THE EFFECT OF THE INTEGRATION OF DESIGN, PROCUREMENT, AND CONSTRUCTION RELATIVE TO HEALTH AND SAFETY

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Promoter:

Professor JJ Smallwood

DECLARATION

I, Claire Helen Deacon, student number 201341247, hereby declare that the thesis for the degree of Doctor of Philosophy in Construction Management is my own work, and that it has not been previously submitted for assessment, or completion of any postgraduate qualification to another university or for another qualification.

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DEDICATION

This thesis is dedicated to the workers who have died, been seriously injured, and become ill while developing the infrastructure in the built environment for South Africa. It is also dedicated to those practitioners in construction health and safety (H&S) and who contribute daily to increase the level of H&S, and better practice.

To Peter Castle, former Occupational Health and Safety Manager of the Eastern Cape Department of Roads and Public Works (ECDRPW); the Bhisho provincial office and Sarah Baartman District, for agreeing to participate in the research, and the Focus Group (FG) participants who contributed their time, knowledge and experience. The ECDRPW has a high standard of H&S, and has become the benchmark in terms of construction H&S for South Africa.

The work is also dedicated to my family: Keith, Ashley, Calum, Bradley and Keagan, ‘my boys’, and those who have supported to me on this journey, and who believed I would complete this with their support.

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My mother, Kathy, you have been an inspiration, rising above so much and teaching me to dream and that nothing is impossible. My father, the late Captain Bob Deacon, you left a legacy hard to follow. I hope I make you both proud. My family, Paul, Teresa and Michelle, we can rise above any challenge, it sometimes takes a while though.

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The main reason for doing this is, the families who have lost loved ones who paid the ultimate price for building this magnificent country of ours, those who have died, been injured and become ill, as a result of what they had to do, to support their families. We cannot take away your loss, but maybe we can prevent more suffering.

ABSTRACT

The rates of fatalities, injuries and diseases from work, has been a longstanding challenge for centuries. The challenge is validated by the fact that there is not a paper, or publication, that appears to have been written worldwide, without discussion regarding the extent of the problem in the construction industry. Despite there being prescriptive statutory requirements applicable to the sector, all attempts to reduce the reduce the accident rates in South Africa appear to have been largely unsuccessful.

The review of literature indicates that most research has focused on design, designers, roles of stakeholders, inter alia that relate to construction health and safety. Given the situation noted, the research investigated design, various aspects of the construction process and stakeholders, and the inclusion of procurement as a major component of the construction process. A triangulated, or mixed methods research methodology was utilised for the thesis. The qualitative methodology utilised in Action Research (AR) and a total of three FGs' sought to develop a theoretical model that would identify multi-stakeholder policies, practice and education requirements. An extensive international, African and South African literature review was conducted as part of the secondary research and the grounding for the mixed methodology of research. The information sought to contextualise the South African paradigm and practices.

Two quantitative, multi-stakeholders' studies were conducted during the development of the research. The quantitative aspect considers the perceptions of those practicing or involved in H&S, the interface regarding the stakeholders and 'issues' experienced in the challenges relating to daily work. Themes were developed, *inter alia: a* general; workers; management (including supervision, responsibilities and pricing); a stakeholders' theme (including project managers; design and designers, and client), and the construction H&S theme (including the CHSA, construction H&S Manager (CHSM), construction H&S Officer (CHSO)). A total of 22 hypotheses were tested. The hypotheses considered all the stakeholders, within the framework of the research. Only 1 hypothesis was not supported, and 1 hypothesis was partially supported.

Three AR FGs' were held in the Sarah Baartman District (a building focus) and at the Bhisho offices (a civil engineering focus) of the ECDRPW. The research considered the procurement processes that

underpins a project, with some elements relative to the interface of H&S, design, the stages of work, and the current legislative framework.

A validated theoretical model, the 'Deacon Procurement, Design and Health and Safety Model' emerged from the qualitative aspect of the research.

The salient findings indicate a tendency in the industry to operate in silos, adhere to minimum levels of compliance, and not determining other aspects that could possibly reduce project and financial risk. Therefore, stakeholders need to work together, across the stages of work. Level of confidence is low among clients and built environment groups regarding H&S across the project life cycle, resulting in the non-compliance, and increased project risk. Clients such as the National Treasury do not identify H&S risks during project planning, resulting in the lack of adequate resources for projects, with supply chain management and procurement not ensuring compliance and technical expertise. Due to lack of knowledge CHSAs', CHSMs', and CHSOs,' are not appointed timeously, resulting in non-compliance, and increased project risk. The construction H&S practitioners level of confidence is affected by lack of experience, not knowledge, in contrast to the lack of H&S knowledge of built environment professionals.

A range of recommendations are provided that include, inter alia: development of policy, guidelines and practice notes regarding H&S, supply chain management and procurement; education and training, continuing professional development, training and workshops, and further research.

Key words: Construction; Design; Health and Safety; Integration, and Procurement.

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Chapter one includes the introduction relating to the research, *inter alia*: the setting; the statement of the problem; identified sub problems; the hypotheses; delimitations; the definition of terms, abbreviations; assumptions; the significance of the research, and the aims and objectives of the research.

Chapter two reflects the relevant local and international literature that supports this research. An extensive literature review has been conducted, using conference and journal papers, media reports, models used, and open source internet resources.

Chapter three describes the research design and methodology used in the research. Methods used included the AR paradigms of triangulation, which incorporated quantitative and qualitative (through FG studies).

Chapter four presents the quantitative studies completed for the research and discussion regarding each as they relate to the stated sub-problems as reflected in the research. The outcomes are concomitantly discussed in this chapter.

Chapter five presents the qualitative FG narratives among the participating 3 FGs' and aspects as they apply to the themes developed, and complement the quantitative studies.

Chapter six considers, synthesises and merges the literature and FG narratives, resulting in the components necessary to evolve the draft model for validation.

Chapter seven outlines the processes followed to validate and refine of the draft model prepared in Chapter six. Data obtained from FG participants through a questionnaire integrating qualitative and quantitative methods, administered with the draft model were analysed to determine the degree of concurrence (DoC) and the chapter summarises the findings and presents a final model.

Chapter eight incorporates the quantitative findings of H&S perceptions among multi-stakeholder surveys and draws on the appropriate literature to test the Hypotheses (HPs).

Chapter nine draws conclusions form the research, presents recommendations for future research, policy at national, provincial and district levels, training requirements at all levels of education, and continuing education, and means of dissemination of the research findings to enhance knowledge and better practice in the construction sector.

The **References** follow Chapter nine, and include a comprehensive list of the literature, and sources used to support the development of this thesis.

The **Annexure** follows the References, which includes communication regarding the preparation, consent, ground rules for the qualitative FGs', and the instruments used for the quantitative studies.

ACRONYMS

Term	Abbreviation
Accident Frequency Rate	AFR
Action Research	AR
Asset Management Plan	AMP
Baseline Risk Assessment	BRA
Bid Award Committee	BAC
Bid Evaluation Committee	BEC
Bill of Quantities	BoQ
Built Environment Professional	BEP
Built Environment Professional Councils	BEPCs
Bid Specification Committee	BSC
Construction Industry Development Board	cidb
Compensation for Occupational and Injuries and Diseases Act	COIDA
Construction Regulations, 2014	CR
Construction Health and Safety Agent	CHSA
Construction Health and Safety Officer	CHSO
Construction Health and Safety Manager	CHSM
Construction Work Permit	CWP
Construction Manager	CM
Construction Project Manager	CPM
Council for the Built Environment	CBE
Custodian - Asset Management Plan	C-AMP
Design Risk Assessment	DRA
Department of Labour	DoL
Department of Public Works	DPW
Expanded Public Works Programme	EPWP
Engineering Council of South Africa	ECSA
Focus Group	FG
Great Britain	GB
Health and Safety	H&S

Health and Safety Executive	HSE
Hazard Identification and Risk Assessment	HIRA
Identity of Work	IDoW
Infrastructure Delivery Management Development System	IMDS
Interim Bid Award Committee	IBAC
International Labour Organisation	ILO
Labour Intensive	LI
Occupational Health and Safety Act	OHSA
Occupational Health	OH
Medium Term Expenditure Fund	MTEF
Principal Agent	PA
Principal Contractor	PC
Project Management/Manager	PM
Professional Service Provider	PSP
Republic of South Africa	RSA
Site Specific H&S Plan	SSHSP
Site Specific H&S Specification	SSHSS
South African Council for the Project and Construction Management Professions	SACPCMP
South African Council for the Quantity Surveying Profession	SACQSP
South African Council for the Landscape Architectural Profession	SACLAP
South African Council for the Property Valuers Profession	SACPVP
South African Council for the Architectural Profession	SACAP
South Africa	SA
Supply Chain Management	SCM
Small, Medium, Micro Enterprises	SMMEs
United Kingdom	UK
United States of America	USA
User-Asset Management Plan	U-AMP
Voluntary Association	VA

DEFINITION OF TERMS

Accident

An unplanned event that results in injury or ill-health of people, or damage or loss to property, materials or the environment or a loss of business opportunity (Hughes and Ferrett, 2013; Zou and Sunindijo, 2015).

Agent

Means any person who acts as a representative for a client (Republic of South Africa (RSA), 2014).

Built Environment

Refers to the functional area in which registered persons practice. The Built Environment includes all structures that are planned and / or erected above or underground, as well as the land utilised for the purpose and supporting infrastructure (South African Council for the Project and Construction Management Professions (SACPCMP), 2013a).

Client

Means any person for whom construction work is performed (RSA, 2014).

Contractor

Means any person or legal entity entering into a contract with the client for the execution of the works or part thereof (SACPCMP, 2013a);

or

Means an employer who performs construction work (RSA, 2014).

Competent person

Means a person who:

has in respect of the work or task to be performed the required knowledge, training and experience and where applicable, qualifications, specific to that work or task: provided that where appropriate qualifications and training are registered in terms of the provisions of the National Qualification Framework Act, 2000 (Act No. 67 of 2000), those qualifications and that training must be regarded as the required qualifications and training, and

is familiar with the Act and with the applicable regulations made under the Act (RSA, 2014).

Construction site

Means a workplace where construction work is being performed (RSA, 2014).

Construction Health and Safety Agent (CHSA)

Means a person with at least five years' experience in the construction industry, and who has been assessed by the SACPCMP council as competent to provide health and safety services (SACPCMP, 2013a).

Construction Health and Safety Manager (CHSM)

Means a person who is appointed to manage construction health and safety performance and compliance for a company in accordance with the Health and Safety Act and Regulations.

Construction Health and Safety Officer (CHSO)

Means a person who is appointed to assist site management with health and safety compliance in accordance with the Occupational Health and Safety Act and Regulations.

Construction Work

Any work in connection with:
the construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure or
construction, erection, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system, or the moving of earth, clearing of land, the making of excavation, piling or any similar civil engineering structure or type of work (RSA, 2014).

Designing for safety

The consideration of construction site safety in the preparation of plans and specification for construction projects (Behm, 2006).

Design

In relation to any structure includes drawings, calculations, design details and specifications (RSA, 2014).

Designer

Describes any of the following persons:

A person who prepares a design;

A person who checks and approves a design;

Building services engineer designing details for fixed plant;

Surveyor specifying articles or drawing up specifications;

Contractor carrying out design work as part of a design and build project;

Temporary works engineer designing formwork and false work, and

Interior designer, shop-fitter and landscape architect (RSA, 2014).

Hazard

The source of or exposure to danger (RSA, 1993);

or

The potential for harm (Asbury and Ashwell, 2007).

Hazard identification

Means identifying hazards, which could cause harm (Hughes and Ferrett, 2013).

Life Cycle

A series of phases that a project passes through from its initiation to its closure;

or

The inter-related phases of a project, programme or portfolio and provides a structure for governing the progression of work (Burke, 2014).

Principal Contractor

Means an employer appointed by the client to perform construction work (RSA, 2014).

Procurement

The process by which the resources (goods and services) required by the project are acquired. It includes development of the procurement strategy, preparation of contracts, selection and acquisition of suppliers, and management of contracts (Burke, 2014).

Project

Means the total development envisaged by the client, including the professional services (SACPCMP, 2006)

or

A temporary endeavour undertaken to create a unique product, service, or result (Construction Industry Development Board (cidb), 2010).

Risk

Means the probability that injury or damage will occur (RSA, 1993),

or

The combination of the severity of harm with the likelihood of its occurrence (Hughes and Ferrett, 2013),

or

Anything that may hinder or assist achievement of business objectives (Asbury, 2007).

Safe

Means free from any hazard (RSA, 1993).

Stakeholder

Means those individuals or groups who can affect, or are affected by the achievement of an organisations purpose (Amaeshi, 2009).

CHAPTER 1: THE PROBLEM AND ITS SETTING

1.1 FOREWORD

The issue of construction H&S has been a longstanding challenge for centuries. This is validated by the fact that there are very few papers, or publications that appear to have been written worldwide, without discussion regarding the extent of accidents, disease, and fatality and injury rates in the construction industry. Thus, the sector remains one of the most hazardous and notorious industries across the globe, irrespective of the much-debated causes, and issues relative to injuries, disease, and fatalities. Yet despite changes to legislation, research, and increased focus in developing and developed countries, to date, there has been no significant reduction in such losses in the construction industry (Rowlinson, 2004; Windapo and Oladapo, 2012; cidb, 2015a; Smallwood, 2015).

In 2009, the cidb reported that the sector had the third highest number of fatalities per 100 000 workers among all industries; and that workers were six times more likely to die at work. Current figures indicate that construction workers are injured, become ill, or die every 15 seconds, with more than 2.3 million deaths globally on an annual basis. History indicates that while the sector has been deemed 'inherently dangerous' and accidents and the loss of life is 'just a part of the job' (cidb, 2009; Windapo and Oladapo, 2012; Musonda, Pretorius and Haupt, 2013; Smallwood, 2015). There is a higher loss of life and limb in developing countries where larger parts of the population work in hazardous environments, where the poorest and least protected are most affected (Kheni, Gibb and Dainty, 2006; Conseil International du Batiment (CIB), 2013; International Labour Organisation (ILO), 2013; Windapo, 2013; Mustapha, Aigbavboa and Thwala, 2014). Despite the high rate of accidents, the construction sector remains one of the most significant in terms of employment. Between 9% and 20% of the population of a country could be employed in the construction sector, making it socially and economically important (Jimoh, Ijigah and Nuah, 2014).

1.2 HISTORICAL BACKGROUND

Deacon (2004) notes some of the earliest records regarding H&S in construction, inter alia:

- The recognition of musculoskeletal injuries, as a result of construction processes, were recorded in the Edwin Smith Papyrus, which dates back to the time of Imhotep, in approximately 2780 B.C. Imhotep was an administrator concerned with a major construction project, an architect and one of the most famous Egyptian physicians. The papyrus written about the project describes cases that are likely to be musculoskeletal injuries during the building of the pyramids. The final case in the papyrus deals with ”instructions concerning a sprain of the vertebra (in) his spinal column project, an architect and Hammurabi, King of Babylonia in 1700 B.C. considered it necessary to include ‘instructions for the construction of a house to ensure it did not collapse in his Building Code 229: ”*If a builder builds a house for a man and do not make its construction firm and the house he has built collapse and cause the death of the owner of the house that builder will be put to death”;*
- The Book of Deuteronomy, Chapter 22; v8, it is recorded: ”*When thou buildest a new house, then thou shalt make a battlement for thy roof, that thou bring not blood upon thine house, if any man fall from thense.”’* (King James Bible (online version, nd), and
- Other construction hazards were identified during the rise of the Roman Empire. The life of a slave working in the lead industry was calculated in months rather than in years, and workers in the cinnabar (red mercuric sulphide) industry were encouraged to use a pig bladder to protect their lungs, and lives were measured in months rather than in years. During the middle ages, the chapter house of the great Batalha monastery in Portugal is reported to have collapsed twice during construction. Possibly due to the risk of losing experienced workers, it was finally built by prisoners already condemned to death.

While not directly related to construction, the duties of the employer were identified during the industrial revolution. There was a growing public awareness of management’s responsibility for the safety of its workers. The first fine imposed on management (£5) was recorded in 1792 as ”intended to operate as a caution to owners,” following the death of a worker in the cogs of a steam-wheel in a foundry (Deacon, 2004).

Deacon (2004) further reports that in 1785, the first real analysis of an accident was made, following a dust explosion in a bakery by Count Morozzo, who stated in this final paragraph: *“It is therefore of*

great importance that these facts should be universally known, that public utility may reap from them every possible advantage."

The practice of procurement is noted from ancient Greek and Syrian culture to modern day practice of public clients using purchasing power to achieve broad social outcomes (Alharthi, Soetanto and Edum-Fotwe, 2014; Rwelamila, 2009).

Smallwood (2015) records that construction workers have experienced major changes in H&S over the past 200 years. Employers were seldom held responsible for their employees' injuries and the fatalities that occurred. Iconic projects in the United States (US) such as the Empire State Building, the Golden Gate Bridge, the Hoover Dam experienced major losses and fatalities. However, during the construction of these structures, major risks were noted, and more importantly, were addressed in innovative ways, given the period. In contrast, the construction of the Olympic Park in east London could be noted as a pinnacle of H&S success. Clear leadership and careful planning and implementation by the client and integration of H&S in all aspects of the project are cited as some of the success factors in the project (Smallwood, 2015).

1.3 CONSTRUCTION STAKEHOLDERS AND HEALTH AND SAFETY

Stakeholders, traditionally, are those who have an interest directly, indirectly in, or create the built environment. Stakeholders include built environment professionals, developers, industry, employer and voluntary associations, and government regulators. Other stakeholders may have a primary or secondary relationship, the latter having influence only through legal or political actions. H&S is noted as a 'secondary' contributor to procurement, with vested interest, which is contrary to the role it can play when included from inception (cidb, 2009; Amaeshi, 2009; Rwelamila, 2009; du Plessis and Cole, 2011).

Literature indicates that clients are a key stakeholder, and therefore have influence over project standards from their inception. Where leadership and collaboration is seen in relation to H&S, benefits are more likely to be perceived and achieved, thus, resulting in risk reduction during design, planning, and procurement (CIB, 2013). Despite multi-stakeholder responsibilities being entrenched in South African legislation, there appears to be a lack of commitment to the inclusion of H&S in projects (Amaeshi, 2009; cidb, 2009; Windapo, 2013; Goldswain, 2014).

Procurement practices and requirements in the public sector are set by the Department of Public Works (DPW), with particular financial controls applicable at national, provincial, and regional, or district level. While National Treasury is the overarching organ of state, each of the provincial departments and other public entities are required to provide and maintain infrastructure (cidb, 2010a). The traditional approach to procurement and supply chain management (SCM) does not deliberately single out, or appear to consider H&S, competence and the important role of stakeholders. SCM rather considers lowest cost as the key selection factor. Client leadership is noted as a crucial driver for improving H&S throughout the supply chain (Office of Government Commerce (OGC), 2007; Wells and Hawkins, 2010).

1.4 HEALTH AND SAFETY COMPETENCE AMONG CONSTRUCTION STAKEHOLDERS

The cidb (2009) reports that the level of H&S in South Africa lags significantly in comparison to developed countries. Critical aspects include, *inter alia*, the redistribution of responsibility for construction H&S from the contractor to all stakeholders, the leadership and management skills of which were noted as critical. There has been no notable reduction in injury, disease, and fatality rates, and stakeholders lack requisite knowledge competency and accountability. South African research conducted among architects regarding H&S and ergonomics indicates the lack of knowledge and pro-active risk reduction during the design stages of the life cycle (stages 1-3, as indicated in Table 2) (Goldswain, 2014).

Smallwood and Haupt (2008) published the findings of an exploratory study relative to construction H&S competencies among site personnel, CHSOs', and client appointed CHSAs'. The study determined the importance of surface competencies in terms of seventy-nine knowledge areas, and fifty skills that are integrated within the construction process. The findings were further summarised by evolving eight composite knowledge areas. Smallwood and Haupt's (2008) findings are further supported by the cidb (2009) who reported that training programmes for construction H&S have been haphazard, ad hoc, or on the job short courses, and rarely accredited. The top four outcomes of the Smallwood and Haupt (2008) study relate to H&S.

