. Vertical plumb, square, right fixing.			
		Quality of the materials (SABS requeriments).			
Roofing		Correct size and spacing of the trusses, rafters and purlings/battents.			
		Tie down to the wall.			
		Trusses, rafters and purlings line up/straigtness/level/vertical plumb/pitch.			
		Roof tiles/sheets mecanically and correctly fixed(i.e. clips, nails, screws).			

General Comments: _____

Date of final inspection:_____

Inspected by:_____ Signature: _____

Figure 13: Inspection form for Construction (Source: KZNDHS, 2012)

The inspectors receive regular training from the NHBRC. 100% of the inspectors interviewed confirmed that they had received inspector training as compulsory during their employment with the department.

ii) Inspections by NHBRC

In 2014, the NHBRC employed in-house inspectorate services, which was previously an outsourced service. Inspection coordinators were also employed to manage inspectors. A total of 200 inspectors have been employed by NHBRC to ensure that inspections are carried out according the designed model. The NHBRC ensures that a minimum of four inspections and a maximum of eight inspections are conducted for each house that is under construction.

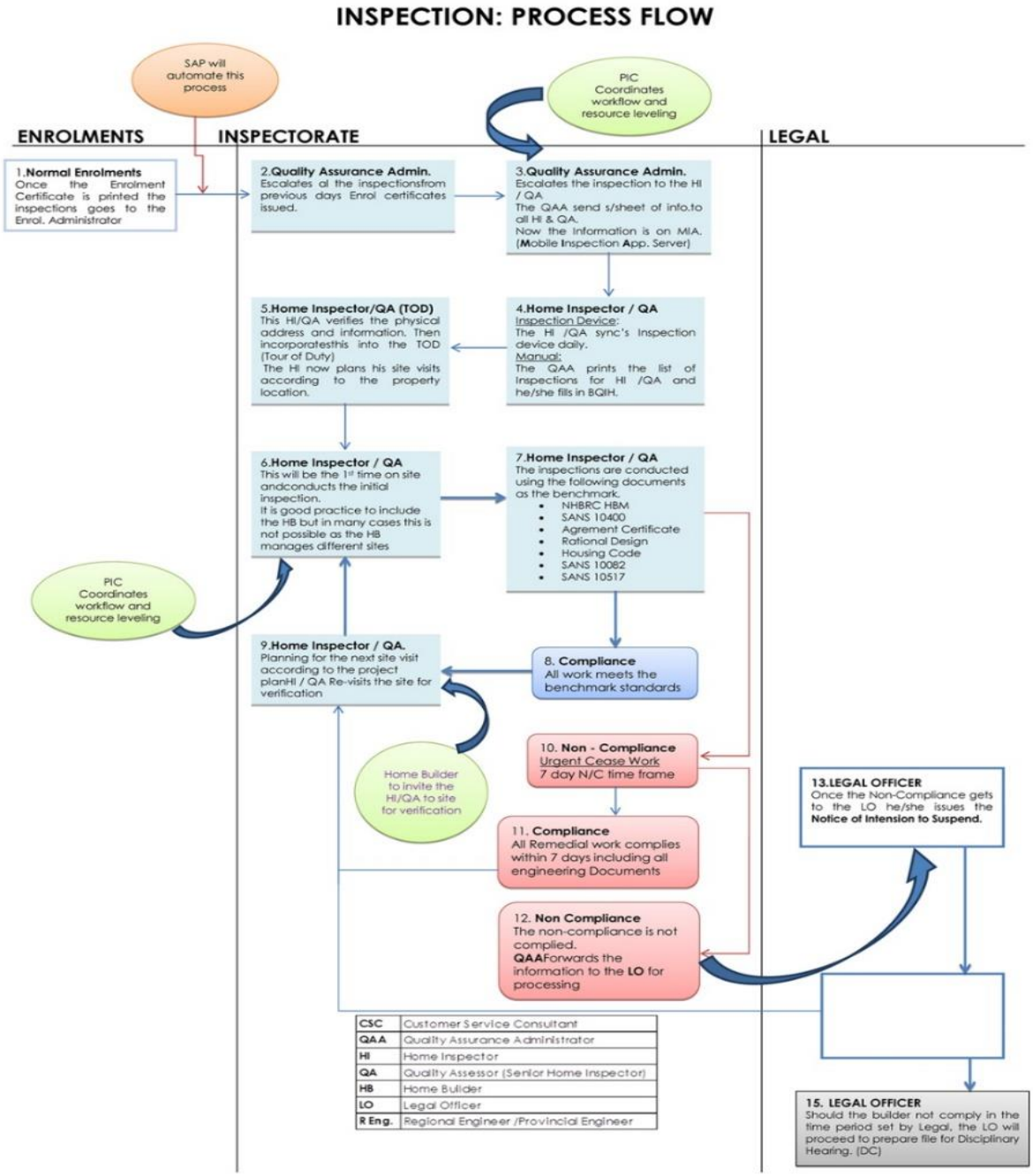


Figure 14: NHBRC inspection process flow
Source: NHBRC, 2017c

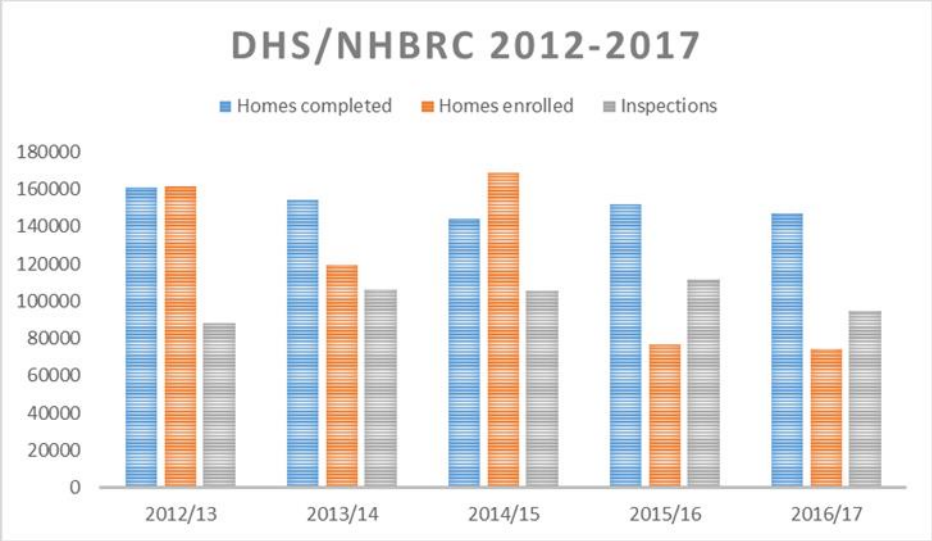


Figure 15: NHBRC home enrolment and inspection statistics 2012-2017

When assessing the delivery and performance statistics by the DHS and NHBRC in figure 15 above, it is noted that there is a correlation between homes completed and NHBRC enrolment of homes by the DHS. However, it should be noted that some of the enrolments are late enrolments which were completed in previous years. Late enrolments are a common challenge which means that there were no inspections during construction for these houses. This is an additional challenge that contributes to the proliferation of the defective housing stock.