A further study relative to the performance of CHSOs' indicate that they in many cases, CHSOs' are only part-time or contractual appointments, and lack knowledge and have limited training. The aforementioned, ultimately, could affect their ability to ensure adequate H&S during a project. Several of other significant barriers included, *inter alia*, the CHSOs' being excluded from decision making, their lack of authority, and their exclusion from managing H&S on their project or being consulted by management (Smallwood, 2011). Following the Smallwood and Haupt (2008), and cidb (2009) reports relative to the status of H&S, there was greater focus on developing the scope of services, deliverables and the registration of those practicing in the field of H&S in the construction sector (Smallwood and Haupt, 2008; Smallwood, 2011; cidb, 2009).

1.5 REGULATING CONSTRUCTION HEALTH AND SAFETY

Any person or organisation that employs persons, or does work, is required to comply with the Occupational Health and Safety Act (OHSA), No. 85 of 1993 (RSA, 1993). The Construction Regulations (CR's) were introduced originally through statutory promulgation in 2003, and amended in 2014. The 2014 amendments increased, inter alia, the requirements for the level of competence and accountability among stakeholders (RSA, 2014). The poor performance of the sector suggests that construction stakeholders do not comply to statutory or regulatory requirements. The CR's were enacted to safeguard lives and to improve product and process quality (cidb, 2009; Windapo, 2013). However, research conducted among South African contractors indicates that the level of compliance is directly related to perceived cost savings, and not the degree of risk (Windapo, 2013).

The South African Council for the Project and Construction Management Professions (SACPCMP) is one of six Built Environment Councils appointed by the Minister of Public Works to oversee the registration of those practicing in the sector. In 2013, an amendment was made to Act No. 48 of 2000 Section 18 (1) (c) (RSA, 2013 (a)(b)(c)), which included three H&S categories for registration. The three categories include:

- The CHSA (the only professional category);
- The CHSO, and
- The CHSM.

The SACPCMP (SACPCMP, 2013a) as custodian and regulator, identified standard services that must be performed during each of the six stages of projects. The involvement of the three categories of H&S practitioners in the stages are presented in Table 1.1.

Table 1.1 Construction H&S Project Stages (SACPCMP, 2013a).

SACPCMP Construction H&S Project Stages	
Stage 1:	Project Initiation and Briefing
Stage 2:	Concept and Feasibility
Stage 3:	Design and Development
Stage 4:	Tender Documentation and Procurement
Stage 5:	Construction Documentation and Management
Stage 6:	Project Close-out

Responsibilities of the SACPCMP regarding the regulation of the disciplines per category include the following:

- Registration of the categories;
- Providing a code of conduct;
- Monitoring professional development;
- Determining conditions for maintaining annual registration;
- Providing guidelines, and
- Fee structures (SACPCMP, 2013a).

The 2014 CR's (RSA, 2014) introduced the requirement for stakeholders to use the registered construction H&S categories across the stages of the construction life cycle. Further amendments included the development and consideration of design hazard identification and risk assessments (HIRAs), increased levels of communication, and accountability among all stakeholders. The prescriptive nature of the amendments increased significantly, relative to all stakeholders. The aforementioned aspects were mainly due the lack of significant reduction in incident, injury and fatality rates (cidb, 2009; RSA, 2014, and Federated Employers Mutual Association (FEMA), 2016).

1.6 DESIGNING FOR HEALTH AND SAFETY

The concept of H&S and any associated liability during a project has, until recently, remained within the construction stage (stage 5) (see Table 1.1) of the project. The construction process is a multi-stakeholder approach, made up of the client, designers (architects, engineers, project managers (PMs), quantity surveyors (QSs'), and contractors). Stakeholders appear to limit involvement of H&S during the various phases, possibly due to the value-added benefit to include the principles of H&S. The importance of H&S stakeholders is due to the evolving transformation and complexity in the sector (Gambatese, 1998; Ganah and Godfaurd, 2014).

The designing for safety approach is practised in the United Kingdom (UK); the United States of America (USA), and Australia. Literature indicates that if applied at the appropriate time, H&S has a positive impact on the project (Schulte, Rinehart, Okun, Geraci and Heidel, 2008; Gambatese, 2013). The 'Prevention through Design' (PtD) approach used in the USA is cited as one of the most effective means of preventing the losses experienced in construction, 'design out' hazards and risks at work (Schulte *et al*, 2008), Gambatese, 2013). Schulte *et al* (2008) state that the practice of anticipating and 'designing out' potential H&S hazards and risks is associated with a range of opportunities for application. Examples of designing out hazards include a range of opportunities that includes all stakeholders across the stages of construction. However, it is not only designers that are responsible for H&S. All those who procure products and services have a responsibility to prevent exposure and risk to protect workers; therefore, what is used or procured should meet this requirement (Schulte *et al*, 2008).

The South African legislative framework set out in OHSA, and its Regulations, impose various responsibilities on employers, employees, manufacturers and users to ensure the limitation of risk during the design and use of products, services, and processes (RSA, 1993; RSA, 2014).

1.7 PROCUREMENT PRACTICES

Construction in the public sector is influenced by procurement procedures that are decided by the stakeholders using their preferred SCM methods. Public sector infrastructure development needs to ensure the reduction of risk, particularly in developing countries. Developing countries wishing to ensure a good standard of project H&S, such as financiers, donors and those who are setting the procurement 'rules' may be required to ensure the H&S standards are in place to maintain reputation

and continued funding. Furthermore, many secure work in the sector, noted as a potential route out of poverty, but the resulting ill-health, fatalities, or injury could send such families back into a state of destitution. The use of procurement to promote and enhance H&S has not been noted in many cases, increasing project risk and liability (Wells, and Hawkins, 2010).

South African procurement practices are well defined by National Treasury through the Infrastructure Development Management System (IDMS), which in turn guides the industry in procurement practices and the standards to be used (cidb, 2011).

1.8 THE WAY FORWARD

The South African legislative framework provided by the Department of Labour (DoL) through a range of legislative requirements has developed over time, to address the unacceptably high levels of fatalities, injuries, and occupational diseases (RSA, 1993; RSA, 2014). Procurement practices and SCM frame the practice of construction, specifically in the public sector, and require the involvement of a range of stakeholders (cidb, 2011), the amended CR's (2014) (RSA, 2014), including the input of H&S professionals through the critical stages of construction. However, the focus on the cost of H&S compliance, rather than risk, by contractors, as reported by Windapo (2013), amplifies the need for attention to H&S by all stakeholders, as workers are downstream and therefore the recipients of construction practices.

A meta-analysis conducted by Zou and Zunindijo (2015) of 88 construction H&S papers published in 2009, indicated that the predominating research methodology adopted was quantitative. The meta-analysis further identified that 'what has happened' predominated rather than the 'why and how'. Zou and Zunindijo (2015), thus, recommend a more qualitative approach to gain a deeper and richer understanding of the challenges facing the construction sector.

1.9 THE STATEMENT OF THE PROBLEM

The construction process is a complex one, involving a range of stakeholders that include clients, designers, and contractors. South African construction stakeholders are required to practice in frameworks, defined by the built environment, H&S legislation and National Treasury requirements

(cidb, 2009; cidb, 2011); RSA, 1993; RSA, 2014). The construction process requires a multi-stakeholder approach. Stakeholders appear to limit the involvement of H&S practitioners during the various phases. The importance of H&S practitioners is due to the evolving transformation and complexity of construction processes in the sector (Gambatese, 1998; Ganah and Godfaurd, 2014).

South African procurement practices and the involvement of stakeholders to date has had minimal input by H&S practitioners through the critical stages of construction. The use of procurement to promote and enhance H&S has not been noted during procurement activities and SCM, increasing project risk and liability (Wells, and Hawkins, 2010). Research conducted by Smallwood and Haupt (2008) indicate a range of competencies identified as needed for those practicing construction H&S. The lack of H&S knowledge on the part of built environment professionals increases project risk, potential loss of life, and the economic burden carried by the State (cidb, 2009).

Research conducted among South African contractors indicates that the focus on perceived cost of compliance with H&S legislation rather than risk, leads to increased risks to workers. The focus on cost therefore reduces compliance levels to the OHSA and Regulations among contractors (Windapo, 2013). Based on the statistics published, there appear to have been no significant decrease in the accident frequency rates, despite legislative changes (cidb, 2009; FEMA, 2016).

International literature indicates that there are several of countries that have introduced methods to 'design out' hazards and risk during the very early stages of a project. Designing out risk is cited as one of the most effective means of preventing the losses experienced in construction, and is associated with a range of opportunities for application. The initial literature review indicates that current research is focused on reducing risk during design, specific stakeholders and their impact on H&S within the built environment (Schulte *et al*, 2008; Gambatese, 2013).

Procurement is a discipline through which the construction industry procures its services, materials, and suppliers (Tukuta, Saruchera, 2015). Procurement has largely been excluded from construction H&S research as a critical role player, and not considered as influencing H&S in the built environment (Wells and Hawkins, 2010).

The researcher identified the need to investigate the relationships between design, procurement, and construction, relative to H&S, in South Africa. The initial literature survey indicates that H&S is not

addressed uniformly during all stages of the construction life cycle, and H&S Practitioners are not included as a stakeholder in the construction sector. The research would attempt to, *inter alia*:

- Identify any gaps that exist in the construction sector between design, procurement and construction, researching subject matter not previously investigated;
- Determine whether there is a relationship, and the effect is between design, procurement, construction and H&S;
- Develop a model relative to design, procurement, and construction relative to H&S based on an extensive (international, national, and regional) literature review and the results of action research in the form of focus group discussions, and
- Provide stakeholders operating in the sector with ways to further ensure that design, procurement, and construction are integrated relative to H&S.

The conceptual framework relating to the research relating to the identified approach is identified in Figure 1.1 below. The literature review and the conceptual framework outlining the approach are included in the sub-problems (S-Ps'), and hypotheses proposed.

Figure 1.1 Proposed conceptual framework.

1.10 RESEARCH AIM AND OBJECTIVES OF THE STUDY

1.10.1 Research Aim

The aim of the study is to provide evidence to stimulate a multi-disciplinary stakeholder approach within the South African construction sector, to develop a model of design, procurement and construction relative to H&S to contribute to the reduce occupational diseases, fatalities, and injuries in South Africa.

1.10.2 Research Objectives

The research objectives were achieved using mixed methods. Following a survey of relevant national and international literature, the quantitative and qualitative approaches will be adopted for the empirical study. The qualitative approach to achieve the aim and objectives is as follows:

- Action research using focus groups among construction stakeholders to determine the procurement practices at provincial and district levels of a public entity;
- To identify existing national and international models and the relevance of developing a model relative to the South African context;
- To determine outcomes and recommendations from stakeholders, and
- To develop a South African model, including the validation of the model through the engagement of stakeholders that include clients, designers, procurement, contractors, and H&S practitioners.

The quantitative approach to achieve the aim and objectives includes:

- The use of questionnaires among stakeholders practicing in the sector that are based on the survey of the literature, and
- To determine current practices, perceptions, and aspects as they relate to the diverse stakeholders and affect the industry.

1.11 THE IMPORTANCE OF THE STUDY

The paucity of H&S research and knowledge relative to the integration of design, procurement, and construction in South Africa and internationally is significant. Therefore, the examination of these

relationships is significant to government, and the built environment. The role of procurement and how it affects H&S has not been previously considered, or researched in South Africa. International literature surveyed for the study indicates strong relationships between the role and effect of design and construction, relative to H&S.

The public sector has SCM and procurement duties to ensure statutory compliance with the National Treasury requirements, as well as the OHSA. Using the conclusions and recommendations emanating from the study, National Treasury, as a leading Government stakeholder, could significantly influence the appropriate level of risk reduction that includes H&S, by competent stakeholders. The development of a model from the findings of the study would expedite better practice H&S in terms of the integral life cycle approach, SCM, and the built environment. The aforementioned should be an imperative by clients, and BEPs, to limit the potential project risk that could realise a reduction of occupational diseases, fatalities and injuries to workers.

The study is therefore deemed to add significantly to the research body of knowledge.

1.12 THE SUB-PROBLEMS

The statement of the problem introduced the S-Ps' that relate to the research. The S-Ps' identified originate from a combination of the researcher's extensive experience working in the sector, and a survey of South African and international literature.

Construction stakeholders are required to adhere to the minimum standards that are set out in the OHSA and its Regulations. H&S stakeholder involvement is required from such statutory requirements. H&S risk reduction through adequate resourcing and competent stakeholders are further statutory requirements. Contractors are required to provide competent leadership, training, and meet statutory requirements (RSA, 2014).

Procurement and SCM requirements required by National Treasury stipulate the requirements that apply, and that need to be followed in all public-sector projects.

Built environment professionals (BEPs) stipulate the designs, materials and broad methodology to be used during the construction process. BEPs' include, *inter alia*, architects, engineers, quantity

surveyors. The proposals by the BEPs' regarding designs, materials and costs are generally accepted by clients along with the complexity and risk that are related to the project.

The S-Ps' are listed as follows:

1. Contractors are exposed to hazards that could have been mitigated during design;
2. Contractors lack the necessary resources for H&S during construction;
3. Workers are injured, become ill and often fatally injured at work, and
4. Stakeholders do not comply with statutory and contractual H&S requirements.

1.13 THE HYPOTHESES

The hypotheses selected for the research expand on the S-Ps', and include the stakeholders and the areas of inaction or action that the research will test. The hypotheses considered that are deemed to relate to the S-Ps' are listed as follows:

1.13.1 Hypothesis 1:

1.1 Many hazards encountered during construction could be mitigated through design HIRAs;
1.2 Designers do not conduct effective design HIRAs resulting in the non-mitigation of hazards;
1.3 CHSAs' do not conduct effective design HIRAs resulting in the non-mitigation of hazards;
1.4 CHSAs' lack 'designing for construction H&S' competencies;
1.5 CHSAs' are generally not involved in the pre-construction stages (stages 1-3), and
1.6 H&S Specifications, design reports, and 'final' H&S specifications generally do not schedule 'residual' risk.

1.13.2 Hypothesis 2:

2.1 Lack of resources for H&S experienced during construction is attributable to a lack of H&S involvement during the preparation of tender documentation;
2.2 Lack of resources for H&S experienced during construction are attributable to ineffective construction project management, and
2.3 Contractors do not have the internal H&S competencies to determine H&S needs during construction.

1.13.3 Hypothesis 3:

3.1 Contractors' non-compliance with statutory and contractual H&S requirements results in workers being injured, becoming ill, or being fatally injured at work;

3.2 Stakeholders' non-compliance with statutory and contractual H&S requirements results in workers being injured, becoming ill, or being fatally injured at work, and

3.3 The exclusion of appropriate H&S information through the project life cycle increases project non-compliance with statutory and contractual H&S requirements and results in workers being injured, becoming ill, or being fatally injured at work.

1.13.4 Hypothesis 4:

4.1 Stakeholders' non-compliance with statutory and contractual H&S requirements is attributable to a poor H&S culture;

4.2 Stakeholders' non-compliance with statutory and contractual H&S requirements is attributable to inadequate H&S competencies;

4.3 H&S practitioners' statutory compliance is dependent upon planning and communication by the client and designers;

4.4 H&S practitioners' non-fulfilment of their statutory roles is attributable to inadequate related H&S competencies;

4.5 CHSO and CHSM participation and contributions are limited due to contractors' appointment practices, and

4.6 CHSO and CHSM involvement across stages 4-6 is limited due to lack of construction management competencies and exclusion from the management of the construction process.

1.14 THE DELIMITATIONS OF THE STUDY

The study was limited to the participation of the Eastern Cape Department of Roads and Public Works (ECDRPW) as a client, at Provincial and District levels. The study aimed to include a range of BEPs', including SCM, contractors, stakeholders, H&S disciplines, and other groups where identified.

1.15 THE ASSUMPTIONS MADE

The assumptions link the aims, objectives, S-Ps' and hypotheses. The assumptions relating to the research include that:

- The integration of H&S in design, procurement, and construction is possible;
- H&S non-compliance occurs;
- Stakeholders' inadequate H&S knowledge affects the provision of resources and competent H&S stakeholders at the appropriate levels of a project;
- The lack of knowledge relating to construction processes and practice among those practicing H&S increases project risk;
- The lack of resources impacts on the risk to workers;
- The lack of resources negatively impacts on the rates of occupational diseases, fatalities and injuries, and
- There are CHSAs', CHSOs', and CHSMs' in the construction sector.

1.16 SUMMARY

Chapter one has provided an outline of the problem and its setting, and discussed the importance of the study relative to the construction H&S body of knowledge.

Aspects such as acronyms, and definition of terms, to ensure standardisation are included. The sub-problems, the related hypotheses, the assumptions, the significance of the study, and the aim and objectives are addressed.

Chapter two presents the review of the literature appropriate for the study and the aspects that are addressed in both the qualitative and quantitative studies

CHAPTER 2: THE REVIEW OF RELATED LITERATURE

2.1 FOREWORD

"*Improving occupational safety and health in the construction industry is a slow but achievable process*" (Neale, 2013). Neale (2013) further states that the United Kingdom took 40 years to improve H&S on site, and asks the question: "How can African countries make such a transition?" The literature review on the issue of construction H&S for this research identified the broad range of areas on the built environment in its broader context in South Africa. The literature review considers South African, and international literature, standards and practices.

2.2 INTRODUCTION

No research is complete without knowing or determining what has transpired before. The literature review assists with finding literature related to the research and ensures thorough knowledge of the subject and the research problem. Literature informs researchers of what is known, but more importantly, what is not known, and therefore what still needs to be determined (Creswell, 2003).

Objectives that should be accomplished during a literature review include the broad context of the research, clearly demarcating the scope and the justification of the investigation. A range of sources of literature, such as conference proceedings, journal papers, books and open source publications further informs popular areas of research, which in turn adds value to the research. The presentation of the literature relevant to the area of research indicates the wide range of information that is available, through robust research. A substantive, thorough and sophisticated literature review is a pre-condition for an adequate outcome, as the researcher needs to understand the literature available (Creswell, 2003; Boot and Beile, 2005; Leedy and Ormrod, 2014).

Research could be considered as a 'voyage of discovery', whether anything is discovered or not. A PhD is work that should make an original contribution to the related body of knowledge. The research overall should be worth the time and effort; however, data are transient in nature, volatile and may evaporate quickly (Fellows and Liu, 2003; Leedy and Ormrod, 2014).

Each area of literature that is included is deemed relevant, especially given the paucity of literature available over the broad and important nature of the research presented.

2.3 HEALTH AND SAFETY IN CONSTRUCTION: THE SOUTH AFRICAN PERSPECTIVE AND PRACTICES

The Republic of South Africa is a member country of the ILO, and is therefore compelled to comply with its conventions and ratifications (Hughes and Ferrett, 2013). Section 24 of the Bill of Rights of the Constitution of South Africa states that those living and working have the right to an environment that is not harmful to the health or well-being (RSA, 1996; cidb, 2009).

The OHSA and Regulations have been developed over the years in line with the ILO requirements and are entrenched in Section 24 of the Constitution. However, the poor statistics relevant to the sector appear to indicate there are clearly issues. Issues have been noted relative to the poor culture of the sector on the part of contractors, as well as the lack of knowledge of designers and clients (cidb, 2009).

The CR's were originally published in 2003, and amended in 2014. There appears to be some thought that the level of compliance has improved since the promulgation of the initial CR's in 2003 (cidb, 2009). The DoL approach to date has been to introduce legislation to limit loss in areas where industry does not comply. The approach cannot be deemed optimum. The industry perception, and research indicates that irrespective of what the DoL does, nothing will be done to bring those responsible to book and be charged is some manner (Geminiani, 2008; cidb, 2009; du Toit, 2012).

2.4 ACCIDENT AND INCIDENT STATISTICS IN SOUTH AFRICA

Any injury or disease that occurs as a result of completing a task, or repeated work over a career is not acceptable. South Africa has had tragic accidents, with high numbers of fatalities over the past few years. In 2009, the cidb reported that the sector had the third highest number of fatalities per 100 000 workers among all industries; and that workers were six times more likely to die at work (cidb, 2009; Windapo and Oladapo, 2012; Musonda, Pretorius and Haupt, 2013).

During an address by the Deputy Minister of the DoL, who discussed the statistics for the period 2012 – 2013, 230 fatalities, 780 non-fatals, and 12 major incidents were cited. The Deputy Minister further stated that if workers had a choice, it was not to go anywhere near a construction site, due to the risk, and that they are driven to work through sheer desperation (Furter, 2014). Smallwood (2013) reports that the construction industry fatality rate is 25.5 /100 000 full time workers. In contrast, the cost of accidents is estimated at approximately 5% of the value of completed construction. The irony is that literature indicates that the cost of implementing H&S is estimated to be between 0.5% and 3% of project cost, and that the cost of accidents, which contributes to the cost of construction, is ultimately paid for by clients (Smallwood, 2013).

Registration with the Compensation Commissioner in terms of the Compensation for Occupational Injuries and Diseases Act (COIDA), No. 130 of 1993, is compulsory, as is it is of the OHSA, and all Regulations, national and international codes of practice (RSA, 1993(a); RSA, 1993(b); RSA, 2014). The Compensation Commissioner, responsible for the management of work related injuries and diseases, has not published statistics since 1999 (cidb, 2009). The Federated Employers Mutual Association (FEMA) is a mutual insurer for the construction sector. FEMA insures approximately 50% of the construction sector, with ‘membership' rates varying year on year. The remainder are registered with the Compensation Commissioner. Current statistics recorded by FEMA (2016) indicate that overall injury rates remain unacceptably high, as indicated in Table 2.1.

Table 2.1 presents the types of accidents in terms of the percentage of total injuries reported for the years 2011 to 2014. Of concern are the significant percentage of ‘Caught in, on, between’; ‘Fall on to different levels’; ‘Fall on to same level’, and ‘Slip or over-exertion’, ‘Contact with temperature extremes’; ‘Inhalation, absorption, ingestion’, and ‘Striking against’ and motor vehicle accidents (MVAs) (FEMA, 2016).

Table 2.1 Percentage (%) of injuries by type (FEMA, 2016).

Type	2011	2012	2013	2014
Caught in, on, between	6.60	7.48	6.71	6.95
Contact with electric current	0.41	0.41	0.44	0.47
Contact with temp extremes	1.32	1.23	1.45	1.35
Fall on to different levels	12.14	12.27	11.35	12.33
Fall on to same level	4.42	3.70	3.94	3.80
Inhalation, absorption, ingestion	0.98	0.78	1.59	1.06
Motor vehicle accident	12.01	12.08	12.43	10.35
Slip or over-exertion	8.96	9.63	10.23	11.43
Striking against	10.95	10.87	9.31	10.20
Struck by	40.65	40.00	40.69	39.37
Unclassified-not sufficient Data	0.06	0.10	0.07	0.04

Table 2.2 indicates that the accident frequency rate (AFR) for the years 2011 to 2014, has reduced marginally (FEMA, 2016).

Table 2.2 Accident Frequency Rates (AFR) for the period 2011-2014 (FEMA, 2016).

Year	2011	2012	2013	2014
AFR	2.84	2.69	2.66	2.51

The use of legislation as a means of promoting H&S would appear to not have been entirely successful, given the costs noted. H&S is therefore deemed to be best promoted in terms of the financial benefits related thereto. Research conducted by du Toit (2012) cites Geminiani (2008), whose research determined that the custodian of H&S in South Africa, the DoL, is under-resourced in every sense. Comments regarding the effectiveness of the DoL Inspectorate, as recorded by respondent construction H&S consultants include, *inter alia* (cidb, 2009):

- "*Under-staffed, very little skills, untrained, little authority, and little knowledge";*
- *"The Regional Office has become totally ineffective due to all the expertise having left";*
- *"More reactive than proactive",* and
- "*Skills, knowledge and competency non-existent."*

Comments in the same report, from designers, included:

- "DoL have no idea of what dangers can be encountered on a construction site. They do not identify a real danger staring them in the face";
- "Hopelessly understaffed and not enough resources", and
- "They don't contact *us, neither do we."*

Students of H&S are taught that an accident is defined as "an unplanned event that results in injury, ill health, property, plant, material, or environmental loss or damage." Opportunistic loss is included as it relates to business (Zou and Sunindijo, 2015). According to definition, an 'incident' or 'near miss' is an event or opportunity that had the potential to have been an accident or an opportunity for loss. Two main researchers have been largely influential in assessing the ratios between accidents and incidents. Researchers, Heinrich and Bird's studies are deemed seminal work and have been the basis for many of the approaches toward risk management over the past decades. Heinrich published a model in 1950, indicating that for every 300 near misses, there are likely to be 30 minor accidents, and 1 major incident. Bird published a model in 1969, commonly known as the 'Bird Accident Triangle'. The figures shown in Bird's triangle indicate that for every 600 near miss accidents, there are likely to be 30 damage accidents, 10 minor injuries, and 1 serious or disabling injury (Hughes and Ferrett, 2013).

The causal relationship between exposure, incidents and accidents is complex and the human element is believed to be a major contributing factor (du Toit, 2012). Given the definition of accidents taught to students, and the seminal research findings of Heinrich and Bird, and that there are clearly indications of unsafe conditions or behaviour leading to near misses or damage accidents, it is highly unlikely that accidents are unplanned, rather than planned as so many have been taught (Hughes and Ferrett, 2013).

2.5 THE COST OF ACCIDENTS AND HEALTH AND SAFETY

While the cost of accidents (CoA) is not the focus of the research, the CoA does need to be included. Efforts continue to be made to improve H&S across the world, however, several barriers remain. Profit margins and H&S investments, or costs because of H&S expenditure have been noted as expensive and used to mainly avoid statutory fines. Project spend is more likely to be based on the more general project objectives, such as cost, quality, and time. Any investment related to H&S is perceived as none, or low return on such investment (Zou and Sunindijo, 2015).

Goldswain (2014) states that the results of accidents and resultant losses are counteractive in terms of economics. Accidents inflate the cost that is borne by the client, both directly and indirectly. Windapo (2013) reports on the findings of research relating to contractors' perceptions of cost of H&S compliance and risk. The research indicated that compliance with H&S statutory requirements is significantly related to perceived cost savings and the degree of risk. Compliance is often seen as an unnecessary cost, and time consuming, and contractors perceive that the greater the level of compliance required, the more expensive H&S becomes. Heinrich, classified accident costs into direct and indirect costs in the 1930's (Zou and Sunindijo, 2015). Direct costs relate to the CoA, as a form of insurance; whereas indirect costs are those non-recoverable costs relating to down time, loss of productivity, training and the hire of new workers, sick pay, damage to buildings or equipment, administrative costs of management, and other opportunistic costs (The Hazard Information Foundation, Inc. (HIFI), 2008; cidb, 2009; du Toit, 2012; Emuze and Smallwood, 2012; Windapo, 2013; Goldswain, 2014; Zou and Sunindijo, 2015).

There is a paucity of literature relating to the cost of including H&S in projects in South Africa. International comparisons suggest that the CoA (indirect costs) in the USA is approximately 6.5%, and in the UK approximately 8.5%. In South Africa, initial research conducted by Smallwood (2004) indicates the cost of H&S to be between 3% and 5%. An interesting note cited by du Toit (2012) relates to the fact that a low accident or ill-health rate, even over an extended period is no guarantee that risks are being managed or controlled, or a guarantee fewer accidents in the future.

The direct costs relative to accidents contribute approximately 27% and indirect costs 73%, which amounts to approximately 2% of the R3.5 billion attributed to the value of construction in South Africa (cidb, 2009; Goldswain, 2014). The actual CoA is deemed to be 5% of the value of construction costs in South Africa. Unfortunately, historical records of occupational diseases are deceptive indicators, and therefore not reliable (cidb, 2009; du Toit, 2012; Emuze and Smallwood, 2012).

Zou and Sunindijo (2015) discuss attempts to calculate the social CoA's in terms of the impact on related families and communities. To consider the total emotional and psychological cost experienced by family and communities following the loss of a family member is almost impossible. A review of data pertaining to 1414 accident data on 119 projects, identified that the social costs for the years 1999-2001 were US$101million; US$69.5million, and US$49.7million, respectively. The significant finding was the estimation of return on investment (ROI) relating to resourcing H&S of US$1:US$2.27 (Zou and Sunindijo, 2015).

Wells and Hawkins (2010) report that the system of 'Pay for Safety' reported on in Hong Kong allowed 2% of project value for small projects and 1% for large projects in terms of H&S allowed in the BoQ. In Australia, the cost of injury and illness at work during 2008-09 was approximately 4.8% of gross domestic product (GDP), which equated to 60.6$billion. The construction sector accounts for 10.6% of the total cost of GDP. Studies have attempted to determine the ratio between the indirect and indirect COAs (Wells and Hawkins, 2010).

The HIFI (2008) states that historically, the value of goods and services is not just based on value, but on people. Given the value of people therefore, H&S becomes an economic issue, as, if project funding is not provided for prevention, there could be indirect post injury consequences. Further to the , where H&S is not integrated, H&S concerns only arise post an occurrence, and possibly labelled as having a high cost aspect, or as an impediment to profit. Unfortunately, H&S only becomes an issue when workers are injured, or die because of their injuries. in many instances H&S standards are usually developed after an egregious time lag, and with delays until the 'dots' are connected between the hazardous condition and the form of injury experienced (HIFI, 2008).

2.6 HEALTH AND SAFETY IN CONSTRUCTION, A GLOBAL PERSPECTIVE

Developed countries appear to have well-developed and established legal systems applied in the construction sector. In contrast, the H&S standards and systems in developing countries vary, and workers are deemed at greater risk of being seriously, or fatally injured. Despite all the efforts, systems and legislation, statistics remain at alarming levels, irrespective of the status, and whether countries are deemed developed or undeveloped (Rowlinson 2004; Murray, 2004; Wells and Hawkins, 2010; Yi Man Li and Wah Poon, 2013; Olutuase, 2014).

Olutuase (2014) notes the irony of H&S issues, and states that the causes of accidents are mostly known, are largely preventable and able to be dealt with as much as any other business practice in an organisation, irrespective of whether the country is regarded as developing or not. Chiocha, Smallwood and Emuze (2011) indicate a range of common issues in Botswana, Egypt, Malawi, Nigeria, and South Africa. Commonalities among countries include aspects such as clients not supporting H&S initiatives, H&S priorities are at a very low level in comparison to those of developed countries, there is inadequate enforcement, and inconsistently, tools and equipment are used unsafely, and female workers are at an increased risk.

The International Network of Safety and Health Practitioner Organisations (INSHPO) is a global alliance of H&S organisations that provides international standards for H&S professionals and determines a global body of knowledge and core competencies for practitioners (INSHPO, 2015). Migratory practices, distribution of products and H&S services are noted by INSHPO (2015) as being global in scope.

The global perspective of H&S commences with the Africa and Asia Pacific perspective, and then the major first world countries, the UK, Australia, New Zealand, the USA, and Canada.

2.6.1 Botswana

The ILO (2013) cites a range of H&S legislation relating to industry, that includes applicability to the construction sector. Statistics Botswana indicate that the construction sector employed 23 200 people in 2010, constituting 6.2% of the formal sector. The fatality rate of 0.26 per 1 000 is the highest among all sectors, and the compensation rate five times greater than other sectors. However, it is noted that as with other developing countries, comprehensive information is lacking (Tau and Seoke, 2013).

Research conducted by Musonda and Haupt (2009), among designers practicing in Botswana, indicated that H&S was not a top priority and not particularly motivated to incorporate H&S in their designs to mitigate risk. Stakeholder requirements do not appear in briefs given to incorporate H&S.

2.6.2 Egypt

No reference or link could be made to construction H&S in Egypt. Labour laws identifying H&S provisions do exist, however, but appear to be poor. Employers are not required to train employees or keep accident records. Employees have limited rights, and small businesses do not need to keep accident records. No inspections by H&S Officers are undertaken, and consequences following accidents are arbitrary and deemed inadequate (Yi Man Li and Wah Poon, 2013).

2.6.3 Ghana

H&S administration in the Ghanaian construction sector has multiple ministerial departments. H&S regulations are piecemeal and scattered haphazardly through various pieces of legislation. There are two major institutes responsible for H&S and welfare administration under the Ministry of Manpower Development and Employment. General aspects, such as workplace inspections, surveys, and registration construction sites, actively promoting H&S through various levels of training (Kheni, Gibb and Dainty, 2006; Yi Man Li and Wah Poon,2013; Annan, Addai and Tulashie, 2015)). Statutes appear to be inconsistently developed and have resulted in poor management and implementation of H&S legislation. Kheni *et al* (2006) and Chochoa *et al* (2011) cite the lack of governmental commitment exemplified by logistical constraints that face many departments in carrying out their mandate of H&S responsibility.

2.6.4 Kenya

Comments regarding the state of H&S in Kenya by the Minister of Labour include that globalisation affects business, and H&S culture should be entrenched in the country for businesses; to increase productivity, and to attract competent workers and investments. Multiple H&S issues exist, which include poor culture, low levels of knowledge, and the poor delivery of services (ILO, 2013).

2.6.5 Kuwait

Labour laws in Kuwait give officials the right to inspect, supervise, and enforce H&S labour laws. Site engineers acting for clients, or their representatives, complete site H&S inspections. In 2005, employees were prohibited from working between 12h00 and 16h00 in summer, which was agreed among stakeholders and included in conditions of contract. The standards are not limited to those of Kuwait, and follow the British Safety Standards, however they do not necessarily reflect

international standards. A range of aspects are cited that are required by stakeholders to reduce accidents (Yi Man Li and Wah Poon, 2013).

2.6.6 Malawi

Chiocha *et al* (2011) express similar sentiments to other authors, in that developing countries have a low level of H&S awareness, implementation, and management commitment to H&S.

The National Construction Industry Act No. 19 of 1996, addresses construction and H&S in Malawi, and established the National Construction Industry Council (NCIC). The NCIC further registers persons engaged in the industry, and coordinates training. Recent research indicates that the failure to manage and implement H&S negatively affect projects relative to leadership, budget, training and H&S responsibility (Chiocha *et al,* 2011).

2.6.7 Mauritius

Mauritius is an ILO member country and has a wide range of legislation. The Health, Safety and Welfare Regulations cover electricity, building and construction legislation (Jauhanger, 2012).

2.6.7.1 Mauritian requirements for Professional Registration of H&S Officers

Mauritius requires that a person practicing as an H&S officer is required to be registered with the Occupational Safety and Health Inspectorate, of the Ministry of Labour. Most H&S Officers are qualified with a Diploma or BSc degree. H&S Officers can work in a sector, governing a maximum of four places of work, with between 100-500 employees. An H&S Officer is required for full time employment in an organisation where there are between 500 and 2 000 employees. Most H&S Officers are members of institutes such as the Occupational Safety and Health Management (IOSHM). IOSHM is a member of the Asia Pacific Occupational Safety Organisation (APOSHO) and has memoranda of understanding with the Korean Occupational Safety Health Agency (KOSHA) and IOSH (UK) (Jauhanger, 2012).

2.6.8 Nigeria

Adeogun and Okafor (2013), Ibudor and Oisamoje (2013) and Olutuase (2014) state that Nigeria has existing H&S legislation, but very few indigenous organisations recognise the importance of H&S. H&S practices therefore are very scant and cited as 'not needed' by some employers. Multi-nationals working in Nigeria are more compliant, as many implement H&S practices of parent organisations. Despite 'imported' H&S systems, contractors still report high numbers of repeated injuries, that include falls from height; being struck by moving vehicles; flying or falling objects, and contact with electricity, to name a few. The weak legal structures and lack of enforcement of H&S measures could be deemed to be one of the reasons the poor accident rates occur and that would not be tolerated in other countries.

Nigeria as a member of the United Nations adopted the conventions of the ILO, and has a Factories Act of 2004, a Workman's Compensation Act (1987) and a Labor, Safety, Health and Welfare Bill of 2012 (Adeogun and Okafor, 2013; Ibudor and Oisamoje, 2013; Olutuase, 2014).

2.6.8.1 Nigerian requirements for Professional Registration of H&S Practitioners

Nigeria registers H&S professionals. The Institute of Safety Professionals of Nigeria Bill of 2011 (ISPON) (Federal Republic of Nigeria, 2011), known as the 'Institute' or ISPON. The institutes objectives deal with training; sets standards of practice and skills, and promote advancements of the profession. ISPON states that members may make H&S recommendations relative to designs in buildings and other structures; conduct H&S audits, provide training, and consultancy work. The Institute does not allow a firm, or person to practice as a professional, unless they have professional registration. Current membership sits at over 5 000 members, and is constituted of, *inter alia*, H&S Managers and Officers, Factory Inspectors, Occupational Hygienists, Engineers, Safety Consultants, the Military and Occupational Health Physicians and Nurses. There are criteria for membership and registration, and a register of those registered is kept and maintained. Classes and grades of membership are also noted for both individual and corporate members. Memoranda of understanding (MOU) exist with the Institute of Safety and Health (IOSH) in Great Britain (GB), have a Charter of the International Association of Safety Professionals (IASP), and are affiliated to the American Society of Safety, Health and Environment (SOITSHA) and are a corporate member of the National Safety Council of America (NSCA).

2.6.9 Tanzania

The Tanzanian construction sector employs approximately 2.9% of workers in the formal sector, and is the fifth largest source of employment. There is little promotion of H&S, cited because of competition among contractors and the drive to complete projects on budget and time, while the H&S performance is noted as being unacceptable. H&S legislation has been streamlined over the past decade and more recently the Contractors Registration Board Act (CRBA) was promulgated in 2010 and the National Construction Council Act, as amended in 2007. The CRBA regulates and develop a competitive and sustainable industry, including contractors observing H&S during project execution. Further legislation relating to Architects and Quantity Surveyors and Engineers Registration Acts require that projects are designed and construction with H&S standards (Matiko, 2013).

2.6.10 Singapore

Singapore Building Operations and Works of Engineering Construction (BOWEC) Regulations list a total of 13 elements, considered good construction H&S systems. The elements noted include the requirement of, *inter alia*: an H&S policy; practices; organisation rules and regulations; control of contractors; inspections; emergency preparedness, and hazard analysis. Legal requirements are scaled relative to value and H&S requirement. An example provided includes the requirement of supplying an H&S safety supervisor for projects worth S$5 million. Projects worth S$10 million are required to provide an H&S plan that outlines the H&S system in use. Procurement practices require at least 10% of the value of construction to be included for H&S, with poor H&S performance negatively approached with limiting the contractor to tendering for public sector work (Wells and Hawkins, 2010; Yi Man Li and Wah Poon, 2013).

2.6.11 Peoples Republic of China

The Administrative Regulations, in the Work Safety of Construction Projects, in the People's Republic of China (PRC) regulates H&S in construction. H&S responsibilities of contractors (owner, supervisors, the designer, and stakeholders), H&S systems management, H&S staff, and employee training, assists in ensuring hazard identification, and analysis. Workers compensation is also required to assist those injured at work. Further legislation requires site inspections, and the use of photographic evidence for on-line reporting (Yi Man Li and Wah Poon, 2013).

2.6.11.1 Hong Kong

Yi Man Li and Wah Poon (2013) state that accident rates in Hong Kong have reduced significantly over the past few years. While H&S systems and approaches are locally developed, large numbers of systems and technology are imported. Of significance is the use of the Total Quality Management (TQM) Based Safety Management System (SMS), where the goal is a zero-accident rate. The TQM approach has H&S built into the work as it commences, and H&S conformance is required. All employees are required to be involved, and a continuous improvement approach accepted as part of the TQM systems approach. The theory of the TQM based SMS is that all accidents are avoidable (Yi Man Li and Wah Poon, 2013).

2.6.12 Australia

Yi Man Li and Wah Poon (2013) state that improvements in H&S standards within an organisational context is an important global concern. Coupled with the challenge of achieving high levels of productivity with simultaneous H&S improvement, is noted as difficult.

Legislation relative to construction H&S exists across many countries around the world. The Building and Construction Industry Improvement Act, 2005 used in Australia, stipulates the inclusion of H&S measures. Each of the states in Australia has unique H&S requirements included in their regulations, which focus on a preventative approach. A requirement specific to New South Wales is that of worker involvement (Yi Man Li and Wah Poon, 2013).

2.6.13 New Zealand

The Health and Safety in Employment Act introduced in New Zealand in 1993, provided for a comprehensive approach to managing H&S in all workplaces.

Guidelines for the provision of Facilities and General Safety in the Construction Industry were promulgated in 1995. The guidelines provide information relating to compliance, to principals, employers and employees. The guidelines further refer to legislation, and are themselves based partly on standards used in earlier legislation, and accepted good or best practice. References are also provided to assist users with resources that link to Regulations. The guidelines are aimed at employers, or those who are undertaking construction work, however exclude H&S roles and responsibilities of clients or designers (Council New Zealand Construction Industry (CNZZCI), 2006).