5.2.1.3. Quality Control

The Departmental Project Monitors and Inspectors are to certify that all technical and contractual obligation of the developer, as it relates to the construction phase of the project to this point, have been checked and also comply with norms and standards and NHBRC. Technical completion is required for the close out checklist, including the completion certificate from the consulting Engineer and Top-structure completion certificate.

5.2.2. Causes of quality defects

According to DHS reports, the most common causes of quality defects are poor workmanship, use of inferior and inappropriate material, deviation from specification, poor project management, lack of supervision and unscrupulous contractors. The NHBRC also identified

challenges within the subsidy housing sector, including departments and municipalities failing to adhere to construction schedules, appointment of homebuilders who are not registered with NHBRC, building homes when home enrolments is not in place and approved by NHBRC, challenges with continuous leadership changes at provincial level, and projects that are stalled with no indication and when they are revived NHBRC not informed so that we can continue with inspections (NHBRC, 2015). Furthermore, the following are still experienced during the projects, as noted by the NHBRC:

- The quality of the materials used, in particular the concrete, does not meet Standards;
- Late enrolments or non-enrolment of homes with the NHBRC warranty scheme, leading to no inspections;
- Poor workmanship;
- Use of inappropriate materials and technologies;
- Lack of appropriate attention given to structural detailing such as connections; and
- Relatively few quality assessment systems in place to monitor and capture aspects of construction quality in a structured and consistent way (NHBRC, 2015).

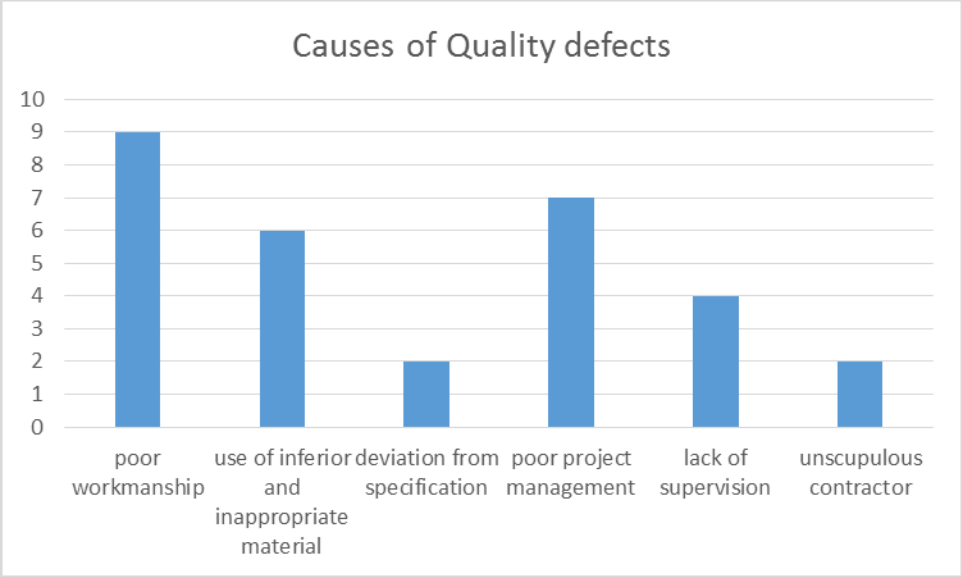


Figure 16: Causes of quality defects

In the questionnaires filled out, poor workmanship, use of inferior and inappropriate material, and poor project management were listed as the 3 most common causes of quality defects (Figure 16). This means that whilst there have been great strides in addressing housing defects, rigid enforcement is required to address the above-mentioned issues.

It was argued in the literature that causes of quality defects are interrelated, as shown in the causal loop diagram. The causes listed above also confirm this notion. For example, poor site management is a result of poor project management and lack of strict quality control. Poor site management can also result from lack of contractor expertise and the use of inexperienced subcontractors. By virtue of their interconnectedness of quality causes, it would be ill-advised to adopt a narrow approach to address these challenges. It affirms the literature's findings that quality management is effective when applied throughout the entire project life-cycle.

5.2.3. Frequency of defects

A large majority of the housing defects were experienced during the 1994-2002 period. It is during this time that the Ministry was chasing targets and focusing on quantity. The NHBRC enrolment process came into operation in 2002, meaning that houses built prior that were not enrolled and inspected. A large majority of these houses were not built in accordance with SABS building standards.

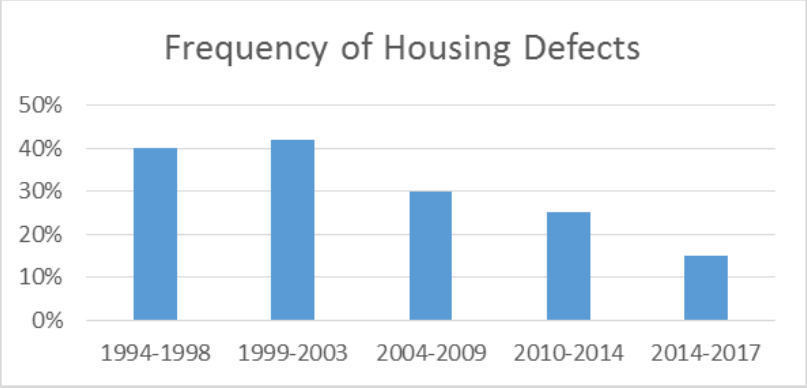


Figure 17: Frequency of Housing defects, derived from questionnaires

The introduction of BNG in 2004 shifted the paradigm from focusing on mass housing to addressing housing quality defects. At the end of 2010, approximately 3 million houses had been built. The total number of units enrolled between 2002 and 2010 were 409100; which meant that 2638500 units were at risk (NHBRC, 2011). A desktop study by the NHBRC showed that 60% (1,583,100 units) of the houses at risk will need to be rectified, as detailed below:

- 40% (1,055,400 units) of the houses under risk will have workmanship related problems at a cost of R12 000 per house, at an estimated cost of 1,055,400 X 12 000 = R 12.7 billion;
- Approximately 20% (609 520 units) of houses at risk will have major structural defects, which will require demolishing and rebuilding at current subsidy quantum of R 87 000, totaling R46 billion.

The total estimated remedial cost sat at R58.7 billion, excluding the estimated enrolment and professional fees, which would have brought it to a total of R64.4 billion. All houses rectified and meeting NHBRC requirements would be enrolled and provided with 5 year major structural warranty covered by the NHBRC (NHBRC, 2011).

5.2.4. Corrective Measures

5.2.4.1. DHS Rectification Programme

The aim of the National Rectification Programme was to correct defects on subsidy houses resulting generally from poor workmanship. These are subsidy houses that do not meet technical requirements as specified by South African National Standards (SANS) 10400 and NHBRC, as may have been applicable at the time of construction.

The Rectification Programme was meant to be implemented and managed under the auspices of the Programme Management Unit (PMU) at a national level. The process of rectification would

be preceded by a thorough engineering assessment of the structural condition of each unit to determine the nature and extent of the defects and the rectification required.

The Ministry of Human Settlements spent more than R2 billion between the years 2011-2014 to rectify approximately 28 000 subsidy houses. This was coupled by the blacklisting of a number of contractors responsible for the building of these defective houses. However, the rectification programme was halted in 2014. Beyond this point, those who received government-issued houses were told to fix them as part of maintaining their houses. The Minister and the provincial Housing MECs will only consider extending help to indigent people, pensioners and the disabled or direct the National Home Builders Registration Council (NHBRC) to use its warranty fund to fix affected houses (Makatile, 2015).

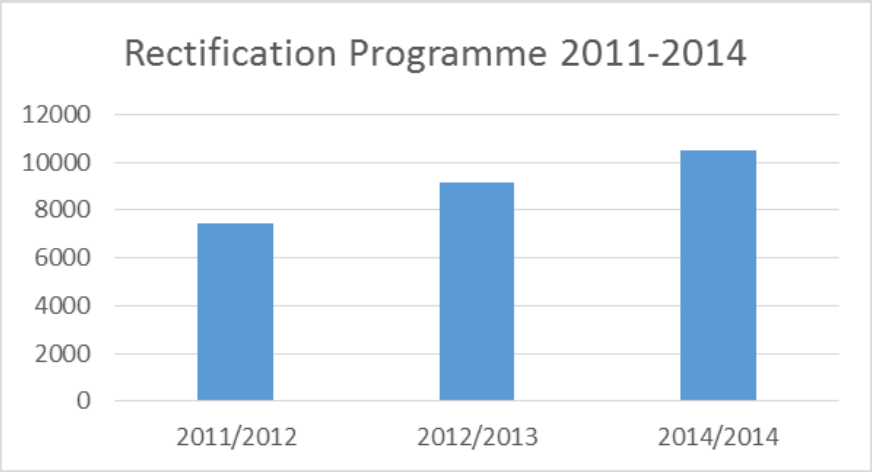


Figure 18: National Rectification Programme 2011-2014

In return, the government would continue to intensify efforts to find the contractors and developers who built the low quality houses to fix them. In a statement made by the Minister Lindiwe Sisulu, she proclaimed that "where defects and poor workmanship are identified, they remain the responsibility of the province, municipality and/or the developer to take relevant remedial action against the contractor and enforce repairs at the cost of the contractor or

developer," (de Kock, 2016). A special investigative unit was also been set up by the department to monitor the work of these builders and enforcing legal compliance, with some of them going into out-of-court settlements to fix the houses. The Ministry insisted that contractors and builders who do shoddy work must be blacklisted, their NHBRC certificate withdrawn and the money recovered from them to fix the houses.

Provincial Human Settlements Departments also continue to implement the National Housing Programme: Rectification of Houses delivered between 15th March 1994 and 31st of March 2012, which was approved by Housing MINMEC in 2005, in respect of Municipal Services and Top Structure defects, excluding PHP projects (DHS, 2015).

Table 10: Rectification of 1994-2002 stock statistics by PHSD

Report as at 31 March 2015 (Rectification)						
Province	Annual Targets			Delivery Performance		
	Sites	Units	Funds Allocated R'000	Sites	Units	Expenditure R'000
Eastern Cape	-	3,061	362,393	-	5,297	471,522
Free State	-	772	93,374	-	321	102,484
Gauteng	-	-	12,000	-	-	31,732
KwaZulu-Natal	-	2,258	133,723	-	2,054	92,401
Limpopo	-	700	58,100	-	8	7,253
Mpumalanga	-	-	593	-	-	489
Northern Cape	-	261	13,624	-	45	8,131
North West	-	23	5,599	-	146	40,438
Western Cape	-	365	11,270	-	8	3,137
Total	**-**	**7,440**	**690,676**	**-**	**7,879**	**757,587**

(Source: DHS, 2015)

The National Department of Human Settlements also established a Project Management Unit (PMU) which is aimed at providing technical support for provincial and municipal departments. The NHBRC is working closely with the NDHS PMU because NHBRC has established a Project

Management Office (PMO) which would be able to work directly with the PMU from NDHS. The NHBRC Project Management Office (PMO) will continue to assist with conducting assessments on houses for the rectification. It should be noted that municipalities are being accredited and they will be offering the same services as the PHSD (Provincial Human Settlements Departments). Once they are accredited to carry out their functions the NHBRC should be able to communicate and work directly with them (NHBRC, 2017c).

Quantification of the defective stock rectification has also been a challenge for DHS. Hence, it is unclear to quantify the progress of the rectification process to date. It can however be noted that progress has been slow under the remaining 1994-2002 rectification programme, which has been marred by budgetary constraints, especially after the abandonment of the national rectification programme. For example, only 7879 were rectified for the year 2014/2015 (table 10), which is insignificantly low considering that the number of houses identified in 2010 for rectification were approximately 1.5 million. The 27,000 units rectified between 2011 and 2014 was also a small portion of the stock.

5.2.4.2. The role of the NHBRC

As mentioned in the literature, the NHBRC has been mandated with:

- Project and home enrolments in subsidy and non-subsidy sector;
- Home Inspections;
- Training and development of home builders and government;
- Enforcing legal compliance of home builders; and
- Administer the warranty scheme for remedial work.

Remedial work

Claims against the Fund	2014/15	2015/16	2016/17
Foundation	1 330 741	353 386	-
Substructure	2 995 222	1 605 413	1 198 581
Superstructure	2 892 690	896 915	634 128
Roof Structure	147 781	34 709	24 515
Professional fees	1 104 356	332 875	4 721
Settlement	2 011 880	1 015 589	6 277 572
Transport and Storage	143 298	4 059	-
Accommodation	477 592	238 980	25 000
Total claims against fund	11 103 559	4 481 925	8 164 518

Figure 19: Claims against the warranty fund 2014-2017
Source: NHBRC, 2017b

Claims against the warranty fund for remedial work continues to be received and processed by the NHBRC, as indicated in figure 19. The NHBRC enforcement section suspended 621 home builders between 2014 and 2017, whilst 1083 disciplinary hearings were held during the same time (figure 20) (NHBRC, 2017b).

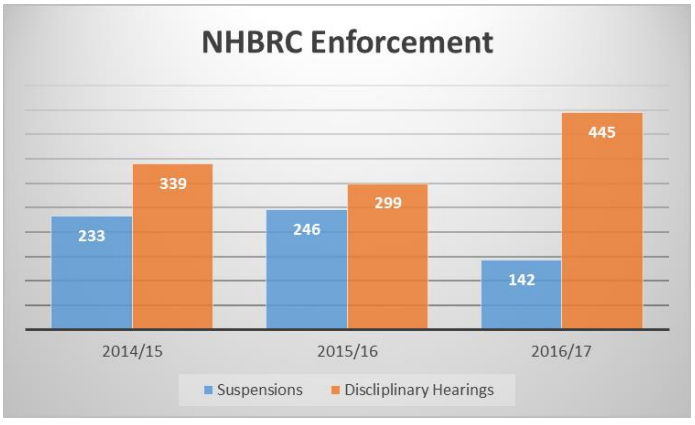


Figure 20: NHBRC suspensions and disciplinary hearings 2014-2017 (Source: NHRBC, 2017b)

The offences before the Committee were generally in relation to failure by the home builder to rectify major structural defects, failure to rectify workmanship related defects, failure to enroll homes, and code of conduct related matters.

i) BQIH

BQIH is a Construction Quality Assessment System developed by the NHBRC and the Council for Scientific and Industrial Research (CSIR). It is based on CONQUAS, which has 3 main components, i.e. structural, architectural and mechanical/electrical. It was developed so that the home building industry has a standard quality assessment system, achieved by measuring constructed works against workmanship standards and specifications.