2.6.14 Great Britain (GB)

The Health and Safety at Work Act (1974) governs the H&S of workers within Great Britain. The Construction Design and Management (CDM) Regulations (CDMRs) were introduced in 2007, and since then, there have been two further revisions, most recently in 2015, each building further on the design role of stakeholders and over the construction life cycle (HSE, 2015).

The CDMR 2015 require duty holders to ensure there is compliance across all activities, through the construction life cycle. The key elements noted include, *inter alia*:

- Managing the risks by applying the general principles of prevention;
- Appointment of the right people and organisations at the appropriate time;
- Ensuring adequate information, instruction, training and supervision needed to ensure their work can be done without risk to their health and safety;
- Duty holders co-operating, communicating and coordinating their work, and
- Consulting and engaging workers to promote and develop the effective measures required to secure health, safety and their welfare (HSE, 2015).

It is clear from the CDMR 2015, that the client is accountable for the outcome or impact of their decisions relative to H&S, including that of the workers' welfare. The accountability remains whether a BEP or not, and ensures that the client take into account the complexity of the project and the risks involved. Designers and contractors have corresponding duties to ensure the implementation of the CDMR 2015. The H&S coordination role has always been fulfilled by the CDM co-ordinator, who could have been a construction H&S professional, but in terms of the CDMR 2015, this is now the responsibility of the principal designer. The other significant aspect noted is the clear responsibilities of all parties, being the client, designer, and PC relative to the pre-construction and construction stages (HSE, 2015).

2.6.14.1 Professional Registration of H&S Practitioners in GB

The Institute of Safety and Health (IoSH) is one of the bodies that are responsible for the registration of H&S practitioners in GB. However, IoSH is not limited to the construction sector and registers across all industries. Those working in the construction sector have interest groups and are encouraged to meet regularly (IoSH, 2015).

2.6.15 Ireland

The Republic of Ireland (RoI) has the Safety Health and Welfare at Work (Construction) Regulations 2013 (RoI, 2013). The Regulations *"apply to construction projects that include the alteration, decoration, maintenance and repair of buildings and the installation, maintenance and removal of mechanical and other systems fixed within or to structures."* The Regulations place obligations on clients and designers to ensure H&S is considered before any construction work commences.

2.6.16 United States of America (USA)

The Occupational Safety and Health Act (OSHA) of 1970 is the core H&S legislation in the United States of America (USA). The Regulations for construction are extensive and prescriptive. Standard interpretations exist for each section of the regulations, linked to queries from institutions or the public.

The National Institute of Safety and Health (NIOSH) (2009) describes the construction sector as having four distinct sectors, namely residential, commercial, industrial and heavy with each having specialist trade contractors in each sector. Systems in place to track injury rates indicate that there has been a reduction in fatalities and injuries across the sector. Extensive research into the sector is evident, with industry participating, and relatively good compliance to H&S legislation in general practice.

2.6.16.1 Professional Registration of H&S Practitioners in the USA

The Board of Certified Safety Professionals (BCSP) is an organisation that registers professionals practicing H&S for more than 50% of their duties. Duties of the Certified Safety Professionals (CSPs) include, *inter alia*, conducting worksite risk assessments, evaluating, assessing hazards and controls, accident investigations, record keeping, training, and providing management advice.

The BCSP candidates are required to have a minimum of a Bachelor's degree, and a minimum of four years of appropriate experience. There are many BCSP approved credentials, relating to associates, graduates, occupational hygienists, including recognition of international organisations such as IOSH, Canadian Registered Safety Professionals (CRSPs), including from Singapore and India (BCSP, 2014).

2.6.17 Canada

Canadian H&S legislation differs across 14 jurisdictions that include one Federal, ten Provincial, and three Territorial areas. Each area has its own H&S legislation. The Canadian Centre for Occupational Health and Safety (CCOHS) based in Ontario was approached, and only their legislation has been used.

The Canadian Occupational Health and Safety Act, Revised Statute of Ontario (RSO), 1990, c. 0.1 governs the practice of H&S that covers general practices, and requirements around compliance. The Ontario Regulation 213/91 for Construction Projects (1991) as amended, covers the requirements when working in construction, and appears quite prescriptive in its detail (Ms W Howe, personal correspondence, 2015). Amendments were made to the Construction Project Regulations in November 2015 that focused on drill rigs and training, strengthening fall protection measures, and hazardous chemical exposure, both biological and chemical (Ministry of Labour (MoL), 2015).

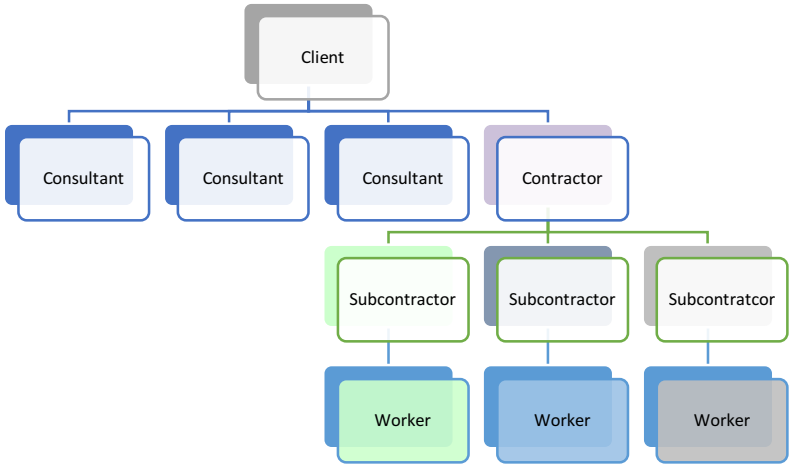
2.6.17.1 Professional Registration of H&S Practitioners in Canada

Canada has a certification process through the Board for Canadian Registered Safety Professionals (BCRSPs). Certified persons cover a cross section of industry sectors, however, while not compulsory, employers are increasingly looking for employees who are certified. The certification process verifies education, knowledge and development, using examinations as the final process. The registration is transferrable between the USA and GB. According to the CCOHS, Ms Wanda Howe (personal correspondence, 2015), on enquiring about their standards stated: "*There are no laws in Canada that we are aware of which require employers to hire certified safety professionals to act as their health and safety representatives. Each company and organisation is free to select whomever they wish to be their safety representative; however, hiring someone with a safety certificate or degree is in the interest of the company and its employees. More and more, companies are hiring individuals with the CRSP certification and/or other similar health and safety education and experience.*"

2.7 THE DEVELOPMENT OF THE CONSTRUCTION DISCIPLINE

"*To build is to be robbed*", Johnson's edict written in the 18th century is still thought to carry weight in the modern age (Heath, 2004). In previous centuries, it was the 'master builder' who was responsible for a project through its life cycle, fulfilling the role of architect, engineer, contractor, and construction manager (CM), in terms of current definitions (Gambatese, 1998). Figure 2.1 illustrates the gradual and current segmentation of the disciplines required to work towards the goal of competing a project on time, and cost effectively for the client. The boundaries between design and construction, and the borders around designers and contractors, outline the scope of their work and delineate responsibility. Each discipline shoulders the responsibilities of the realm of knowledge within the established borders set by the professional bodies (Gambatese, 1998; Gambatese, 2013).

Figure 2.1 The design-bid-build system of construction (Gambatese, 2013).



The effect of the design-bid-build system essentially transfers liability to the contractor, and all responsibility for worker H&S. Historically the design professions did not address construction stage H&S, nor were designers trained in doing so. Designers further believed that they did not have the authority or were in the position to dictate site activities. Professional inattention of transferring risk was supported by legal advisors, to limit designers' liability and exposure (Gambatese, 1998; Gambatese, 2013). The maintenance and regulation of H&S on construction sites is problematic due to each type of work to be completed presents a range of hazards and solutions (Tau and Seoke, 2013).

Construction work is further noted as being dynamic, complex, diverse, and highly specialised. Figure 2.1 further illustrates a form of project relationship or system of project delivery, namely design-bid-build, widely used in South Africa (Gambatese, 2013).

Gambatese (1998) reports an increased realisation among professionals and contractors regarding the need for all parties to work together, rather than independently. However, the nature of contracting has resulted in highly specialised, layered and interlocking interests, and traditions. One of the common forms of traditions is the diverse and fragmented practice of subcontracting (cidb, 2009). The Latham Report (1994) published in the UK, along with the Egan Report (completed in 1998), painted a picture of distrust, poor culture and conflict among client, contractors, designers and the construction teams themselves (Heath, 2004; Murray, 2004). In many cases legislative compliance in terms of H&S is minimal on the part of client and designers, as the perception is that it is not their concern, but that of contractors (Murray (2004).

2.8 BUILDING AND CIVIL ENGINEERING WORKS

Two distinctive categories of specialisation developed over time within the industry, namely building and civil engineering works. In many countries, civil and building work is generally equal in spread between the two, however, during periods of development, the percentage of civil engineering projects increases (Rowlinson, 2004). The term ‘contracting’ refers to the common term in the industry relating to ‘subcontractors’. With respect to this research, the term ‘contracting’ will be used, as this is the definition used in the CR’s (2014) (RSA, 2014). Contractors function in a unique way relative to conventional industry, with site functions operating independently. As a result, there is generally a great deal of decentralisation, and decision making at site level. It is not unusual to have extensive multi-layering of contracting, with a contractor hiring one or more other contractors to undertake their work, and the hired contractor to take on further contractors. The practice is noted in Figure 2.1, but may have further layers of contractors than those noted. The dynamic nature of construction means that the site is continually evolving, with new tasks and new workers constantly arriving is noted by Tau and Seoke (2013). Gambatese (2013) states that the issue of site H&S is often not addressed until construction commences. The traditional process followed is to design the product (the structure) and the process (for example, construction methods, and materials) sequentially. Because of the sequential progression there is limited, if any, opportunity to modify design, and therefore any opportunity to optimise the process is lost. Contractors are therefore left with only a few options to mitigate risk in

the hierarchy of controls, namely warnings, training, and the provision of personal protective equipment (PPE).

The cidb (2009) cites anecdotal evidence that indicates that medium to large contractors working on their contracts tend to pay greater attention to H&S than smaller contractors do. One of the possible reasons for the increased risk is the size of contractors. Often the size of the contractor is small, compared to the total size of the project, which means reduced resources and facilities that in turn impact on H&S. Small, Medium and Micro Enterprises (SMMEs), who generally constitute most of the contractors, are unable to adequately train and educate their workers, which over time, has resulted in skills shortages.

Further consequences of shortages impact on performance in terms of productivity and quality, which is likely to affect H&S on site. SMMEs will work on a site for a brief period, before moving onto another project (Rowlinson, 2004; Tau and Seoke, 2013).

2.8.1 Construction Stages

There are many processes involved in a typical construction project, which may include H&S aspects. Murray (2004) simplifies the processes broadly as follows:

- Conception: The project owner defines the scope of requirements, and may include a preliminary feasibility study;
- Design: The scope is translated into a preliminary design, and then detailed design by a professional design team;
- Call for tenders: Following possible further feasibility studies, the tender documents may be prepared, that include a Bill of Quantities (BoQ) that may be priced, and include environmental and H&S considerations to some extent (often noted as just a token statement);
- Tender preparation: Contractors focus on planning, and scheduling or programming to achieve competitive pricing given that most contract awards are based on the lowest price. Labour and materials costs are common to all tenders, and the only advantage to be gained is through creative planning and programming. Sums will be included in the preliminary and general section of the BoQ to cover essential items, and where basic H&S requirements could be included. However, the focus is on the ‘golden triangle’ of cost, quality, and time related to construction performance;

- Construction planning: On award of the contract the tender plan is detailed and developed into a programme, and used as a guide during actual construction, and
- Construction execution: Most often it is only during the execution of the works that H&S issues are really addressed. Induction of workers arriving on the project and issues identified by inspection are most common.

2.9 THE PROJECT MANAGEMENT BODY OF KNOWLEDGE AND LIFE CYCLE

Project management (PM) techniques developed during the late 1950's, are currently widely used across most industries, including construction. PM has evolved over the years and is currently known as the 'Project Management Body of Knowledge' (PMBOK) or PMBOK (Murray, 2004; Burke, 2014). The Project Management Institute (PMI) (PMI, 2003) states that the construction sector is unique, with geographical differences, the specialists, communities and the quantity of materials, tools and the need to move such around site. The PMBOK further states that "Projects and project management operate in an environment broader than the project itself." Burke (2014) discusses project life cycle, or project life span, which PM terms are used to divide projects into phases, to produce a distinct result using the PMBOK. Each project phase is sequential, and has characteristics. Each project has a range of stakeholders involved across the phases, which include the client, project manager, and the project team.

Projects are characterised not only by stakeholders, but include the scope of work, schedule, budget, type of procurement system used, resources, risks and quality aspects (Smallwood and Venter, 2002; Watermeyer, 2012; Burke, 2014). According to Tau and Seoke (2013), and Smallwood (2013), the burden of improving construction H&S does not rest on the shoulders of one stakeholder alone. All stakeholders have a role to play in minimising risk in a comprehensive, integrated, and effective systems approach.

2.10 PROCUREMENT

Sir John Egan, in *Accelerating Change*, articulated *"I passionately believe in the importance of tackling the industry's health and safety problems. Pre-planned, well designed projects, where inherently safe processes have been chosen, which are carried out by companies known to be*

competent, with trained work forces, will be safe: they will also be good, predictable projects. If we are to succeed in creating a modern, world-class industry, the culture of the industry must change. It must value and respect its people, learn to work in integrated teams and deliver value for clients' money." (Office of Government Commerce (OGC), 2007),

More recently, the term 'procurement' has been defined in the International Standards Organisation (ISO) 1085-1:2010, which describes the processes, methods, and procedures for the establishment of a procurement system within an organisation that is fair, equitable, transparent, competitive, and cost effective. The standard includes the framework for policy and methods and procedures to be used. Any construction project needs to be delivered on time, within budget and quality requirements that will meet the expectations of the client (Watermeyer, 2012).

Over the past decades, the construction sector has adopted a range of procurement practices, driven largely by economic situation, and expectations around procurement outcomes, as often client expectations are not met (Watermeyer, 2012; Alharthi, Soetanto and Edum-Fotwe, 2014). A variety of procurement systems have been developed and in use, namely:

- Separated procurement;
- Design and build / construct, and
- Partnering (Watermeyer, 2012; Alharthi *et al*, 2014).

Procurement is an important means of achieving organisational goals, with clients continuously striving to assess and improve the efficacy of their procurement activities (Plantinga, Voordijk and Dorée, 2014; Alharthi *et al,* 2014).

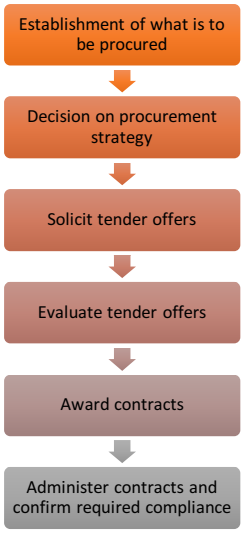
Public procurement has its origins in the fiduciary obligation of government to deliver goods and infrastructure, such as roads, harbours, and services. Procurement further refers to how the government will purchase such goods and services needed to perform its services (Ambe and Badenhorst-Weiss, 2012).

As projects increase in value and complexity, the need for a sound procurement strategy becomes increasingly important and may require third parties (or consultants) to support the need for improved performance. The success of the relationships between the client and consultants depends on the level of mutual understanding between the parties (Alharthi *et al*, 2014).

The development of construction projects is fragmented as each party has its own priorities. The need is thus, for all parties to improve the methods of procurement, as well as ensuring cost based strategies, and the adoption of a systematic and strategic approach. The principles of efficiency, accountability and appropriate transfer of risk are some of the elements required to maximise the value and sustainability of construction activities (Alharthi *et al,* 2014).

Watermeyer (2012) states that a system is 'an established way of doing things', that provides order and a platform for methodical planning, all of which are required to proceed. Systems are underpinned by processes, procedures and methods, and in turn need to be documented, managed and controlled. Auditing is a further requirement to ensure limitation and management of risk and exposure. Figure 2.2 indicates the six basic activities associated with procurement. Standardising the procurement system can be achieved by developing the appropriate sets of procedures and methods that could guide the tender offers and awards of contracts. A variety of standard forms of contract exist, noted in Figure 2.2. The forms of contract include the management of the client's policies, strategies, and procedures.

Figure 2.2 Basic Procurement Activities (Watermeyer, 2012).



2.10.1 Tendering Practices and Forms of Contract

The practice of contracting is noted as having the potential to intensify project risk. The increased risk is because of economic pressure and competitive tendering, where those that take H&S into consideration are penalised due to higher tender pricing (Wells and Hawkins, 2010; Zou and Sunindijo, 2015). Most contracts are awarded through competitive tendering, with the lowest tenderer being awarded the contract (Rowlinson, 2004; Wells and Hawkins, 2010). Rowlinson (2004) states that this form of tendering has been identified as the cause of a vicious cycle of cost cutting and claims generation. Other factors include a negative impact in terms of cost, quality, and time and H&S, with H&S most likely to suffer first due to budget cuts. Furthermore, Wells and Hawkins (2010) state that many contracts make vague and general reference to H&S. However, without clear benchmarks and definitions the terms used such as 'reasonable precautions' tend to be ignored.

The General Conditions of Contract (GCC) (South African Institute of Civil Engineering (SAICE, 2015) and the Joint Building Contracts Committee (JBCC) (JBCC, 2014) were developed in South Africa. Other forms of contract utilised in South Africa include the FIDIC and NEC3 used and developed internationally. The forms of contract noted are in use in both the public and the private sector, and most organisations generally use one form of contract. FIDIC states in their general conditions that the contractor should essentially take reasonable precautions to protect the H&S of workers, while the NEC requires compliance with H&S as stated in the Works Information.

A summary of the sector and H&S references for each form of contract are as outlined in Table 2.3. The 'Standard for Uniformity in Construction Procurement' recommends the use of a range of standard forms of contract to be used in engineering and construction works as listed (RSA, 2008) in Table2.3.

Table 2.3 Forms of contract, related sector and references to H&S compliance (cidb, 2009; Wells and Hawkins, 2010).

Form of contract	Sector	Reference to H&S
General Conditions of Contract (GCC)	Civil Engineering sector	Only requires the Engineer to report accidents
International Federation of Consulting Engineers (FIDIC) (an international form of contract	Building and Civil Engineering sectors	References H&S, but is not aligned with South African legislation
Joint Building Contracts Committee (JBCC) Principal Building or Minor Works Agreement	Building sector	Not explicit, but requires legal compliance with South African legislation and bylaws
NEC3 Engineering and Construction Contracts, as published by the Institution of Civil Engineers	Building and Civil Engineering sectors	Does reference H&S requiring the contractor to adhere to standards included in the Works Information

2.11 SOUTH AFRICAN TREASURY AND PROCUREMENT PRACTICES

There is a daunting level of legislative requirements when dealing with H&S, and then in terms of infrastructure a further range of legislation, including aspects such as the King III Public Sector Guide, as listed hereunder:

- Public Finance Management Act, 1999;
- Government Immovable Asset Management Act (GIAMA), 2007;
- Intergovernmental Relations Framework Act, 2005;
- Construction Industry Development Board Act, 2000;
- Division of Revenue Act;
- Municipal level:
    - Local Government: Municipal Finance Management Act, 2003, and
    - Municipal Systems Act, 2000 (cidb, 2011; Ambe and Badenhorst-Weiss, 2012).

The public sector is responsible for managing the planning and implementation of infrastructure. The Infrastructure Delivery Management System (IDMS) is a model describing the processes that make up public sector infrastructure management (cidb, 2011).

The IDMS applies mainly to the construction sector and outlines the core processes associated with the model for planning, delivery, procurement and maintenance of infrastructure. A Management Toolkit was developed by the cidb to enhance the knowledge and capacity for infrastructure delivery managers responsible for managing the planning and implementation of infrastructure using the IDMS model. Five key areas have been identified for institutionalising the IDMS in provinces that include planning, procurement; implementation; compliance, and capacitation. The IDMS is a thinking tool or model within the public sector, specifically infrastructure personnel who are involved in portfolio management, project management, operations and maintenance. The model is complex, and made up of a multitude of processes or layers. The layers include the delivery elements, processes, delivery gates, milestones, performance management processes, and triggers (cidb, 2012). The cidb (2012) further defines the methodology as "*a description of what to do to achieve a specific outcome."*

A work breakdown structure includes the phases, activities, and tasks with clear descriptions of the deliverables and responsibilities that are associated with each task. Ultimately, the cidb (2012) states that there are two main factors that influence the infrastructure methodologies that each project goes through a design stage, and the need to procure professional service providers (PSPs), and / or contractors. The cidb (2012) states that a construction procurement strategy is a combination of a delivery management strategy, contracting and procurement. Many critical success factors are noted in the IDMS that includes a range of aspects such as consistency with standards, management, synergy, and delivery. The current procurement system requires three bid committees that include a bid specification committee (BSC), a bid evaluation committee (BEC), and a bid adjudication committee (BAC). External stakeholder involvement in the procurement processes is understood to minimise unethical and corrupt processes and waste of public finances (Ambe and Badenhorst-Weiss, 2012; cidb, 2012).