In line with the NHBRC mandate, the system should focus on assessing aspects of the quality of basic construction that affect the structural performance and safety of housing units (NHBRC). Important aims applicable to the South African situation were identified as:

- the provision of an objective method for evaluating the performance of building contractors,
- the identification of good and bad construction practices, and
- Identification of the training needs of contractors.

The BQIH adopts six basic building components which are all assigned different weightings (table 11) and scores ranging from 0% to 100%:

- Houses with a score of more than 85% are generally good and pose little structural integrity risk;
- Houses between about 50% to about 85%, generally require remedial works, ranging from minor to major structural repairs; and
- Houses less than 50% are not acceptable and need to be demolished (NHBRC, 2015b).

Table 11: BQIH Weighting of Building components

Reference	Description	Weighting (%)
1	Foundations	30
2	Floors & stairs	15
3	Walls	25
4	Roofs	20
5	Electrical & plumbing	10

Source: NHBRC, 2015b

BQIH was also used to assess, categorize and score defects to derive financial implications for the Rectification Programme (Table 12). 6 categories were derived from this process, which were directly derived from the score ranges of BQIH.

Table 12: Category of defects and rectification cost estimate

Category of Defects and Rectification Cost Estimate		
Category	**Description**	**Cost Estimate**
Category 1	Moderate rectification Housing units with BQIH scores of between 75% - 100%, will undergo normal rectification and thus be classified as Category One	R 19,523.74
Category 2	Extensive rectification Housing units with BQIH scores of between 50% - 74%, will undergo extensive rectification and thus be classified as Category Two	R 38,673.00
Category 3	Demolish and rebuild to new standard of 40m^2 Housing units with BQIH scores between 0% - 49%, will be demolished and rebuilt and are classified as Category Three	R 85,468.88

Extra over	Cost of temporary accommodation	R 25,000.00
Extra over	Cost of Civil Engineering Infrastructure per Stand- where applicable	R 45,000.00
Assessments	New assessments for houses that have not been assessed	R 1,200.00

Source: DHS, 2015

Through BQIH, the NHBRC and DHS are able to monitor and capture aspects of construction quality in a structured and consistent way. This system is also relevant for administering the NHBRC Warranty Fund.

ii) IBTs[2]

This dynamic NHBRC Database provides a list of homes built with Agrément certified or NHBRC rational design approved Innovative Building Systems (IBTs) that have been inspected by the NHBRC and passed the criteria, which serves as guidance on acceptable performance on the ground. The inspections focus on the general technical performance of IBT homes with more weighting on the structural performance using a Condition Assessment Tool developed by the NHBRC to ensure consistency.

This database will be regularly updated and IBT system owners whose system did not perform well can reapply at any time. The advantage of this database is that it allows the provincial departments (developers) of Human Settlements to check which systems have been inspected and passed the NHBRC assessment for relevant appointments in subsidy housing projects.

The selection from this database should be complemented using an IBT analyzer or relevant sound analytical methods for technology selection for a specific geographic location to foster sustainability. However, it needs to be noted that defects can still arise as a result of design errors

[2] https://www.nhbrc.org.za/innovative-building-systems/

by professionals, manufacturing flaws, defective materials, improper use of installation of materials, not conforming to the design and specifications, or any combination of the above.

iii) Capacitation of officials

The DHS had indicated a lack of technical and operational capacity for programme and implementation monitoring in the Department. It was therefore not only about inspecting projects, but also included interrogation of the planning, project readiness, reasonableness, and whether the project met the priorities (NHBRC, 2015). The DHS had alerted provinces on the unacceptability of spending money on rectification because it would amount to a double subsidy. As such, the NHBRC offers the following training to DHS officials and contractors:

- Inspector training, which is also offered to internal NHBRC inspectors

  This is aimed at enhancing performance of Home Inspectors in building skills and technological advancements, including:

  - Introducing Alternative and Innovative Technology;
  - Steel Frame Skills;
  - Timber Building Skills;
  - Concrete Technology.

- Home Builder Training

  This programme is aimed at training NHBRC registered members. These trainings focus on supporting builders with technical and management skills.

- The NHBRC Government Programmes caters for key sectors operating entities of the following beneficiaries:

  - Youth Contractors and Learners;
  - Women Contractors and Young People;
  - Military Veterans Contractors;
  - Municipal and Provincial Human Settlements Inspectors.

5.2.4.3. CIDB

The CIDB's mandate is derived from the CIDB act, which assigns the CIDB with the responsibility for risk management in procurement, performance improvement and contractor development. However, it is worth noting that it is not a requirement that home builders register with the CIDB, which has proven as a challenge for entity to fully effect change according to their mandate. As the quality expertise of contractors continues to be one of the most common causes for quality defects, the CIDB's role of contractor development becomes critical. Hence, some of the interventions employed by the CIDB include collaborations with:

- National Treasury on building procurement capacity in national and provincial departments;
- NHBRC encouraging clients to require CIDB registered contractors on home building;
- NHBRC to share knowledge and systems in the area of quality improvement;
- built environment professionals (BEPs) to enhance focus on contractor development; and
- SACPCMP in establishing the necessary mentoring capacity for contractors (CIDB, 2014).

5.3. Analysis of Findings

The research sought to articulate quality management gaps and shortcomings within South Africa's low-cost housing sector to understand the persistent nature of housing quality defects. A list of challenges were discussed in the literature section, most of which continue to plague the industry to date, including:

- Implementing agent challenges -
    - Poor project management – lack of supervision and lack of technical and operational capacity for programme and implementation monitoring in the Department;
    - Insufficient scope of work;
    - Influence of politics in project timeframes and budgeting ;

    - Corruption in the political sphere and between officials and the private sector which affects procurement processes and results in the appointment of questionable and dodgy contractors;
    - Non-enrolment or late enrolments of projects by DHS and limited enforcement by the NHBRC.

- Contractor related challenges -
    - Use of inexperienced contractors;
    - Poor workmanship;
    - Corruption;
    - Deviation from specifications; and
    - Use of inferior and inappropriate material.

The NHBRC's role in the subsidy sector has been central to ensuring that quality homes are built. Whilst the DHS assumes the role of the implementing agent, the NHBRC plays the supporting role of regulator in the home building industry. Efforts by both entities to address the common causes of quality defects has resulted in the decrease of the frequency of defects over the years.

The NHBRC project and home enrolment process effects the warranty scheme cover for houses enrolled with the NHBRC. This process has been put in place to ensure that home building standards are complied with and the houses are protected against structural defects. This has been critical in decreasing the frequency of housing defects. However, non-enrolment and late enrolment are still a common problem. This in effect means that there are still non-compliant houses being built that will not be covered by the warranty scheme. This directly results in increasing the defective housing stock. Stricter quality control measures need to be effected to ensure that subsidy houses are enrolled.

Quantifying the current national defective housing stock has proved challenging as not all statistics are available from the relevant departments and entities i.e. NDHS, PHSG, NHBRC, etc. A large uncoordinated bulk of defective stock remains, characterized as such:

- Housing stock built between 1994 and 2002, where the highest number of defective stock is found. The NHBRC was not operational as yet, hence there were no enrolments or inspections.
- Housing stock built between 2002 and 2010. Only 409 000 homes were enrolled with the NHBRC.
- Housing stock built from 2010 onwards, where the highest enrolments and inspections occurred.

The 2011 national rectification programme was nationally abandoned in 2014 after fixing approximately 28000 houses out of the 1.5 million units requiring rectification (1994-2010 stock). What remains is a slow rectification programme for homes built between 1994 and 2002, as implemented by provincial Human Settlements departments. A large defective housing stock remains, which is not covered by the NHBRC warranty scheme. Unfortunately this forms the bulk of the defective stock. Budgetary constraints limit the speedy eradication of defective stock. At this rate, it will take decades to eradicate this backlog. Meanwhile, beneficiaries continue to be forced to live in structurally defective homes, most of which cannot afford to fix the houses themselves. This brings into question whether the entire housing programme has been successful if a large number of homes provided do not meet the building regulations and standards.

It also remains the responsibility of the province, municipality and/or the developer to take relevant remedial action against the contractor and enforce repairs at the cost of the contractor or developer, which is a process that has proved particularly challenging. Subsequent interventions included the blacklisting of a number of contractors responsible for the building of these defective houses. The government, through the NHBRC, also continues to intensify efforts

to find the contractors and developers who built the low quality houses to fix them. In the last 3 years, the NHBRC enforcement section suspended 621 home builders, whilst 1083 disciplinary hearings were held.

Rectification is a costly exercise. In 2010, the NHBRC put the rectification bill at R64.4 billion (NHBRC, 2015). Claims against the warranty scheme also continue to grow. This is money that could have been spent on other projects or providing more houses for the needy. This puts additional strain on resources, especially when they are already limited. The costs of rework also determines whether the project has been successful or not, which can be argued as the latter in this case. The higher the costs of rework, the more cost overruns occur. This has damaging implications for the creation of sustainable human settlements.

Skills development and capacitation for contractors and government officials include continuous training through the NHBRC government training programmes. These are continuous efforts to address issues of capacitation of municipal and provincial departments and contractors. Inspectors and government employees are regularly capacitated with training. However, human capital challenges still remain. The training needs to also sensitize officials and contractors on the importance of quality management. As argued in the literature review, project managers should be capacitated in system optimization, project management tools like QMS, human relations and organizational development, as compulsory training (Gabula, 2012).

Quality management should be prioritized throughout the entire project life-cycle. Over-emphasis on one part or the other is ill-advised. A culture of continuous improvement should also be encouraged. The DHS has also improved on its quality management systems, which now extends beyond inspections. The current standards for stand-alone dwellings is prescribed by the revised National Norms and Standards (2007). An array of manuals and guidelines have also been set out to ensure that quality is achieved throughout the life-cycle of projects. The NHBRC has

also been at the heart of quality management and ensuring that quality homes are built through the project and home enrolment process. Once enrolled, the warranty scheme comes into effect to cover the houses against any structural defects. Regular inspections are carried out by both DHS and NHBRC inspectors.

The development of BQIH promises a standardized quality assessment system for the home building industry, achieved by measuring constructed works against workmanship standards and specs. The NHBRC, alongside the CIDB, continues to invest in innovative practices to improve the home building industry, i.e. IBTs.

6. CHAPTER 6 - RECOMMENDATIONS AND CONCLUSION

6.1. Summary of Research

The research sought to uncover the progressiveness of housing policies and strategies in addressing quality defects challenges experienced in government-subsidized housing projects. As discussed in chapters 3 and 5, there have been notable changes to the policies and strategies of the Department of Human Settlements, amidst budgetary constraints and increasing housing backlogs.

The increase of the housing subsidy in 2004 and the introduction of sustainable human settlements (through Breaking New Ground) was a key milestone towards ensuring that quality homes are built. This was complemented by the regular update of building standards and quality strategies. The advent of the NHBRC in 1998 as a regulator, although operationalized in 2002, has been pivotal to the regularization and improvement of the home building sector, through the introduction of the project and home enrolment, and the warranty scheme. This means that subsidy (and non-subsidy) homes can be covered against structural defects, once enrolled with the NHBRC. The condition of the enrolment is dependent on compliance with building standards and the use of appropriate materials and technologies. All these concerted efforts led to the decrease in the frequency of the housing defects over the years.

However, a large and uncoordinated defective housing stock remains, which has proved difficult to quantify. Rectification has been costly and has put additional strain on the limited resources available. The rectification programmes have been slow in eradicating the defective housing stock, due to budgetary constraints and the unwillingness by national government to spend more money on rectification. At this point, it does not seem likely that the defective houses backlog will be eradicated anytime soon. Beneficiaries continue to be forced to live in structurally defective homes, most of which cannot afford to fix the houses themselves. This brings into question whether the entire housing programme has been successful if a large number of homes

provided are not up-to-standard. The persistence of these quality management challenges threaten the sustainability and viability of the entire Human Settlements programme. Tracking the progress of rectification and remedial works programme should be critical.

Moreover, non-compliance to the National Building Regulations, non-enrolment and late enrolment are still a common problem. This can be attributed to human resource challenges from both the department of human settlements and home builders. Measures of stricter controls need to be put in place to address these infringements on national building standards. The NHBRC is ideally structured to impartially implement these measures. It has been argued throughout the research that an organizational culture prioritizing quality management throughout the entire organization should be promoted. This means that the enforcement of policies are strategies to support quality management should be coupled with addressing human capital dynamics to ensure that the policies are implemented efficiently.

6.2. Recommendations of the study

Firstly, the importance of implementing wholesome quality management systems is pivotal to proactively avoiding quality defects. Neither of the approaches and its associated tools, i.e. quality planning or assurance or control, are effective when implemented on their own. It is therefore critical to adopt systems that are all inclusive of the different quality management needs at every step of the project life cycle. Perhaps exploring the implementation of TQM will be beneficial for the DHS. This will also require revisiting current procurement processes. The current recommended procurement process is the lowest cost-based selection method, which unfortunately denies opportunity to assess value and quality from the onset. Rectification is costly and wasteful. Quality should be an explicit criteria from the definition of the scope of works, design specifications, construction and close out assessment, along with monitoring and evaluation systems.