2.11.1 The IDMS Gateway System

A 'gate' is a control point in the infrastructure life cycle that requires a decision before progressing to the next stage (cidb, 2012). Known as the Infrastructure Gateway System (IGS), or 'Gateway reviews', the gates or control points were introduced by the cidb to improve the IDMS's efficiencies. Many control points or gates are included in the infrastructure life cycle where decisions are needed prior to being able to move to the next stage. An IGS review team would be involved in the review at various stages and supply critical information relative to the project (cidb, 2010(a); cidb, 2012).

The methodology for each project as noted by the cidb (2012), determines the contracting strategy, which in turn determines the gateways, or insertion points for the procurement phases, and the responsibilities for developing the project design. To ensure the efficiency of the delivery of infrastructure, the infrastructure delivery cycle provides particular timeframes that make provisions for due process and link various infrastructure delivery cycles and gateways (cidb, 2011; cidb, 2012).

Financial projections are required to assist with the generation of long term estimates for cash flow, that relate to capital and operating costs within the various governmental organisations at various levels. The cost estimation process is conducted at high levels and related to the life cycle of each asset, and require a pre-feasibility study. Cost estimates are based on the capacity required for the management of the planned works and work required on assets. Cost estimates for work in each organisation is expedited and included in a long-term budget.

Plans are reviewed annually and included in the medium-term expenditure framework (MTEF), with work schedules adjusted to match the available budget. Construction H&S is impacted by various participants across the life cycle of a construction project. Where a decision is made during one stage in the life cycle, others will be affected, an impact that not only affects those appointed, but key stages too. Those appointed should have the necessary competencies have the necessary capacity in construction H&S relative to project risk, and indicated in Figure 2.3 (cidb, 2009).

Figure 2.3 The Construction Life Cycle (cidb, 2009).

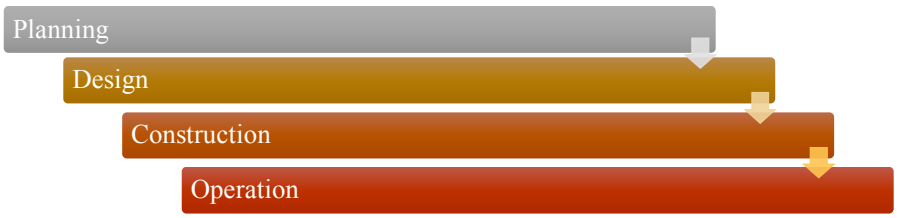


Table 2.4 indicates the summarised stages and gateways that are applied to the procurement processes. The IDMS provides gates at each stage, each slightly different. The notable aspect is the IDMS stages have several of ‘pre’ stages to the built environment professionals (BEP) stages. The reason for the various stages is because the National Treasury is required to put the infrastructure development programmes and infrastructure development that eventually would be disseminated to the provincial and district levels.

The BEP Stages noted are a summary of all the BEP terminology used the Identity of Work (IDoW), which highlights the core activities as stipulated by the built environment Councils. The arrows indicate the flow of information, which commences at National Treasury, through the processes until it reaches the BEPs' and the contracts at all levels. The information flows in both directions.

Table 2.4 Summarised IDMS Stages and Gateways, Information Flow (cidb, 2011).

IDMS: NATIONAL TREASURY		**IDMS**		**BEP STAGES**	
Stages		**Stages**		**Stages**	
1	Infrastructure planning	1	Infrastructure Plan	Not applicable	
2	Procurement planning	2	Procurement Strategy		
3	Package planning	3	Strategic Brief		
4	Package definition	4	Concept report	1	Project Initiation and Briefing / Inception / Inception Services
5	Design Development	5	Design development report	2	Concept and viability (preliminary design)
6	Design documentation	6a	Product information	3	Design Development (Detailed Design)
		6b	Manufacture, fabrication and construction information		
		6c	Logistics information	4	Documentation and Procurement
7	Works	7	Completed works	5	Contract Administration and Inspection
8	Hand over	8	Works handed over to user	6	Close out
9	Close out	9a	Updated asset register	Not applicable	
		9b	Completed contract or package order		

The initial CR's in 2003 introduced prescriptive requirements for the consideration of H&S among the duties of the client and designers, redistributing the responsibility for construction H&S to all parties, thus, is far reaching, and requiring a team approach among key role players. The amended CR's (2014) (RSA, 2014) increased the focus on clients and designers, revised notification systems,

and introduced the CWP system, similar to that used in the sector prior to commencing with building works (cidb, 2009; RSA, 2014).

2.12 PROCUREMENT AND HEALTH AND SAFETY

There is a paucity of literature relative to the links, roles, and responsibilities relating to procurement and H&S, which includes South Africa, where no literature was identified. The client is increasingly being held responsible for H&S on projects, with shared responsibility among all stakeholders through legislative means. Therefore, procurement practices need to ensure that H&S is taken seriously, and the clients' interests are safeguarded. The use of procurement as an instrument to promote improved H&S practices has received minimal attention, and where guidelines exist, there is limited attention to improving H&S standards through the procurement route (Wells and Hawkins, 2010). H&S problems encountered during construction stage could be avoided if due consideration were invested during the early stages of design (The Office of Government Commerce (OGC), 2007; Wells and Hawkins, 2010; RSA, 2014).

The OGC (2007), states that H&S are integral to the project process, and not confined to the construction stage but considered throughout the project life cycle. Government departments need to do more than the minimums set by statutory H&S laws. As a major construction client, government departments and their agencies should commit to, and demonstrate excellence in their procurement practices (OGC, 2007). Wells and Hawkins (2010) state that while there are many measures required relative to H&S, when in place, procurement procedures and contract documents are potentially important mechanisms to remind the parties of their legal obligations.

The OGC (2007) state that various levels of emphasis should be placed relative to H&S during the project life cycle. The emphasis is required on health, safety and people-related risk management aspects. Such emphasis and attention would deal with the incrementally developing project risk register and at gateways during the project that could be project specific. H&S should be driven by a senior team member, with the project leader being responsible the H&S performance of the project and its inclusion into the project management strategy.

2.12.1 Procurement Strategy

H&S assumptions in the project brief, and considerations in the feasibility and choice of procurement route are noted to establish core elements of the project through its life cycle. Aspects such as

'buildability' and other potential risks that could affect the post construction period need to be considered during feasibility studies.

H&S aspects built into contracts allow for monitoring and measures, with the involvement of the entire team to ensure project success (OGC, 2007; Wells and Hawkins, 2010). Procurement procedures are noted as being able to inhibit H&S better practice. The most common method of awarding contracts, especially in developing countries is using open competitive tendering, and the evaluation thereof mainly based on price. This results in the practice of reducing costs, with the aspects around labour and H&S being downstream, resulting in falling short of most legal compliance aspects. The context set for the project is a low price for the client at the expense of H&S (Wells, and Hawkins, 2010).

2.12.2 Tendering and Pricing for H&S

The client's approach to H&S, or the 'tone' and objectives should be set out in the invitation to tender. The details of specific requirements need to be included, and referenced during pre-tender meetings. Reasons for rejection or deeming it a non-responsive tender need to be clearly stated (Wells and Hawkins, 2010).

Pricing for the project and 'making adequate provision for H&S needs to be assessed during the adjudication process. How pricing is applied in practice varies. Items that are identified as being required to meet the client's requirements could be separately prices and listed as a prime cost item, provisional sum or other mechanisms where the contractor is required to price each. The benefits of adequate pricing, while thought to be high, in the longer-term contractors indicated savings and therefore could price tenders at a lower rate. Attention is suggested when evaluating tenders to determine the allowances made. An example provided includes whether the contractor building a multi-storey building has included an allowance for temporary support systems in the Bill of Quantities (BoQ) (Wells and Hawkins, 2010; RSA, 2014).

The World Bank deems projects where H&S provision is not adequate, non-conforming, or non-responsive, and could be rejected (Wells and Hawkins, 2010). Recent procurement reforms in Singapore, included the use of weightings relative to the quality of the tender proposal, where H&S may not be less than 10% of the value of the work. Furthermore, if the contractor's H&S record is poor, they are rejected from tendering on public works projects. Benefits from appropriate pricing include the reduced project risk, fewer disruptions to work schedules, and reduced reputational risk (Rowlinson, 2004; Wells and Hawkins, 2010).

2.13 DESIGN, HEATH AND SAFETY: INTERNATIONAL APPROACHES

Gambatese (1998) states that designers dictate the various aspects relating to the components of a facility through the design documents. As design influences construction, there is deemed to have a domino, or 'knock on' effect and H&S risks during the construction phase could well be increased if no consideration is given to either aspect.

Smallwood (2009) argues that the separation of the design and construction phases could seriously limit the identification of, and implementation of H&S innovations. Therefore, the integration of design and construction is critical if optimum H&S is to be achieved on a project. Other aspects affected by the lack of H&S during design include, *inter alia*, construction methods and materials, site location, and coverage. The opportunity to consider H&S during design formally and systematically could lead to safer design (Workcover New South Wales (NSW), 2001; OSG, 2007; Wells and Hawkins, 2010; Lingard, Pirzadeh, Harley, Blismas, Wakefield, 2014).

H&S through design has been shown to be a familiar concept in general industry where the application of a hierarchy of controls to limit exposure is more likely to be the norm. Examples in terms of the construction process include, *inter alia*:

- Substituting or eliminating a system of work or plant, e.g. using pre-assembled equipment rather than working at height;
- Modification of a system of work or plant, e.g. ensuring attachment points fall arrest systems when window cleaning;
- Isolating a hazard, e.g. asbestos where restricted access is required;
- Administrative controls using signage as advanced warnings;
- Engineering controls, e.g. increasing parapet wall heights to limit the possibility of falling, and
- PPE is always the last resort, and only used when all other forms of control or eliminating have been exhausted (WorkCover NSW, 2001).

H&S in design is not so, the case in construction (Hecker and Gambatese, 2003; Lingard *et al*, 2014). Behm (2006) describes designing for H&S as the amount of consideration of construction site H&S in the preparation of plans and specifications to be used in construction projects. However, the H&S of

workers is not traditionally part of the designer's role, leaving the workers vulnerable during the construction phase (Gambatese, 1998; Gambatese, Hinze & Behm, 2005).

It is clear however, that projects completed on time, within cost and appropriate quality reveal positive outcomes when H&S is included in the design thereof (Gambatese, 2008). Hindrances to include H&S during the design stage are relevant to the design team, and results in limiting the communication between them both inter- and intra-organisation interactions. Some designers do not believe that H&S and design go together, or apply to them. Other designers only do what they have been told to do or what was in the contract, and are not paid to design for H&S (Ulang, Gibb, Anumba and Gambatese, 2012). Ulang *et al* (2012) further states that some designers do not believe that they have any impact on construction H&S, and it is the responsibility of the contractor. The fact that designers do not necessarily spend much time on site, which could be a negative factor for young designers.

Musonda and Haupt (2009) completed a literature review that considered a range of studies to determine which of the studies had an influence on H&S during construction. The following studies were deemed to be of significance:

- The UK HSE (1995) completed an investigation into representative accidents across a range of industries found that as many as 60% of accidents had root causes in design;
- Hecker, Gibbons & Barsotti (2001) identified elements in design, planning, scheduling, and material specifications as probable contributors to working conditions that pose risks to musculoskeletal injuries during the actual construction process;
- Behm (2004) identified that design was linked to accidents in approximately 22% of the 226 injury incidents that occurred from the year 2000 to 2002 in USA's Oregon, Washington and California in the USA. He also determined that 42% of the 224 fatality related incidents in the USA from the year 1990 to 2003 were also linked to design;
- Gibb, Haslam, Hide and Gyi (2004) reviewed 100 construction accidents and identified that in 47% of the cases, changes in the permanent or final design would have reduced the likelihood of the accidents, and
- Kinnersley & Roelen (2007) completed an investigation across aviation and nuclear industries, which confirmed that 50% of all accidents have root causes in the design.

There are many international models used that illustrate the use of planning for construction H&S. Such models consider all construction issues, but have incorporated H&S at critical stages to ensure the reduction of risk. Furthermore, models incorporate the use of gateways, which ensure that the finalisation of all steps before the next phase is initiated. Most recently, the Olympic Park project built for the 2012 Olympic Games in east London achieved unprecedented levels of H&S, making it one of the pinnacles of success in the industry. A team effort, driven by committed leaders, extensive planning and implementing of systems are noted among the reasons for the success (Smallwood, 2015).

2.14 THE CONSTRUCTION HAZARD ASSESSMENT IMPLICATION REVIEW

The Construction Hazard Assessment Implication Review (CHAIR) is an Australian model that aims to promote a multi-stakeholder approach that ultimately reduces the potential H&S risks that could be linked to the design (WorkCover NSW, 2001). The model, commonly referred to as 'CHAIR' brings together key stakeholders involved in design that assists with the identification to limit or minimise the inherent risks in a structured and systematic manner. The acronym CHAIR is cited as "*because a function of both a chair and a design review is to provide an opportunity to site down, pause and reflect on possible problems."* The model acknowledges the various key considerations that are included in design, influences, and the broad numbers of stakeholders involved. The model seeks to include the elements and influences. The focus incorporates the reduction in life cycle costs, approach, improving constructability and thus, reducing incidents. There are three stages in the CHAIR process are addressed below.

2.14.1 CHAIR-1

CHAIR 1 includes a review of H&S at the conceptual stage of design, where it is noted as being the best opportunity to influence change, even though most of the design still needs to be determined. Once the critical risks are identified the controls can be introduced or established to ensure the level of risk is as low as reasonably practicable. Many organisations perform feasibility or conceptual operational design assessments that address various functions and elements of a design including that of H&S. Although the activities during the CHAIR 1 stage are basic, it does allow significant changes to improve H&S and operability. The reasonable approach is necessary at this stage, as not all risks may be foreseen or addressed at any of the three stages.

2.14.2 CHAIR-1 - Study Team

The CHAIR study team is noted as not being required to have any H&S training, but would need to have appropriate stakeholders led by a stakeholder who is aware of all the requirements. Increased diversity means reduced risk of overlooking a critical problem.

Guidewords used in this stage emulate those used in other industries, and include terms such as:

- 'Hazard and operability' (HAZOP) study;
- 'Overview', and
- 'Generic.'

The methodology cited by WorkCover (2001) divides design into logical components to be used for analysis. Components of design, risks, or other factors related to the risks of accidents are identified, and an appropriate level of assessments relative to the risk and controls applied.

2.14.3 CHAIR-1 – Guidewords

CHAIR-1 is similar to methods used in the petro-chemical industry using the Hazard and Operability (HAZOP) study. The use of the term is to stimulate discussion and risk identification. A logical process prompts and promotes discussion against the issues to be discussed. An overview of guidewords could include a word and a sub-prompt, which would be explored to ensure all aspects of design at the appropriate levels are investigated. There are two levels of guidewords used, namely 'generic', for which there are eleven broad terms with sub-prompts, and 'overview' that have fifteen broad terms and sub-prompts. Examples include those listed in Tables 2.5 and 2.6.

Table 2.5 Examples of Guidewords used in CHAIR-1: Generic.

Guideword Examples: Generic	Sub-prompts
Size	Too large, small, long, short, wide, narrow
Heights / Depths	Working at heights, falls / struck by falling objects; scaffolding, confined space, and access / egress
Position / Location	Too high, low, far, misaligned, and wrong position
Movement / Direction	Stability, compression, physical damage, vibration, friction / slip; rotation, upwards / downwards, reverse, expansion / tension, and rollover
Energy	Low / high energy, and tension

Table 2.6 Examples of Guidewords used in CHAIR-1: Overview.

Guideword examples: Overview	Sub-prompts
Environmental Conditions	Weather, temperature, noise, water, and ground conditions
Toxicity	Lead / asbestos / handling, precautions, and ventilation
Utilities and Services	Lighting, effluent, seepage, and waste
Construction Equipment	Sequence, timing, and access
Heights / Depths	Working at heights, falls, struck by falling objects, scaffolding, confined space, and access / egress
Access / Egress	Number of exit or emergency points, external impacts, maintenance, people, and movements

2.14.4 CHAIR-1 - DOCUMENTATION

The findings of the process are documented that reflect each of the processes, and minutes produced.

2.14.5 CHAIR-2

The focus in CHAIR-2 is on construction and demolition, following the full detailed design, and performed just prior to construction. The format followed is the same as CHAIR-1, however the outcome is to identify any issues not identified during CHAIR-1, and ensure that any further risks identified are managed. The guidewords used in CHAIR-2 are focused to the likely construction sequence, and have increased.

2.14.6 CHAIR-3

CHAIR-3 focuses on maintenance and repair, and could occur simultaneously to CHAIR-2 or immediately prior to CHAIR-3. Complexity and size drive the size of the team, which could be from a single individual to a team. The CHAIR-3 process is more concerned with plant and equipment, and the appropriateness of each.

Examples provided relative to CHAIR during design include:

- The consideration of external wall cladding that are installed as soon as the framework is complete;
- The design of higher parapet walls or integrated guardrails along exposed edges to eliminate the need for temporary barriers, and
- The placement of permanent structures such as stairs to eliminate the need for temporary works.

The CHAIR process includes the following processes:

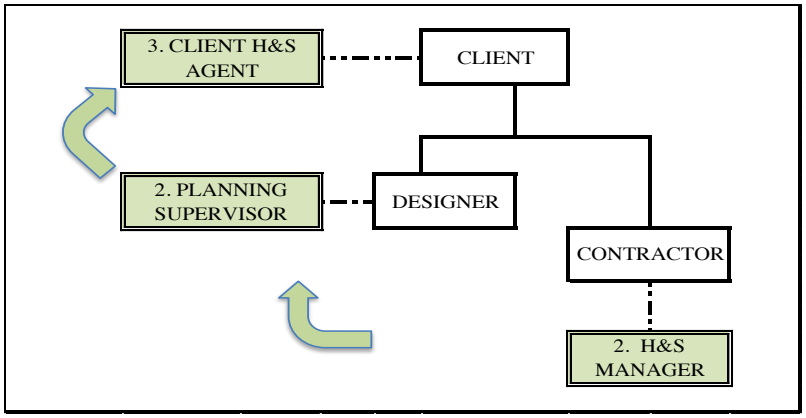
- Assemble the CHAIR study team that includes all stakeholders;
- Define the objectives and scope;
- Agree on the guidewords and prompts to assist with brainstorming;
- Partition the CHAIR stages into the different and logical blocks and sizes;
- Discuss the appropriate risk management and mitigations and measurement reviews, and
- Document comments, actions and, and identify aspects still to be determined.

2.15 THE GATEWAY MODEL

The 'Revitalising Health and Safety in Construction' research completed by the HSE (2002) explored the possibilities of the 'gateway' approach. The development of the model was based on a framework for construction procurement that encourages a multi-stakeholder integrated approach, and is noted as resembling the stages identified in the CDM Regulations. The HSE (2004) highlighted the evolving role of construction H&S during the amendments made to the CDM Regulations. Figure 2.4 indicates the roles and the hierarchy of construction H&S on projects in terms of the evolving role of construction H&S in the sector. The first point indicating the 'H&S Manager' in Figure 2.4, would manage H&S for a contractor, as the thinking was always 'H&S is the contractor's responsibility', and liability shifted accordingly. The development of the CDM Regulations included the 'Planning Supervisor' who had the responsibility of exclusively assisting the designers with planning for H&S on the project. The designers were further required to manage H&S risks on the project. The third change introduced the 'Client H&S Agent', representing the client and ensuring representation at that level, moving upstream in the project life cycle, and encapsulating all those involved in a project (Figure 2.4) (HSE, 2004). The link was then made to include H&S into the procurement process, and project planning, using a series of 'gateways'. The gateways were developed by the OGC who positioned the gateways at key decision points throughout the project life cycle. Progressing through each gateway required satisfying several of predetermined 'critical success factors'. Decision points in design were also included in the documentation, which are considered gateways too. Gateways are also considered to be strategic points, and should, therefore, be integrated with managing project risk. Gateway reviews were recommended, to include an element of independence. Use of the gateways

system is applied to any form of project, and the CPM is required to sign off as evidence before moving to the next stage (HSE, 2004; OGC, 2007)).

Figure 2.4 The Evolution of the Project Construction H&S Hierarchy (HSE, 2004).



The Gateway model has been noted as being structured, systematic, logical, rigorous and transparent. Ownership moves upstream to designers and client or other duty holders, as defined by legislation. Gateways are included in five phases: 'Concept'; 'Feasibility'; 'Design and Planning'; 'Construction', and 'Maintenance phase'.

Planning for construction covers a range of activities, from pre-planning, through design, to planning of specific site activities. Studies cited by the HSE (2004) indicate that effective management embraces PM objectives, including H&S, and satisfying all PM requirements and not one at the expense of the other (HSE, 2004; Goldswain, 2014).

A further aspect used with the gateway approach is the use of colour coded lists. The lists are to assist with the identification of the level of associated risk with a particular item. The colour coding is similar to that of traffic lights, using 'red, amber, and green lists' or RAG lists. The opportunity of assessment is to guide the design team, and ultimately design out the risks as far as possible. The colour 'red' warns of high risk, the 'amber' warns of proceeding with care, and the 'green' identifies the aspect is safe, and the design can continue (HSE, 2004, Goldswain, 2014).

The construction industry tends to be under resourced, and under planned relative to general industry, which promotes a reactive or crisis management approach. Highly planned works run more smoothly, and it is noted that routine work benefits from rigorous short-term planning. The HSE (2004) recommend that the gateway process considering the key points through life cycle is optimum.

Gateways 1-3 cover the Concept and Feasibility stages, which are identified as critical in ensuring adequate planning is done for the project, and that the following gateways only require design risks to be addressed.

2.15.1 Gateway 1: Strategic Assessment.

Gateway 1 occurs during concept and feasibility stage, or Stage 1. The H&S advisor, or CHSA would be appointed to integrate project planning and H&S. Key activities during Gateway 1 include, inter alia:

- The development of H&S policies;
- Developing the project strategic objectives;
- Identifying key project risks;
- Developing a risk register;
- Ensuring financial resources for the project, and
- Identifying communication channels.

2.15.2 Gateway 2: Project Risk Assessment.

Aspects considered during Gateway 2 include H&S performance, life cycle costing, value management, consideration for the operation and maintenance (O&M) requirements, and concept designs. Optimum pricing and project duration are critical at this point to allow for H&S (HSE, 2004; Goldswain, 2014).

2.15.3 Gateway 3

Gateway 3 essentially covers the procurement strategy for the project, namely H&S objectives, what is to be achieved, measures to be used to determine success, and further elaboration on the risk register. Key performance indicators could be used to assist with H&S focal points (HSE, 2004; Goldswain, 2014).

2.15.4 Gateway 4

Gateway 4 indicates the partner or contractor selection aspects. Documentation requires that development and controls be set to ensure all the outputs required are appropriately identified and on

record, and set out in specifications and tender documents. Irrespective of the form of procurement chosen, SCM is a key factor, as is H&S for the project (HSE, 2004; Goldswain, 2014).

2.15.5 Gateway 5

Gateway 5 considers the initial or preliminary design processes, to ensure legal compliance to continue with construction. The process during this gateway is to limit design changes from occurring during construction stage. Records are kept of the documentation developed in H&S files and construction H&S plan, which is developed by the client for the contract (HSE, 2004; Goldswain, 2014).

2.15.6 Gateway 6

Gateway 6 covers the detailed designs and drawings, various technical issues, with the focus on the life cycle, change management through the project, and again the documentation as this gateway would be part of the construction stage (HSE, 2004; Goldswain, 2014).

2.15.7 Gateway 7

Gateway 7 details the end of the project, handover, and final completion. H&S documentation pertaining to the project is required to be in place for the maintenance of the project, including lessons learnt on the project (HSE, 2004; Goldswain, 2014).

2.15.8 Gateway 8

Gateway 8 monitors and reviews the total H&S actions throughout the project, value for money so that future projects can benefit from such lessons learnt. A contract review forms part of Gateway 8 (HSE, 2004; Goldswain, 2014).

2.15.9 Application of the Gateway model to small projects

The flexibility of the gateways was considered as projects vary in size, risk, and value. The model can be ‘collapsed’ to accommodate smaller projects, using the gateways in combination. Gateways 1 and 2 and 3 are combined (G1), as well as Gateways 4 and 5 (G2), Gateway 6 becomes G3, and gateway 7, G4. G5 or Gateway 8, becomes feedback and finalises the project (HSE, 2004; Goldswain, 2014).

The Gateway model has a range of other tools and activities that are used in conjunction with the model to support and assist with the application and processing throughout the project, able to be used by the project team (HSE, 2004).

2.16 RISK IDENTIFICATION AND MANAGEMENT DURING THE LIFE CYCLE

Risk is interpreted in many ways. The CIB (2013) defines risk as the chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard. Once a hazard is identified, the associated risk is assessed (HIRA) and a hierarchy of mitigation methods applied, through to elimination of the hazard.

The South African OHSA (1993(a)) defines risk as the probability that injury or damage will occur (RSA, 1993), whereas the HSE (2004) defines it as a combination of the severity of harm with the likelihood of its occurrence. Asbury (2007) states that risk amounts to anything that may hinder or assist achievement of business objectives. Whichever definition is applied, the consideration employed could be that risk could be assessed from many perspectives. As many perspectives as there are, there are just as many perceptions that exist relative to the extent or level of risk.

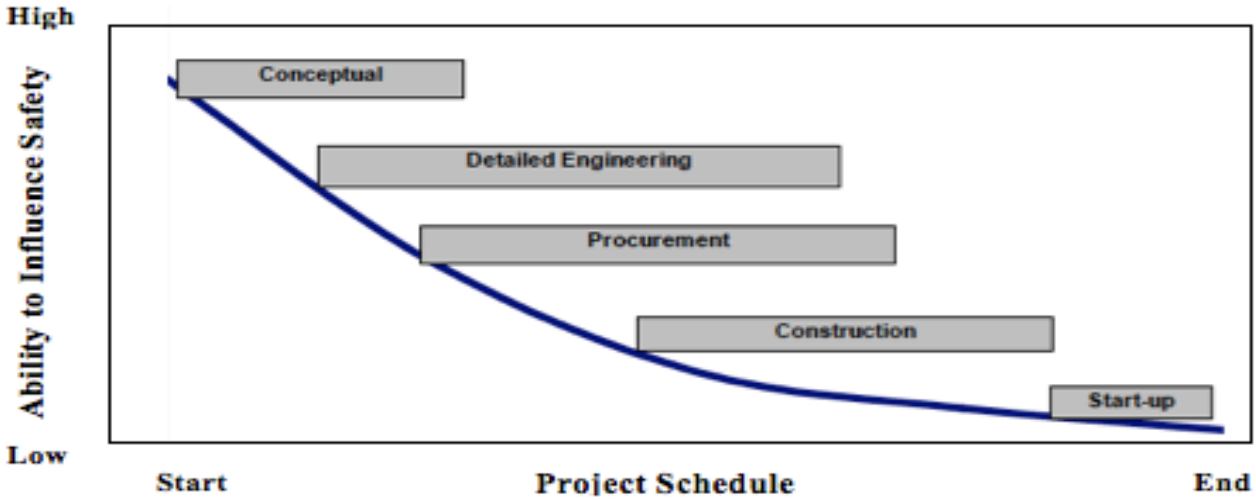
The CIB (2013) states that risk management compromises four interdependent elements that include hazard identification, risk analysis, risk control selection, and risk control implementation and maintenance. du Toit (2012) cites the crossing of a road as an example of risk identification, where a person is required to make a series of instant assessments of the probability of being knocked over as it relates to the environment. All activities entail some level of risk, or inherent risk, which is composed of probability and severity of harm, or the distinction between reality and possibility.

The CIB (2013) states that construction hazards could be classified into four categories, which include job site conditions (nature and physical layout), equipment and materials, and human and management factors. Mitigation or the limitation of the effect of risk is directly related to the severity of the potential consequence. The identification, mitigation or elimination of risk is entrenched in South African legislation, as ultimately the suite of regulations available indicates the areas of risk and constitute a guide to management and mitigation set down in each across different disciplines. The lack of attention to risk could lead to liability of various parties.

Designers have control over most of the stages in the construction life cycle, and are directly responsible for decisions made during such stages. Therefore, if designers are cognizant and responsive to the potential risks created by the design, the inherent or embedded risk can be reduced. The HIFI (2008) states that the term risk identification is in fact, a misnomer, as the cause of accidents, or failure is due to ignorance, oversight, negligence, greed, or criminal behaviour of some, or all of those involved.

In the past managing risk has included the transfer of the cost of failure to another party or parties, and arose from the practice of 'bonding' to cover the financial losses from a failure. Thus, many hazards related to risk, are considered acceptable to some extent. There are many models that indicate the appropriate time to identify and manage risk. Figure 2.5 indicates one such model, a time and influence curve (Gambatese, 2013). The model indicates the life cycle approach and the optimum time to determine and identify project risks from start date to the end date of the project schedule. The ability to influence H&S, and to manage risks decreases as the project progresses.

Figure 2.5 The Szymberski (1997) Time / Safety Influence Curve (Gambatese, 2013).



2.17 LIABILITY

Gambatese (2008, 2013) presents a liability matrix in terms of the liability that designers could be exposed to, or limit such liabilities where workers are injured or die at work (Figure 2.6). While the matrix was developed with the designer in mind, it could be possible to apply it to clients, as they often are built environment professionals. The issue of duty of care, prudent design and what could be deemed as reasonable by a designer in terms of legal responsibilities, is noted by Gambatese (2013) as part of their professional obligation to protect the public, and ethical behaviour.

Gambatese (2008) records that in a USA case, the court ruled that "*One who undertakes to render professional services is under a duty to the person for whom the service is to be performed to exercise such care, skill, and diligence as men in that profession ordinarily exercise under like circumstances*." Contractually designers who failed to meet the duty of care could have faced potential liability from only the contractual party. However, in subsequent cases, the view has been that the designer's duty of care supersedes other contractual duties. Therefore, should a worker be injured there is a possibility of a third-party claim from what is deemed negligence on the part of the designer. A negligence claim could be interpreted as the designer not taking reasonable steps to prevent workers from working in a way that could expose them to personal harm, or property damage (Gambatese, 2008; Gambatese 2013).

Designer liability can be determined by evaluating the level of risk reduction methods that were applied to a project. Should a worker be fatally injured at work, Figure 2.6 indicates the potential liability that exists for the parties involved. The higher the complexity of the project, where standard practices may not be able to be applied, the designer has two choices, to apply extra H&S knowledge in which case it is unlikely the designer will be found liable. Where no H&S risk reduction or H&S knowledge is applied, and a worker dies, parties could be liable. The example provided is applicable to any project, as it is related to risk.

Figure 2.6 Liability for Worker Injuries or Fatalities (Gambatese, 2008; Gambatese 2013).

Practice	**Safety knowledge Implemented**	**Safety Knowledge Not Implemented**
Not Standard Practice	Not Liable	Liable
Standard Practice	Not Liable	Liable

2.18 DESIGNING FOR PREVENTION

The Center for Disease Control (CDC) (2012) and Prevention in the USA, state that one of the most effective ways to prevent and control occupational injuries, disease and fatalities is to ‘design out', limit, or minimise hazards as early as possible during the design process.

2.18.1 Prevention through Design

The Prevention through Design (PtD) approach requires attention by all parties to minimize risk, not just those designing, but includes manufacturers and service providers (Schulte *et al,* 2008). Gambatese (2013) reports that the UK, and Australia have developed strategies and introduced legislative requirements that address and actively promote H&S interventions during the design stage of projects.

Feedback has been positive regarding the initiatives made. Between 40 and 60% of accidents could have been prevented using adequate planning (HSE, 2004; Musonda and Haupt, (2009). Musonda and Haupt, (2009) provide a broad review of literature that supports the notion of designing out risk. Yet construction tends to be under-resourced and planning is limited, when compared to other industries, which promotes crisis management, and impacts negatively on H&S.

Kabiri, Hughes and Schweber (2012) note that construction design teams include a range of individuals, with large numbers of people possibly being involved in a project before the construction stage is reached. Furthermore, contractors state that the pressure during the tender process does not leave adequate time to read the entire contract by potentially increasing project conflict (Kabiri *et al*, 2012). This would include the H&S requirements as they relate to the scope of works (Hecker & Gambatese, 2003).

The HIFI (2008) supports the notion and ‘myth’ that accidents cannot be prevented, which myth has been used as an excuse for the failure to include H&S as an important consideration during design and construction planning. The myth is further echoed among stakeholders, including suppliers and the manufacturers of equipment used in the industry. The investigation of the cost of failure or probability at the time of design or period prior to construction is rare. The practice of transferring the cost of such failure to the compensation insurer is most often the case, with the further investigation into other potential causes not determined (HIFI, 2008).

2.19 COST, QUALITY AND TIME: THE GOLDEN TRIANGLE, AND HEALTH AND SAFETY

It is a widely accepted thought that construction project performance in South Africa is generally based on the triangular model of cost, quality, and time rather than including H&S (HSE, 2004; Hinze, 2006; Smallwood, 2009; Windapo and Oladapo, 2012; cidb, 2015 (b)). Windapo and Oladapo (2012) suggest that further indicators have been included, *inter alia*: H&S; sustainability; client satisfaction, and accident / incident record monitoring.

Internationally, the HSE (2004) suggests that the triangular model should be challenged, as the application of H&S on any aspect of the model could have a positive effect on the others. The integration of H&S extends to all project planning, and the greatest effect on a project are those that are taken early in the project life-cycle. The earliest intervention possible relative to the integration of H&S is imperative to reduce project (Gambatese, Hinze and Behm, 2005; OSG, 2007; cidb, 2009).

2.19.1 Competence of Stakeholders

The 2014 CR's introduced the dramatic requirement for those practicing construction H&S to be registered with a statutory council, to increase H&S standards among those practicing and advising in the sector. Further prescriptive requirements included, *inter alia,* competencies, temporary works and fall protection and linked occupational exposure and worker risk profiles and the need for medical surveillance among all construction workers (RSA, 2014).

The introduction of the term 'competence' is a theme throughout the CR's (2014), as well as the increased responsibilities of the client, designer, and the introduction of the CHSA.

2.20 CONSTRUCTION STAKEHOLDERS

There are many stakeholders involved with the construction process throughout the life cycle. The client is at the commencement of the process. No construction occurs without a client, whether a home-owner, the government or public sector, or the private sector.

Terminology relevant to the stakeholders varies, the CR's (RSA, 2014) and the forms of contract, guidance and standards use varying descriptive terms. Table 2.7 indicates the current differences.

Table 2.7 Conflicting Contracting and Legal Terminology.

CR Term	Construction term	OHSA and Regulations meaning of construction term
Client	Employer	An employer is defined as "*any person for whom construction work is being performed"*
Agent	Principal Agent, Engineer, Resident Engineer	Anyone who represents the Client
Principal Contractor	Main Contractor /| Selected / Nominated / Domestic	
Contractor	Subcontractor / Labour only / Domestic	

2.20.1 The Client

A client is defined in the CR's (2014) as "*any person for whom construction work is being performed."* (RSA, 2014) Clients have a legal and moral responsibility to ensure risk reduction during the construction life cycle. Smallwood and Emuze (2013) state that clients play a pivotal role in the level of standard of H&S on projects, as they are influential in terms of the tone, the form of contract, project budget and duration and select the designers and contractors.

Clients are not necessarily construction professionals, but those that are required to be registered with their professional body. Clients include, *inter alia*, engineers, CMs', CPMs', and QSs'. Clients are required to ensure that all the key stakeholders and are adequately resourced, competent and monitored.

The way the procurement process is applied in the South African public sector is described in the IDMS whereby the 'ultimate' client is the Department of Public Works (DPW). The DPW is the 'custodian' of state assets. The role of client is devolved to 'user' departments, for example, the Department of Health, Education, and Justice, who have their own assets such as hospitals, schools and law courts respectively. The client is further devolved to provincial and district levels, as 'implementing agents' who control projects on behalf of the 'user' department (cidb, 2012).

2.20.2 The Designer

The CR's (2014) describes who is deemed a designer and has a relatively prescriptive section of the 2014 CR's devoted to it. The definition is broad and includes the BEPs' and their roles as discussed in Section 2.13. The inclusion of the term 'competent' adds the aspect of knowledge of H&S, and includes a competent person who:

- Prepares a design;
- Checks and approves a design;
- Arranges for a person at work under his or her control to prepare a design, including an employee of that person where he or she is the employer; or designs temporary work, including its components;
- An architect or engineer contributing to, or having overall responsibility for a design;
- A building services engineer designing details for fixed plant;
- A surveyor specifying articles or drawing up specifications;
- A contractor carrying out design work as part of a design and building project, and
- An interior designer, shop-fitter or landscape architect (RSA, 2014).

In the South African public sector, designers are procured as CPMs', who could be any of the persons included the definition of designer. The practice in industry is for the client to appoint PSPs to act on their behalf, as PAs as described in the CR's and the IDMS (cidb, 2012). The CPM or PA in the role of the client carries similar responsibility as the client, but not totally. In terms of the CR's (RSA, 2014) the client cannot transfer liability to another. In the same way, the designer cannot transfer liability either to the contractor or any other party.

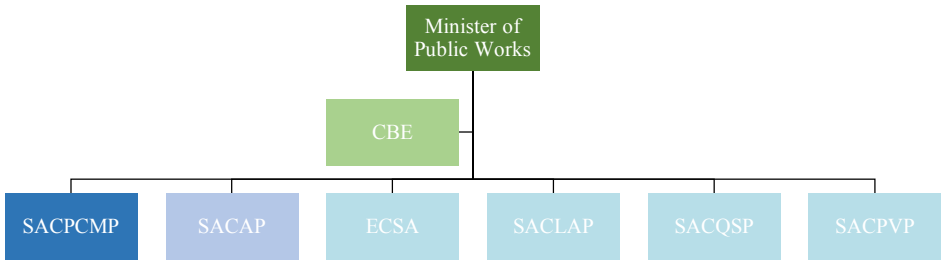
2.21 BUILT ENVIRONMENT PROFESSIONALS

Those practicing in a professional capacity, as a BEP, are required to register with a statutory body that identifies the scope of work relevant to the operation of the discipline. While not all are necessarily professionals, many categories are.

There are six statutory councils that register professional categories among engineers, architects, quantity surveyors, landscape architects, property valuers', CMs' and CPMs', as noted in Figure 6. Such professional categories can take on multiple roles and, if they have the requisite knowledge, work as key stakeholders within contracts directly or indirectly as the client, designer, or contractor.

Each council reports directly to the Council for the Built Environment (CBE) and ultimately is responsible for the professional management of each of the categories and to the Minister of Public Works. The CBE is deemed a 'super-council'. Each council has a specialised area of work, or 'identity of work' and categories, as noted in Figure 2.7. The CBE is further responsible for the legislative direction of each council in terms of the Council for the Built Environment Acts 43 of 2000 (RSA, 2000). Each council has its own legislation and qualifications, recognised in each Act as set out by the CBE.

Figure 2.7 The South African Built Environment.



2.21.1 The Identity of Work

The CBE, together with each of the six Built Environment Professional Councils (BEPCs) has noted the need to develop the scope of work, or what is known as the 'Identity of Work' (IDoW) for each of the categories within the BEPCs, as indicated in Table 2.8. The IDoW is essentially the reservation of the work that can only be done by those in the respective categories. Once the IDoW has been finalised, it is required to be submitted to the CBE and then the Competition Commission. At this point the Competition Commission has noted that the IDOW for all the BEPCs are possibly in contravention of the provision of the Competition Act, 89 of 1998 (as amended), and to date none have been accepted. One of the purposes of using professionals is to ensure public H&S, which does link into the Constitution of South Africa (CBE, 2013).

2.21.1.1 South African Council for the Property Valuers Profession (SACPVP)

There were no statements relative to H&S in the draft of the IDoW as published by the SACPVP (SACPVP, 2011).