Secondly, it is also important to adopt progressive policies and strategies that are dynamic enough to timeously respond to the ever-changing nature of construction in the home building industry. It is through adopting this approach that challenges affecting quality will be efficiently addressed. This will also promote a culture of innovation. It is recommended that a robust framework for quality management be formulated to respond to the challenges identified in this research and other publications on the subject matter. Training for project managers, quality specialists, inspectors and contractors should be capacitated in system optimization, project management tools like QMS, human relations and organizational development, should be compulsory.

Lastly, it is noted that although it has been argued throughout this research rectification is costly and counter-productive, the abandonment of the rectification programme is worrying for the remainder of the houses that are defective, particularly because they are not part of the warranty scheme. The DHS should explore other alternatives that will assist the varied beneficiaries to rectify the defective housing stock.

6.3. Areas for further research

The work of the NHBRC to date, in supporting the DHS's mandate towards delivering quality houses, is commendable. The introduction of BQIH is an important milestone for standardizing quality assessment systems in the home building industry. Monitoring the implementation of this system will be beneficial to the housing industry in its entirety. Further studies into how the regulatory role of the NHRBC can be strengthened to effect DHS compliance is critical.

Quantifying the current defective stock will require additional research and time which was not possible during this research. This will require the correlation of national statistics by the NHBRC warranty scheme and PHSD rectifications, and NDHS statistics. Reporting on housing delivery

statistics needs to extend beyond focusing on completed structures and serviced sites to include correlating data on the number of defective structures.

Additional studies should also be conducted explore how the politics affects and influences the low cost housing sector. Complementary this should be a study on how BBBEE system could be better implemented to address skills shortages and the use of inexperienced subcontractors.

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Available at:
http://www.kzndhs.gov.za/Uploads/documents/Resource_Centre/Policy_documents/ ,

- Policy Procedure on Closing out of Projects;
- Policy and Procedure for the Rectification of Houses in KZN;
- Guidelines for Site & House Inspection;
- Project Process;
- Framework for Norms and Standards for KZN.

APPENDICES

APPENDIX 1: CONSENT FORM

University of the Witwatersrand, Johannesburg
School of Construction Economics and Management



RESEARCH CONSENT FORM

Full title of Project:
ANALYZING THE PERSISTENT NATURE OF QUALITY ISSUES IN LOW-COST HOUSING PROJECTS

Name, position and contact address of Researcher:

ZANDILE SIBIYA (MSC STUDENT AT WITS UNIVERSITY)

Please Initial Box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason. ☐

3. I agree to take part in the above study. ☐

4. I agree to the use of anonymised quotes in publications ☐

Name of Participant	Date	Signature
Name of Researcher	Date	Signature

APPENDIX 2: PARTICIPANT INFORMATION SHEET



Introduction

Good Day. My name is Zandile Sibiya. I am currently completing my Master's degree (Building) in Construction Project Management at the University of the Witwatersrand.

Purpose of Study

As part of my course I need to complete a research project. The focus area of my research is analyzing quality management issues in low-cost housing projects by the Department of Human Settlements. The research findings will be in the form of a research report to be submitted to the University for academic purposes.

Do I have to take part in this research?

I would like to invite you to take part in this research. You have a choice to decline the invitation without giving a reason. If you do want to take part now, but change your mind later, you can pull out of the research at any time. Should you agree to take part in this research, you will be asked to sign the Consent Form. Thereafter, you will be given a copy of both the Participant Information Sheet and the Consent Form to keep.

How will the study be conducted?

The research will take the form of face-to-face interviews and questionnaires. The researcher will make prior arrangements with the participants for suitable time and venue. Telephonic interviews will be conducted in cases where face-to-face interviews cannot be secured. The interviews and discussions will be recorded digitally and later transcribed. Only the researcher and supervisor will have access to these interviews.

Research participants

Participants of the research were chosen on the basis of their involvement in low-cost housing projects as employees of the Department of Human Settlements (DHS) or related public entities (e.g. NHBRC). Participants include DHS project managers, inspectors and NHBRC officials.

Duration of interview/questionnaire

- Maximum 30 minutes for the questionnaires.
- Maximum 2 hours for the interviews.

Benefits and risks of taking part in research

There are no known risks or disadvantages of taking part, as we strive to protect your confidentiality, unless you explicitly agree that the name of your company can be mentioned in publications arising from the research. If you are taking part in the face-to-face interview, we will send you the transcript of the interview before the analysis to allow you to ensure that you have not been misrepresented.

If you have any questions, concerns or complaints about the study at any stage, you can contact:

Name, position:	Mr. Paul Rudzinske (Student Supervisor)
Telephone number:	(011) 717 7669
Email:	Paul.Rudzinske@wits.ac.za

Thank you for considering taking part in the research project.

APPENDIX 3: QUESTIONNAIRE

University of the Witwatersrand, Johannesburg

School of Construction Economics and Management



INTERVIEW QUESTIONS (FOR PROJECT MANAGERS AND INSPECTORS)

Full title of Project:

ANALYZING THE PERSISTENT NATURE OF QUALITY ISSUES IN LOW-COST HOUSING PROJECTS

Name, position and contact address of Researcher:

ZANDILE SIBIYA (MSC - BUILDING STUDENT AT WITS UNIVERSITY)

1. How long have you been employed by the Department in your current position?

_____

_____

2. What is the frequency of defects in recent housing projects, prior to 2014?

0 -25%	
25 – 50%	
< 50%	
Comments/Clarity, if any	

3. What is the frequency of defects in recent housing projects, in the last 3 years?

0 -25%	
25 – 50%	
< 50%	
Comments/Clarity, if any	

4. What is the frequency of inspections of the construction projects?

_____

_____

_____

_____

5. Do you deem inspections effective? If not, what improvements are needed?

Yes	
No	
Comments	

6. Have you attended training on quality management (QM) systems? If yes, please provide details of the training. If no, please provide your QM training requirements.

Yes	
No	
Comments	

7. What challenges have you experienced in enrolling projects through the NHBRC?

_____

_____

_____

_____

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_____

8. In your opinion, what are the 3 most common causes of quality defects?

_____

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_____

9. Have interventions implemented to address quality defects been effective? If not, how do you think they can be improved? (Please mention these interventions)