2.21.1.2 South African Council for the Architectural Profession (SACAP)

The most recent IDoW of SACAP (2015) indicates that the architectural professional is responsible and accountable for the design, documentation and detailing of buildings or installations and the holistic coordination between complex factors. The architect professional sets the parameters that all the other BEPs' engage with the project, and therefore is accountable for the level of complexity that includes H&S.

SACAP states that H&S relates to the design and specifications of the buildings as well as the H&S during construction, which in turn informs the design. H&S forms the basis for detail design and co-ordination with other professional consultants and contractors. In terms of the level of competence required in the IDoW among the professional levels of competence H&S is noted as applicable to architectural design across all the complexity factors, including contract documentation and administration, computer applications and office practice, legal aspects and ethics (SACAP, 2015).

2.21.1.3 South African Council for the Landscape Architectural Profession (SACLAP)

The IDoW for SACLAP has some references to H&S among the activities noted in the scope of services and works. H&S is an item which is noted in the core competencies across all the categories, where the Professional Landscape Architect (PrLArch) and the Professional Landscape Technologies (PrLTechno) are expected to be proficient, have skill, knowledge, training and experience to practice. The Professional Landscape Technician (PrLTechni) is required to be competent – having sufficient skill, knowledge, and training to practice, and the Professional Landscape Assistant (PrLAssist) only requires general awareness – knowing about the existence and importance of an issue. The general or typical services of SACLAP members are that there should be better implementation of H&S regulations and standards (SACLAP, 2011).

2.21.1.4 The South African Council for Quantity Surveying Profession (SASQSP)

The South African Council for the Quantity Surveying Profession (SACQSP) published the IDoW in line with the CBE requirements. H&S is noted as a requirement in the additional services that the QS may be provided where they are acting as a principal consultant and/or PA in areas across the stages.

2.21.1.5 The Engineering Council of South Africa (ECSA)

The Engineering Council of South Africa (ECSA) (2014) has a policy regarding the identification of Engineering work (IDoEW), which states that the specified categories established by ECSA will meet H&S requirements in their various categories.

In the characteristics identified as part of ECSA, considering the risks associated with various activities, it is noted that such work should not compromise H&S. Aspects identified in the criteria for IDoW for registered persons under 'Abilities/Competencies' Group C: Impacts of Engineering

Activity is required to "*meet all legal and regulatory requirements and protect the H&S of persons in the course of his or her engineering activities.*"

In the 'Guideline for Services and Processes for Estimating Fees for Persons Registered in terms of the Engineering Profession Act, 2000' (ECSA, 2014), if there is a requirement for an engineer to undertake duties falling under the OHSA and CR's on behalf of the client, there are H&S requirements. In terms of this occurring, the engineer is required to ensure that the contractor provides documentary evidence of compliance. The other aspect of this is the requirement to execute the duties of the client, as his appointed agent, as per the CR's.

Table 2.8 The CBE Councils, applicable Legislation, and identified Professional Groups.

Council	Legislation	Identified Professionals
The Council for Architectural Professions (SACAP)	Architectural Professions Act. No. 44 of 2000	Professional Architect Professional Senior Architectural Technologist Professional Architectural Technicians Professional Architectural Draughtsperson, and Candidates for each category
The South African Council for the Landscape Architectural Professions (SACLAP)	Landscape Architectural Profession Act. No. 45 of 2000	Professional Landscape Architects Professional Landscape Architectural Technologists Professional Landscape Architectural Technicians, Professional Landscape Assistants and Candidates for each category
The Engineering Council of South Africa (ECSA)	Engineering Profession Act. No. 46 of 2000	Professional Engineer Professional Engineering Technologist Professional Certificated Engineer Professional Engineering Technician, and Candidates for each category
The South African Council for Property Valuers Professions (SACPVP)	Property Valuers Profession Act. No. 47 of 2000	Professional Valuer Associated Valuer, and Candidate category
The South African Council for the Project and Construction Management Professions (SACPCMP).	Project and Construction Management Professions Act. No. 48 of 2000	Professional Construction Project Manager Professional Construction Managers Construction H&S Agents Construction H&S Managers Construction H&S Officers, and Candidates for each category
The South African Council for Quantity Surveying Professions (SACQSP)	Quantity Surveying Profession Act. No. 49 of 2000	Professional Quantity Surveyor, and Candidate category

2.21.2 Competence, Competencies, and Competences of Built Environment Professionals

The findings of research relating to the competencies among site agents, and those practicing in H&S were highlighted in Chapter one and beg elaboration (Smallwood and Haupt, 2008). The term competence is a theme that occurs frequently through the 2014 CR's (RSA, 2014), but the terms are much broader, and research indicates that there are further terms, namely competences and competencies that should be included when contemplating the meaning of the term competence.

The term ‘competent’ refers to a person who is qualified to perform to a requisite standard of the processes of a job, whereas competence means the condition or state of being competent, which in turn relates to the skill and standard of the performance that is reached. Competency refers to the behaviour by which the skill and standard are reached. Determining the criteria of performance is complex, with the levels noted as being superior and effective performance, and that only some competencies can predict performance. Competencies are divided into two categories, namely:

- Surface or threshold competencies that are required to be minimally effective and include knowledge and skills, and
- Core or differentiating competencies that distinguish superior from average performers, and include abilities, aptitudes, personal suitability, behaviours, and impact on performance at work (Smallwood and Haupt, 2008; Smallwood, 2013).

Table 2.9 Minimum competencies: CPMs’ and CMs’ (SACPCMP, 2006a) (SACPCMP, 2006b).

Aspect	**SACPCMP Minimum Competencies: Technical**	
	CPM	**CM**
Construction science	Nil	Nil
Knowledge of construction processes	H&S Management	H&S Management
Knowledge of design processes	Nil	Nil
Knowledge of financial and cost factors	Nil	Nil
Project management competencies	Facilitate and monitor the preparation of the H&S Specifications	
	Ability to facilitate and monitor implementation of H&S Plan	The ability to facilitate and monitor implementation of the H&S Plan
	The ability to facilitate and co-ordinate the production of the H&S File	The ability to facilitate and co-ordinate the production of the H&S File

2.21.2.1 Construction Project Management (CPM) Competencies

The CPM competencies are clearly defined in the IDoW and Scope of Services as published by the SACPCMP (SACPCMP, 2006a). Such are relative to the required knowledge and abilities to practice. The competencies noted in Table 2.8 where there is specific reference to H&S include aspects from Stages 1 to 6, where it is noted that there is with no role for CPM during Stage 1 (Project Initiation and Briefing). It is noted that there are no actual deliverables among the IDoW for the CPMs'.

2.21.2.2 Health and Safety Responsibilities among Built Environment Professionals

The H&S responsibilities among the BEPs' have been noted as limited, specifically in South Africa. The limited knowledge relative to H&S has been identified at all levels of education. Minimal, if any, embedded H&S content and training is included in such training that is available to students at undergraduate and postgraduate levels (cidb, 2009; Smallwood, 2013).

Each BEP group has H&S responsibilities for example, leading, supporting or doing construction work. Each of the BEPCs' IDoW will be discussed in line with in the relevant stages of work, and where, if any, H&S deliverables are included.

The following aspects were noted following the analysis of the BEPs' IDoW relative to H&S, which are broadly noted in Table 2.9. None (0%) of the BEPs' includes, or notes stage 1 as part of their functions, yet all except the CM would work at this level. The only proviso that most make is that of consulting with other consultants, as particularly when they are appointed as Principal Agent.

Four of the six (66.7%) BEPs', namely CPMs', landscape architects, QSs', and engineers note they may advise the client that a H&S consultant is necessary during stage 2. The architects and property valuers' note nothing.

Fifty percent (50%) of the BEPs' have H&S functions during stage 3, for CPM and CM as well as QSs' and the engineers. Both the CPM and CM have design related functions that relate to H&S, where input is required by the H&S consultant. Only 16% of the BEPs' (CPMs' and CMs') have any requirements relative to H&S during stage 4, where preparation of the H&S Specification requirements would be facilitated and monitored by the CPM.

The CM would manage and coordinate preparation and implementation of H&S into the tender documents. Three (50%) of the BEPs' include H&S relative to compliance, monitoring of H&S plans submitted by the contractor and approvals by the H&S consultant are noted. The CPMs' and CMs' note ongoing monitoring for compliance during the construction period. The landscape architects note there should be monitoring of landscape contractors in accordance with the requirements of the H&S consultant. Only the CPMs' and CMs' (16%) have noted the finalisation of the H&S File during stage 6.

Table 2.10a References to H&S in Scope of Services and Identity of Work across the BECs.

SACPCMP		**SACAP**	**SACLAP**	**SACQSP**	**ECSA**	**SACPVP**
CPM (SACPCMP, 2006)	**CM** (SACPCMP, 2006)	**Architects** (SACAP, 2015)	**Landscape Architects** (SACLAP, 2011)	**Quantity Surveyors** (SACQSP, 2013)	**Engineers** (ECSA 2013)	**Property Valuers** (SACPVP, 2011)
STAGE 1 DESCRIPTORS: Project Initiation and Briefing / Inception / Inception Services						
Nil noted	Not applicable	Nil noted	Nil noted	Nil noted	Nil noted	Nil noted
STAGE 2 DESCRIPTORS: Concept and Feasibility / Concept and Viability / Concept and Viability Services						
Advise the client regarding the requirement to appoint an H&S consultant where necessary	Not applicable	Nil noted	Advise the client regarding the appointment of an H&S consultant where necessary	Advise the client regarding the appointment of an H&S consultant where necessary	Advise the client regarding the appointment of am H&S consultant where necessary	Nil Noted

Table 2.10b References to H&S in Scope of Services and Identity of Work across the BECs.

CPM (SACPCMP, 2006)	**CM** (SACPCMP, 2006)	**Architects** (SACAP, 2015)	**Landscape Architects** (SACLAP, 2011)	**Quantity Surveyors** (SACQSP, 2013)	**Engineers** (ECSA, 2013)	**Property Valuers** (SACPVP, 2011)
STAGE 3 DESCRIPTORS: Design and Development / Design Development / Design Development Services						
Facilitate any input from the design consultants required by CM regarding constructability	Review designs by consultants in relation to H&S requirements during construction and provide input if required on related practical and cost issues	Nil noted	Nil noted	Facilitating the input required by the H&S consultant	Facilitate input required by the H&S consultant	Nil noted
STAGE 4 DESCRIPTORS: Tender Documentation and Procurement / Document and Procurement / Documentation and Procurement Services						
Facilitate and monitor the preparation by the H&S consultant of the H&S Specification for the project	Manage and co-ordinate the preparation and implementation of the H&S requirements for inclusion in the tender	Nil noted	Nil noted	Nil noted	Nil noted	Nil noted

Table 2.10c References to H&S in Scope of Services and Identity of Work across the BECs

CPM (SACPCMP, 2006)	**CM** (SACPCMP, 2006)	**Architects** (SACAP, 2015)	**Landscape Architects** (SACLAP, 2011)	**Quantity Surveyors** (SACQSP, 2013)	**Engineers** (ECSA, 2013)	**Property Valuers** (SACPVP, 2011)
STAGE 5 DESCRIPTORS: Construction Documentation and Management / Construction Contract Administration / Construction / Contract Administration Services						
Monitor the auditing of the contractors' H& plan by the H&S consultant.	Manage the preparation and agreement of the H&S Plan with the client's H&S consultants and subcontractors	Nil noted	Where the compliance of landscape contractors could be monitored in accordance with the requirements of the H&S consultant	Monitoring preparation and auditing of the contractors H&S Plan and approval thereof by the H&S consultant	Monitor preparation and auditing of the contractors H&S Plan and approval thereof by the H&S consultant	Nil noted
Monitor the production of the H&S File by the H&S consultant and contractors	Continuously monitor the compliance by the site management of the H&S Plan	Nil noted	Nil noted	Nil noted	Nil noted	Nil noted
Nil noted	Provide the necessary documentation as required by the H&S consultant for the H&S File					

Table 2.10d References to H&S in Scope of Services and Identity of Work across the BECs.

CPM (SACPCMP, 2006)	**CM** (SACPCMP, 2006)	**Architects** (SACAP, 2015)	**Landscape Architects** (SACLAP, 2011)	**Quantity Surveyors** (SACQSP, 2013)	**Engineers** (ECSA, 2013)	**Property Valuers** (SACPVP, 2011)
Manage the finalisation of the H&S File for submission to the client	Manage the finalisation of the H&S File for submission to the H&S consultant	Nil noted	Nil Noted	Nil Noted	Nil Noted	Nil Noted

2.22 CONSTRUCTION HEALTH AND SAFETY DISCIPLINES

Currently there are three broad categories of construction H&S disciplines that may practice in the industry. The SACPCMP have registration rules for the disciplines, in terms of Act 48 of 2000 Section 18(1)(c) (SACPCMP, 2013(a)). The registration is in line with the role as required in CR 8.5 (RSA, 2014). Table 2.11 indicates the stages that each discipline practices in. In each of the stages, a defined scope of work and deliverables set the standards required for each discipline.

Table 2.11 Stages of Construction and practices areas of the Construction H&S disciplines

Project Stage	**Category practice areas**	
	CHSA	**CHSO / CHSM**
Stage 1: Project Initiation and Briefing	✓	N/A
Stage 2: Concept and Feasibility	✓	N/A
Stage 3: Design and Development	✓	N/A
Stage 4: Tender Documentation and Procurement	✓	✓
Stage 5: Construction Documentation and Management	✓	✓
Stage 6: Project Close-out	✓	✓

Along with the six stages, there are nine knowledge areas that are applied across each of the applicable stages for each discipline. The knowledge areas are:

- Procurement Management;
- Cost management;
- Hazard Identification Management;
- Risk Management;
- Accident or Incident Investigation Management;
- Legislation and Regulations Management;
- Communication Management, and
- Emergency Preparedness Management.

While procurement and cost management could be deemed the only project management or PMBOK areas, each of the knowledge areas are required to be applied in the construction sector.

2.22.1 The Construction Health and Safety Officer

The CHSO is the person who applies H&S systems on the project, mostly at operational level and may work on one or more project, and there may be one or more CHSOs' on a project, depending on expertise, project risk and size. Each CHSO is required to be registered with the SACPCMP (RSA, 2013c) to practice in the sector. The following aspects are identified by the SACPCMP as part of the CHSO functions, namely:

- Anticipate, identify and evaluate hazardous conditions and practices;
- Design / develop hazard control systems, methods, procedures and programs;
- Implement, administer and advise others on hazard controls and hazard control programmes;
- Measure, audit and evaluate the effectiveness of hazard controls and hazard control programmes, and

Analyse incidents to identify deficiencies in the H&S management systems (SACPCMP, 2013c).

2.22.2 The Construction Health and Safety Manager

The CHSM is a category that has the most limited mention in CR's (2014) (RSA, 2014), but is a category of registration with the SACPCMP. The scope of work and deliverables is the same as that of the CHSO, with the scope of work and deliverables between stages 4-6. CHSMs' are usually employed by the larger contractors and may manage several of CHSOs' across projects. The CHSM category also allows for the development of those CHSOs' who wish to progress in their career. The CHSM services that are required include, *inter alia*:

- Designing and developing organisational H&S management systems;
- Leading and managing the implementation and maintenance of H&S systems;
- Leading and managing the optimisation of compliance with the organisational H&S management system;
- Providing assurance of the effective management of H&S within the organisation;
- Measure, audit and evaluate the effectiveness of hazard controls and hazard control programmes, and
- Analyse incidents to identify deficiencies in the H&S management systems and produce management reports (SACPCMP, 2013b).

2.22.3 The Construction Health and Safety Agent

The CHSA practices across stages 1-6, as indicated in Table 2.10. The level of competence and knowledge, as well as accountability are much greater than those of the CHSO and CHSM, as the CHSA represents the client as their agent in matters relating to construction H&S through the life cycle. The level of H&S needs to be able to relate to the complexity of the design, to be able to design, compile, implement and manage H&S across the stages of the project. The ability to mentor and coach CHSMs' and CHSOs' is a requisite on a project. The following general requirements relate to the ability to register with the SACPCMP are, *inter alia*:

- Demonstrate that they have recognised technical qualifications in the H&S environment;
- Demonstrate that they have at least five years' experience in the construction industry in H&S implementation;
- Demonstrate their knowledge, skills and experience to the SACPCMP by means of completing the requisite testing;
- Be assessed by the SACPCMP as able to act suitably as a Construction Health and Safety Agent following a psychometric examination,
- Be certified as competent in the transfer of skills and knowledge, and
- Undergo an interview with the SACPCMP Health and Safety Agent Registration Committee (SACPCMP, 2013a).

The CHSA is the only category to use the prefix 'Pr' for the professional title, in the same way the title is used for the Professional Project and Construction Manager categories (SACPCMP, 2013a).

2.23 SUMMARY OF THE LITERATURE REVIEW

Chapter 2 indicates the range of secondary data and the broad aspects considered for the research. South African and international considerations have been included that are in line with the sub-problems and hypotheses the aspects across procurement and design. Historically, the construction industry as a sector remains an exceptionally high-risk environment, where risk has been transferred from client to contractor to limit risk.

The industry has moved from a master builder managing the project, to one of separation and fragmentation, with highly specialised contractors completing multiple layers of the works. A range

of gateway systems were noted as being in use in the Australia respectively, namely CHAIR and the Gateway Method. The USA also have a PtD programme that facilitates the assessment of H&S and outcomes to reduce project risk. While each model is different, the principles of risk mitigation and the inclusion of H&S is prevalent against the legislation and practices in each country.

A wide comparison of the approach to construction H&S practices in a wide range of countries in Africa, a number in Asia, then the UK, the middle and north America and Australia and New Zealand. The USA and Canada, Australia and the UK require H&S practitioners to register to practice. However, Nigeria, Mauritius and South Africa are the only countries where the requirement is statutory. In comparison, only South Africa has statutory requirements and specific functionality criteria with a rigorous assessment process required to practice in the field of construction H&S.

Statutory councils within the built environment identify the different disciplines that practice in the sector and have specific duties across the 6 stages of work, through the construction life cycle. Minimal reference across all the disciplines was noted relative to H&S, with none having kept up to date with the changes relative to introduction of the construction H&S categories.

There is a way in which procurement is done in the public sector. A broad range of construction stakeholders are expected to implement the IDMS to be compliant with South African Treasury and a wide range of legislation and procurement practices from national through to local government levels. Aspects such as terminology and the lack of reference to H&S in the statutory and general construction terminology are noted as lacking.

The literature ultimately identified that the outcome of the research would be of benefit to link H&S in the form of a model to the South African IDMS that guides the procurement practices across the built environment, across Stages 1-6.

CHAPTER 3: THE RESEARCH PARADIGM AND METHODOLOGY

3.1 FOREWORD

H&S research in the construction and engineering sectors are typically categorised as social research, with the theoretical inspiration motivated by development and change (Zou and Zunindijo, 2015). Research does not occur in a vacuum and the recognised approaches to research paradigms differ incisively. The use of mixed methodologies for research has increased since the late 1950's, with an increased understanding that all methods have limitations. Chapter 3 introduces, discusses and explains the methodology and various procedures that have been included in this research.

Leedy and Ormrod (2014) state that when considering mixed method research, the researcher should decide how the data are to be analysed, in terms of weighting. However, a researcher should not disregard one set of data because the answers are not as expected. The decisions should resolve how to most effectively integrate the quantitative and qualitative findings, to make a more convincing case for conclusions. Creswell and Planco Clark (2011) state that that selecting the form of mixed method design needs to be underpinned by sound reasoning, methodological arguments and which are directly applicable in practice. In the field of construction H&S, research results should be applied or improve safe working practices (Zou and Zunindijo, 2015).

With technology and the quantitative methods of analysis well defined and in most cases computerised, products to analyse qualitative research is available and widely used. ATLAS.ti is a computer software programme used to analyse qualitative data, which has been used for the research. Friese (2014), discusses the use of computer aided programmes, commonly known as 'Computer Aided Qualitative Data Analysis Software (CAQDAS)'. Such programmes do not analyse the data, but are merely a tool for supporting the process of analysing qualitative data. CAQDAS can assist with increasing the validity of research results. Steps can be traced, and the process is very transparent. The model utilised for CAQDAS is based on work done by Seidel in 1998. There are three basic components on the model which include: 'Noticing things'; 'Collecting things', and 'Thinking about things', or NCT. ATLAS.ti is termed 'Computer-assisted NCT analysis' (Friese, 2014).