_____

_____

_____

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_____

10. What National Department programmes and mechanisms are in place to support effective quality management systems?

_____

_____

_____

_____

_____

11. What is your interaction with municipalities in terms of quality management?

_____

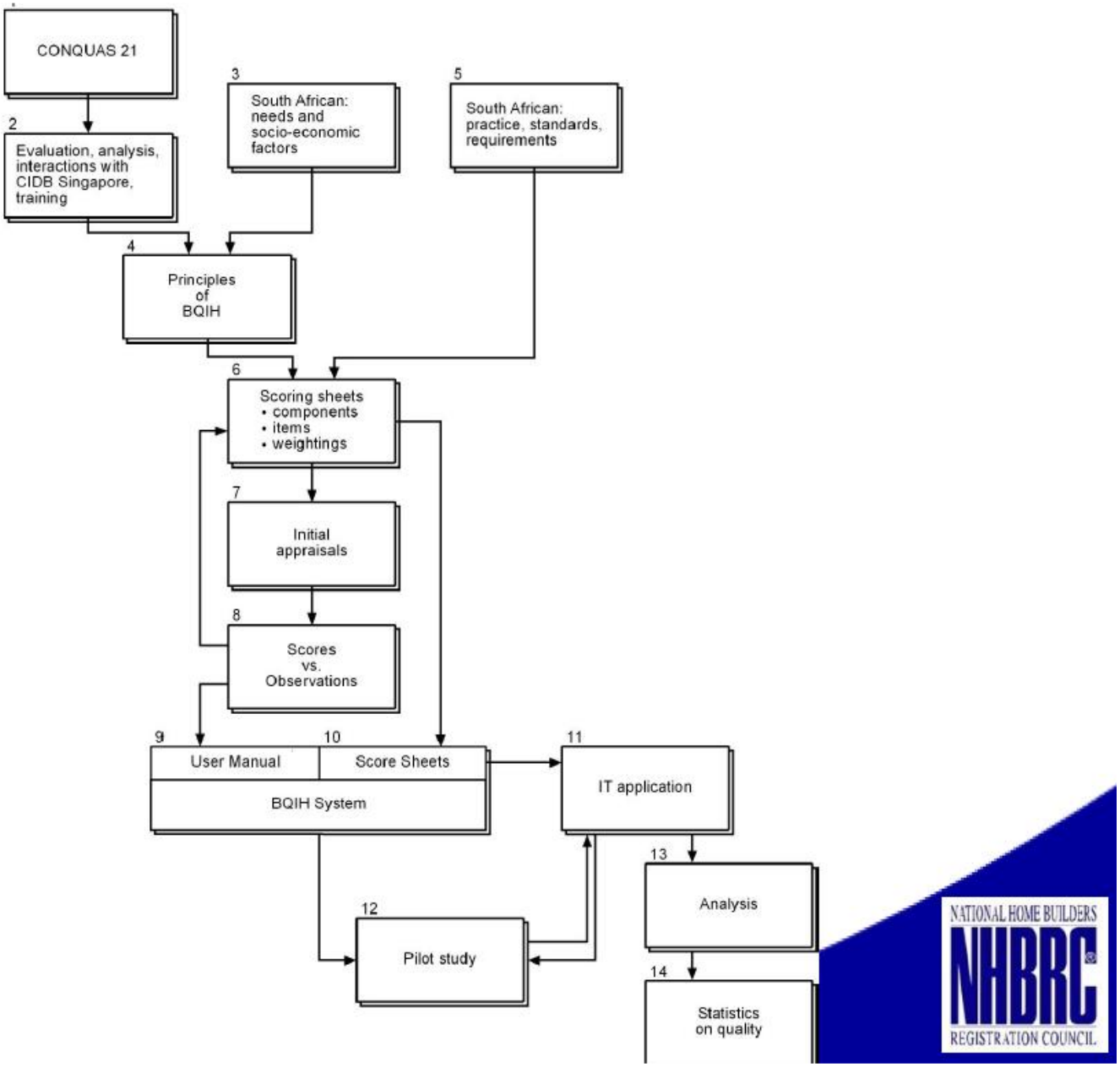
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APPENDIX 4: DEVELOPMENT PROCESS OF BQIH



Source: NHBRC, 2015b: 19

APPENDIX 5: EXTRACT FROM HOME BUILDING MANUAL, 2014

Introduction

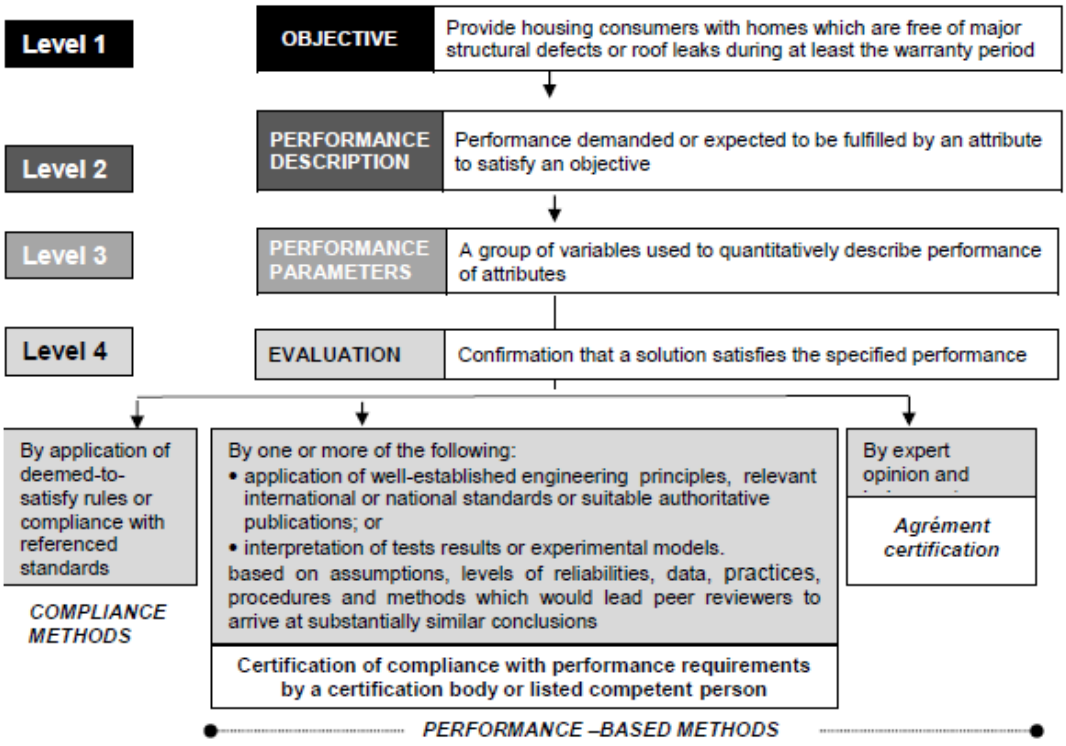
The Housing Consumer Protection Measures Act of 1999 requires the NHBRC to establish a fund for the purpose of providing assistance to housing consumers where a home builder fails to rectify major structural defects or a roof leak attributable to workmanship, design or materials which has manifested itself within 5 years or 12 months from the date of occupation, respectively. The Minister is required to prescribe Technical Requirements relating to the warranty scheme. The NHBRC is required to publish a Home Building Manual which contains the Technical Requirements prescribed by the Minister and guidelines established by the NHBRC to satisfy such requirements. Registered home builders are required to comply with the provisions of the Home Building Manual and to rectify at their own cost major structural defects or roof leakage in a home caused by the non-compliance with the scheme requirements and occurring within a stipulated period.

The Act does not exempt a person from any provision of the National Building Regulations and Building Standards Act, 1977. Although there are many similarities in the approach between the National Building Regulations and the NHBRC Technical Requirements, the onus is on the owner of a building to satisfy requirements in the case of the former and on the home builder in the case of the latter.

The first 8 parts the Home Building Manual contains the NHBRC's Technical Requirements. These NHBRC Technical Requirements:

1) define the categories of dwelling units that are excluded and included from the definition of a home and the structures which are included in the definition of a home;

2) establish both performance descriptions and performance parameters for structural strength and stability, serviceability, materials, behaviour in fire, drainage and storm water management and water installations in relation to the warranty scheme as indicated below;



The framework for assessing the performance of a system, element or component of a home

3) establish requirements for geotechnical investigations to ascertain the design parameters for the foundations of homes and the permitted development of dolomite land for homes;

4) establish procedures for the in principal acceptance of greenfield housing developments for enrolment with or without conditions;

5) establish the framework for the recognition and operation of certification schemes; and

6) establish procedures for the admission to and removal from a Council list of competent persons.

The last 6 parts of the Home Building Manual establishes the manner in which the first 8 parts (NHBRC Technical Requirements) can be satisfied. It:

a) establishes compliance methods to satisfy the performance requirements established in the NHBRC technical requirements i.e. by applying deemed-to-satisfy rules or complying with identified standards;

b) establishes specific procedures for satisfying performance requirements by means of performance based methods i.e. though certification by a certification body, a listed competent person or Agrément South Africa;

c) establishes additional requirements for plans for homes; and

c) establishing requirements for geotechnical investigations, the development of dolomite land and indemnity insurance.

The Concise Guide to the Home Building Manual, which is published separately, not only explains the Home Building Manual but also locates the manual in the broader context of sustainable human settlements with cross references to essential publications such as the National Housing Code, the Housing Project Process Guide (2009) and the Human Settlements Red Book.

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HOME BUILDING MANUAL

Preface

Section 12 of the Housing Consumers Protection Measure Act states that:

(1) The Council shall, for the purposes of this Act, publish a Home Building Manual containing—

(a) the NHBRC Technical Requirements; and

(b) guidelines prescribed by the Council to comply with the NHBRC Technical Requirements, with which registered home builders shall comply.

Parts 1 to 8 of this Home Building Manual are prescribed by the Minister as NHBRC Technical Requirements.

Parts 9 to 13 establish the manner in which the first 8 parts (NHBRC Technical Requirements) can be satisfied.

Source: NHBRC, 2014: ii-vi

Attributes and considerations in the design of homes

Attribute	Typical considerations	Regulator's requirements for attribute	
		National Building Regulations	NHBRC Technical Requirements
Accessibility	Access and ease of movement for a range of users e.g. the elderly and people with disabilities or obesity	Part M: Stairways Part S: Facilities for people with disabilities	Not regulated
Adaptability	Inherent ability of a home to be altered or extended or have its use changed	Not regulated	Not regulated
Acoustics	Control of external and internal noise (continuous and intermittent) Intelligibility of sound	Not regulated	Not regulated
Aesthetics	Appearance of a home	Not regulated	Not regulated
Air purity	Ventilation of spaces Control of odours	Part O: Lighting and ventilation	Not regulated
Contributions to sustainable development	• Usage of resources such as energy and water e.g. greenhouse gas emissions, use of renewable and non-renewable resources and consumption of fresh water) • Choice of building materials e.g. use of renewable and non-renewable resources, use of harmful substances, potential to generate business and employment opportunities for targeted groups and formation of waste hazards) • Choice of construction methods and resources e.g. potential to generate business and employment opportunities for targeted groups and health and safety during construction • Methods of waste disposal .e.g. recycling and disposal of hazardous waste • Resilience (ability to recover / bounce back from extreme hazards / disasters)	Not regulated save for Part XA: Energy usage	Not regulated
Constructability	Transportation to site and erection and health safety considerations..	Not regulated	Not regulated
Durability	Retention of performance of components and elements over required service life subject to regular maintenance	A15 Maintenance and operation Part B: Structural design	Part 2.1 Structural strength and serviceability (2.1.1.3) Part 2.2 Dampness and weatherproofing (2.2.1.1)
Economics	Initial capital and running and maintenance costs	Not regulated	Not regulated
Fire safety	Risks of outbreak and of spread of fire Physiological effects of smoke and heat Alarm time (detection and alarm systems) Evacuation time (escape routes) Survival time (fire compartmentation).	Part A: Administration Part J: Floors Part K: Walls Part L: Roofs Part M: Stairs Part O: Lighting and ventilation Part S: People with disabilities Part T: Fire protection Part V: Space heating Part W: Fire installation	Part 2.1 Structural strength and serviceability (2.1.2.6)
Hygiene	Facilities for human body care and cleaning Water supply Cleanability Evacuation of waste water and waste materials Limitation of emission of contaminants	Part P: Drainage Part Q: Non-waterborne means of sanitary disposal Part U: Refuse disposal	
Hygrothermal (humidity and temperature)	Control of air temperature, thermal radiation, air velocity and relative humidity (limitation of variation in time and in space, response of controls) Control of condensation	Part B: Structural design Part O: Lighting and ventilation Part XA: Energy usage	Part 2.2 Dampness and weatherproofing (2.2.1.1)
Maintainability	Ease / practicality of carrying out cleaning, routine repairs, periodic maintenance, maintenance of services	Part B: Structural design Part R: Stormwater disposal	Part 2.1 - Structural strength and serviceability (2.1.1.3 and 2.1.2.7) Surface water management (2.5.2)
Safety in use	Safety in respect of aggressive agents (protection against explosions, burning, sharp points and edges, moving mechanisms, electrocution, or contact with poisonous substances, infection) Safety during movements and circulation (limitation of floor slipperiness, unobstructed passage, guard rails, etc.) Security against human or animal intrusion	Part D: Public safety Part M: Stairways Part N: Glazing Part U: Refuse disposal Part V: Space heating	Not regulated

Security	Protection against unwanted human or animal intrusion and vandalism	Not regulated	Not regulated
Structural safety	Mechanical resistance of components and elements to static and dynamic actions, both individually and in combination Resistance of components and elements to impacts, intentional and unintentional abuse, accidental actions and cyclic (fatigue) effects	Part B: Structural design F3: Unstable soil conditions Part G: Excavations Part H: Foundations Part J: Floors Part K: Walls Part L: Roofs Part M: Stairways Part N: Glazing Part R: Stormwater disposal	Part 2.1 Structural strength and serviceability Part 2.6 Dolomite land
Structural serviceability	Resistance of components and elements subjected to actions to loss of function and damage, and avoidance of user discomfort		
Suitability of spaces for specific uses	The number, size, configuration, subdivision, and interrelation of spaces Circulation patterns Accommodation of services and equipment Furnishability	Part C: Dimensions Part L: Roofs	Not regulated
Tightness	Water tightness (rain, ground water, drinking water, waste water, etc.) Air and gas tightness Dust tightness	Part K: Walls Part L: Roofs Part N: Glazing Part R: Stormwater disposal	Part 2.2 Dampness and weatherproofing (2.2.1)
Visual	Natural and artificial lighting (required illuminance, freedom from glare, luminance contrast and stability) Sunlight (insolation) Possibility of darkness Aspect of spaces and surfaces (colour, texture, regularity, flatness, verticality, horizontality, perpendicularity, etc.) Visual contact, internally and with the external world (links and barriers for privacy, freedom from optical distortion)	Part O: Lighting and ventilation	Not regulated

Source: NHBRC, 2014