Data analysis is not a direct, sequential process, but rather a recursive process with movement that moves backwards and forwards between NCT. Friese (2014) states that the NCT elements are encapsulated in the traditional research methodologies. Friese (2014) further states that real-life qualitative data analysis can be 'a bit messy, but fascinating and exciting'.

3.2 PRIMARY RESEARCH APPROACHES

While there are many forms of research methodology, the three primary approaches to research methods include the quantitative, qualitative and the mixed method approach, which are most commonly used (Creswell, 2003, 2014; Kahn, 2014). Quantitative research could include the use of narrow hypotheses and the use of instruments to collect data that are analysed using statistical procedures and testing of the sub-problems and hypotheses. Qualitative research leads the researcher to establish the meaning of phenomena from the views expressed by the participants. Participants can be interviewed, observed and share information when using the qualitative approach. The mixed method uses pragmatic knowledge claims, using a collection of quantitative and qualitative data sequentially. The mixed method further commences with a broad approach that results in generalizing the results relative, to a population. The second phase of mixed method research focuses on detailed qualitative open-ended interviews among participants. An alternative term for mixed methods of research, is where the researcher includes a range of various sources, methods, investigators and theories to corroborate the evidence used to validate the accuracy of the research. (Creswell, 2003, 2014; Creswell and Planco Clark, 2011; Friese, 2014; Kahn, 2014).

The choice of method used could be likened to the construction life cycle, as Creswell (2014) states that the research design refers to the entire research process, from conceptualising the problem, writing up the narrative, although not just about the methods of data collection, analysis and writing up the report. Gibb (1997) states that focus groups (FGs') are particularly useful and suited where several perspectives are preferred regarding a topic.

3.3 RESEARCH METHODS AND DATA COLLECTION

Research methods and styles are not deemed mutually exclusive, although generally between one, or a small number of approaches are normally adopted, generally due to a lack of resources for the research. The use of differing methodology focuses on the collection of data rather than the examination of theory and literature. The method of collection has a direct correlation to the analysis of such data, hence the results, conclusions values and validity of the research (Fellows and Liu, 2003, de Vos, Strydom, Fouché and Delport, 2005). Research only becomes viable as an approach when data exist to support it, with data being the components of the information collected regarding any situation, and the information given to the researcher (Gibbs, 2009; Leedy and Ormrod, 2014).

Many research methodologies were utilised to realize the outcome of the research. The triangulation methodologies, or mixed method have been utilised in this research, to maximise the collection, interpretation and analysis of primary and secondary data. The secondary data included a review of local and international resources that included journal articles, books, reports, online sources, conference procedures, including academic dissertations and theses. The information garnered from the stated resources provided a comprehensive basis for developing the primary data. The secondary data further formed the basis for the methodology used for the AR and FGs' that were deemed appropriate methodology for the research. The secondary data utilized in Chapter 2 relate to the development of the provisional studies reported on, as well as the AR elements utilized in the FGs'.

Considering the research conducted is deemed 'triangulation' the data collected in the qualitative and quantitative surveys focused on differing points of practice. The AR aspects using the FGs' considered the procurement process that underpins a project, with some elements relative to the interface of H&S, design and procurement. The quantitative aspect considers the perceptions of those practicing or involved in H&S, the interface regarding the stakeholders and 'issues' experienced in the challenges relating to daily work.

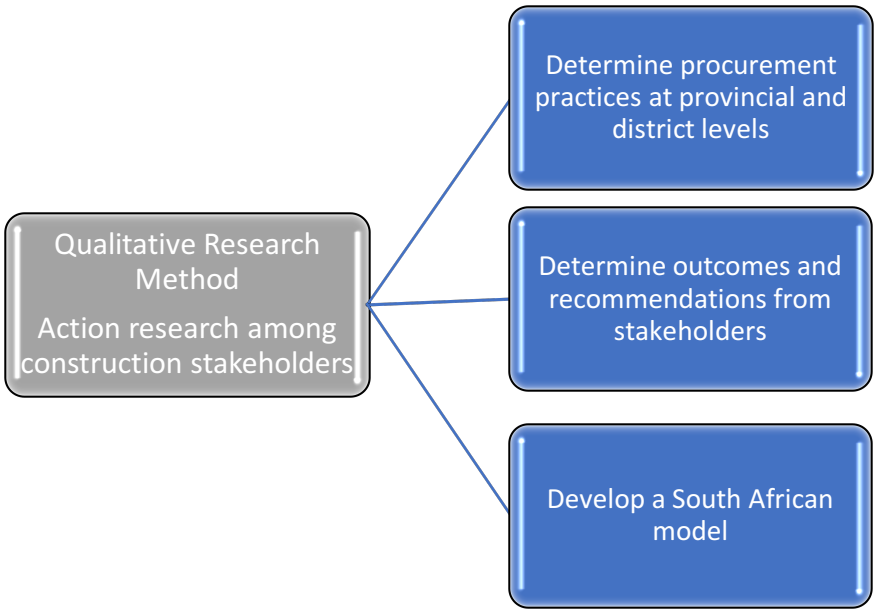
Chapter 1 introduced the methodology, aims and objectives selected for the study. The qualitative approach to achieve the aim and objectives is to use action research, using focus groups among construction stakeholders, to, *inter alia:*

- To determine the procurement practices at provincial and district levels of a public entity;

- To determine outcomes and recommendations from stakeholders;
- To develop a South African model, and
- To validate the model through the engagement of stakeholders that include clients, designers, procurement, contractors, and H&S practitioners.

Figure 3.1 indicates the flow of the qualitative and quantitative research methods selected for the study.

Figure 3.1 Qualitative aspects included in the study.

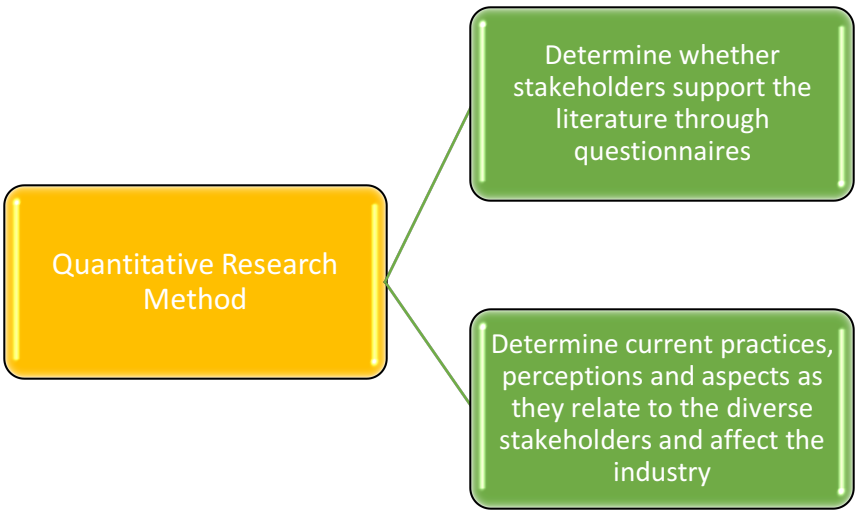


The quantitative approach to achieve the aim and objectives includes:

- The use of questionnaires among stakeholders practicing in the sector that are based on the survey of the literature, and
- To determine current practices, perceptions, and aspects as they relate to the diverse stakeholders and affect the industry.

Figure 3.2 indicates the quantitative aspects that were considered for the study,

Figure 3.2 Quantitative aspects considered for the study.



3.4 ACTION RESEARCH USING FOCUS GROUPS

FGs' are defined in many ways (Gibb, 1997). FGs' are made up of many people who can discuss a issue for between 1 and 2 hours. Optimum numbers range from 5 to 12, but can be increased to 14). FGs' are particularly useful when large amounts of information are needed over a short period of time, rather than interviewing individuals, where there are powerful differences between the participants and decision makers, and culture is of interest, or the researcher wants to explore the degree of consensus on a project. Other advantages and aspects relative to FGs' include a non-threatening environment and access to those in remote areas or those who are disabled (Gibb, 1997; Leedy and Ormrod 2014). Disadvantages noted for using FGs' include increased need for planning, trust issues, special needs or those who communicate poorly (Gibb, 1997).

Many stages exist for interviewing research participants. Each aspect provides a logical sequencing of the research that include the following:

- The research questions to be answered in the interviewed, that are open-ended, general and the focus one the central phenomenon of the research;
- Identification of the interviewees or the participants;

- The determination of the type of interview that will garner maximum output, that could include FGs';
- The form of recording procedures;
- An interview protocol or guide;
- Pilot testing to refine and develop the research instruments, degree of observer bias, and
- Use appropriate interview procedures (Gibb, 1997; Creswell, 2003; Escalada and Heong, 2009).

Gibb (1997), Escalada and Heong (2009), and Leedy and Ormrod (2014) describe the roles and activities during the FGs'. The FG has a moderator, who may be the researcher that introduces the topics to be discussed, ensures focus on the subject and limits domination of the discussion by one or more of the participants. The moderator role is further cited as significant as good leadership and interpersonal skills are required to successfully moderate such groups.

The collection of primary data appears to take many forms, and continually emerging with technological changes. Creswell (2014) records that more frequent use is being made of FGs' on the internet, chat room FGs', and bulletin board groups. However, issues such as informed consent, recruiting participants, and times of the FGs' are cited as problematic using these options. Creswell (2014) further cites a range of researchers who noted advantages of the internet FGs', such as reduction of cost and time, reduced need to travel and costs for data transcription.

3.4.1 Planning for the Research Focus Groups

The FGs' for the research were originally identified to be held at two levels, as the ECRPW primarily streams projects, due to cost. The areas selected from the ECDRPW were the Head Office, in Bhisho, and the Sarah Baartman (formerly Cacadu District) in the Nelson Mandela Bay area.

As the name suggests, the ECDRPW, the Department of Roads manage all civil projects, and Public Works building projects, mainly as the Implementing Agent for the Department of Education. The Researcher therefore determined that each FG should include a building and civil group at Provincial and District level. Gibb (1997) cites Merton and Kendall's (1946) research, which recommended that participants have "*a specific experience of or opinion about the topic under investigation, that an explicit interview guide is used; and that the subjective experiences of participants are explored in relation to predetermined research questions."*

The following actions were completed to plan the FGs':

- A formal letter was sent to the ECDRPW Provincial H&S Manager, requesting permission for participation, from the Researcher's Promotor (see Annexure 1);
- The ECDRPW Provincial H&S Manager sent out formal invitations (see Annexure 2) that included the times, venues, dates and split of possible participants, to his distribution list, to internal staff, contractors, and consultants, and an RSVP requested;
- The H&S Manager followed up with the participants who had sent an RSVP by e-mail, and a reminder to those who had not yet responded, and
- Telephonic and e-mail reminders were sent 2 days prior to the FGs' commencing to those who had responded positively.

Originally, 11 questions were planned, as time was limited to two hours per group. The questions were developed in a reasonably semi-structured way, that allowed for interactive discussion and explanations. However, following the first session the questions were reduced to eight (8), to fit the time frame planned for. The questions as revised are as attached in Annexure 4. Guidelines were set for the FGs' to ensure fairness and everyone having an opportunity to contribute. The guidelines are attached as Annexure 5.

It was identified that to include the range of stakeholders, the maximum number of participants to be accommodated was 14, which would further ensure balanced participation. The numbers selected were in line with those suggested in the literature discussed in Chapter 3.

The researcher facilitated the FG, and commenced the first session using a video camera, and a tape recorder to record the sessions, with permission from the participants. The consent letter is attached as Annexure 3. Each venue was set up well before the start of the sessions, all the documents set out, and tables positioned 'boardroom style' where possible, to engender participation. As the participants arrived, they were orientated and given the consent form to complete. The groups were welcomed and the purpose of the FGs' was shared. Refreshments were served during and following each of the sessions.

3.4.2 The Nelson Mandela Bay (Sarah Baartman) Focus Group (1)

The first of the Bhisho FGs' scheduled was held on 01 June 2015 among those representing the building sector.

3.4.2.1 Coding and Demographics

Each of the participants was provided with a blank board to record their name on, practice area (e.g. Pr. CHSA) and a sequential number from 1-11, with the Researcher noted as 'R1'. Participants were not all sequentially numbered as a few participants entered the session after it had commenced. The participants were mostly internal staff, with the breakdown noted in Table 3.1 relative to the participating number, the form of employer, and category of practice. The only 2 verified professional categories in the built environment apart from the Researcher, were the Architect, and Quantity Surveyor. Four of the participants were H&S interns within the Department.

Table 3.1. **Participant, origin and category of practice Focus Group 1: Sarah Baartman District.**

Participant No.	**Employer**	**Category of practice**
1	Researcher	Pr. CHSA
2	DRPW	Building Inspector, H&S Intern
3	DRPW	Environmental Health, H&S Intern
4	Contractor	CHSO
5	DRPW	Pr. Architect
6	DRPW	Senior Building Inspector
7	DRPW	PR. QS
8	DRPW	Environmental Health, H&S Intern
9	DRPW	ND Building, H&S Intern
10	Consultant	CHSA
11	DRPW	H&S Manager

3.4.3 The Bhisho Focus Group (2)

The second Bhisho FG (2) was orientated, and the purpose of the FG was shared. Six of the eight revised questions that were developed were discussed due to the extensive discussion that further allowed for interactive discussion and explanations.

3.4.3.1 Coding and Demographics

The participants were mostly internal staff, with the breakdown noted in Table 3.2 relative to the participating number, the form of employer, and category of practice.

Table 3.2 Participant, origin and category of practice, Focus Group 2: Bhisho.

Participant No.	Employer	Category of practice
12	Researcher	Pr.CHSA
13	Client	H&S Manager
14	Contractor	CHSO
15	Contractor	CHSM
16	Client	Pr.Eng
17	Client	District Manager
18	Client	Project Manager
19	Consultant	CHSA
20	Consultant	CHSA
21	Consultant	CHSA
22	Consultant	CHSA

3.4.4 The Bhisho Focus Group (3)

The third Bhisho FG (3) was orientated, and the purpose and reasons of the FG were shared. Six (6) of the eight (8) revised questions that were developed were discussed due to the extensive discussion that further allowed for interactive discussion and explanations.

3.4.4.1 Coding and Demographics

The participants were mostly internal staff, with the employer and category of practice noted in Table 3.3.

Table 3.3 Participant, origin and category of practice, Focus Group 3: Bhisho.

Participant No.	Employer	Category of practice
23	Researcher	Pr.CHSA
24	Client	H&S Manager
25	Client	Civil Eng (Tech)
26	Client	CHSO
27	Contractor	CHSO
28	Contractor	CHO / CHSM
29	Contractor	Civil Eng (Tech)
30	Consultant	Pr.CHSA
31	Contractor	QS / Site Agent
32	Contractor	CHSA

The outcome of the 3 FGs' is discussed in Chapter 5, as well as the development of the model.

3.5 ANALYSIS OF QUALITATIVE DATA

The use of ATLAS.ti was used to code the qualitative data following the transcribing of each of the FG recordings. Friese (2014) suggests that ATLAS.ti can be described as a container that keeps track of the data. Each project is termed a 'Hermeneutic unit' (HU), in the tradition of the hermeneutic sciences. Each HU links primary documents, the documents themselves, quotations, code words, notes, memos, links, and stored query results. The stored query results in turn can be exported into programmes such as EXCEL for graphic displays such as charts. 'Object Managers' provide a browser for the selected documents, quotations, codes and memos.

A selection is made of portions of text that forms a quotation. Quotations can be 'free', or coded. Quotations are identified and each has a name. A range of codes are then selected that are appropriate for the quotation. Initially the names of quotations and codes are broad and very general. As the data are sorted, and 'cleaned up' it can be refined and sorted into 'smart codes'. Each Manager has a range of options for querying, sorting and analysing the data.

The analysis of the HU includes assessing the frequency of usage of codes, or code co-occurrences. The programme indicates the number of times the code has been used, and its relevance to the data. The term used to describe this is the 'groundedness' of the code, which relates to its significance, and the 'density', which relates to the number of links to other codes.

Links between quotations and codes, can be made, to interlink them and to cross-reference the material and its relevance. Boolean, semantic and proximity operators are used to combine codes and groups of codes to further interrogate the data. Other methods of sorting and searches are used to further delineate and analyse the data. The data in each HU is continually worked on, and linked between groups of codes and quotations. Memos were set up with each sub-problem, and linked to the appropriate hypotheses. The memos are not necessarily used in the write up, but are means to process the NCT and thoughts that assist with making sense of all the data collected, both qualitative and quantitative data.

3.6 QUANTITATIVE RESEARCH

Quantitative approaches to research involve making measurements by collecting data and trying to make better sense of the world through numbers, looking for patterns and meaning (Fellows and Liu, 1997; Creswell and Clark, 2011; Leedy and Ormrod, 2014). Essentially a research project is a form of information system. To determine the inputs for the information system, the outputs must be determined first.

However, as the very nature of research is noted as a ‘voyage of discovery’, where outputs remain largely unknown until the research is complete, even then the outputs may remain unknown. Outputs are considered in terms of the aim, objectives and hypotheses, and if relevant, sub-hypotheses. Quantitative studies are ‘closed’ and quite rigid as the variables have been identified, and therefore the primary task is to test the hypotheses formulated at the outset of the research (Fellows and Liu, 1997).

3.6.1 Sampling of Data

Sampling provides a practical means of enabling the data collection while testing components and ensuring there is a good representation of the sample population. Normally data are collected from only a part of the total population with which the research is concerned.

Judgemental sampling could be useful in pilot surveys. However, it is more common to ensure strata or clusters of populations are sampled. Non-random samples are obtained by systematic, stratified and cluster sampling. The type of sampling used depends on the population and strata being surveyed. The rule of thumb for usable data sets indicate that at least 100 responses are needed to complete the analysis. The level of confidence in the results increases with the increase in data sets available (Fellows and Liu, 1997).

Scales to measure the types of data are dependent on the nature of the scales used. Uniformity and consistency of scales is essential. A range of scales exist however, for this research, the Likert scale was used for collecting respondents' opinions. Usually a 5 or 7-point scale is used, and can produce hierarchies to compare across groups of respondents (Fellows and Liu, 1997).

The collection of data can be challenging as many perceive the completion of research questionnaires an irritation at best (Fellows and Liu, 1997; Leedy and Ormrod, 2014).

3.6.2 Sampling Design

A range of sampling designs may be appropriate in differing situations. There are approximately 8 approaches that fall into 2 major categories, namely probability and non-probability sampling.

Non-probability sampling means the Researcher has no way of predicting or guaranteeing that the population will be represented. One such form is convenience or accidental sampling, and according to 'makes no pretence of identifying a representative subset of a population'. Quota and purposive sampling are other forms used (Leedy and Ormrod, 2014; Zou and Zunindijo, 2015). Non-probability research design was utilised in the research.

3.6.3 Survey Research

Survey research involves asking groups of people questions, and tabulating answers, by surveying a sample of a population can learn about opinions, attitudes and experiences. Such forms of surveys are also referred to as descriptive or normative surveying. It is noted that such forms of research can be problematic, with the respondents telling the researcher what they think they want to hear, and peoples' descriptions of attitude and opinions constructed in the moment. Forms of survey research could take the form of face-face, telephone, or questionnaires (Leedy and Ormrod, 2014). Questionnaires were used for the quantitative aspects of the research.

3.6.4 Validity Concerns

Whichever method of research is used; the measurement techniques need to ensure the validity of the variables under investigation. The validity is noted as not being the instruments used, but the overall research effort. The forms of validity include internal, external and credibility and trustworthiness (Creswell and Clark, 2011; Leedy and Ormrod, 2014; Zou and Zunindijo, 2015).

3.6.5 Constructing the Questionnaire

Leedy and Ormrod (2014) provide a list of 'rules' that should be employed when constructing a questionnaire. The critical aspects to be considered include short, provide specific instructions, in simple unambiguous language; conduct pilots to determine validity, and make the questionnaire attractive and appear professional.

3.7 DEVELOPMENT OF QUANTITATIVE INSTRUMENTS

A total of two quantitative surveys were completed during the research. The surveys were distributed during a training programme (a pre- and post-test study), and construction H&S practitioners working on projects within the ECDRPW. The findings of the quantitative surveys will be discussed in Chapter 4, and are included as Annexures 8 and 9.

3.8 QUANTITATIVE SURVEYS CONDUCTED

Several instruments were progressively developed, and adapted for the groups to which they were presented.

3.8.1 Multi-stakeholder Construction H&S perceptions

The initial instrument included a range of 47 statements regarding multi-stakeholder perceptions regarding H&S. The terms were derived over time and were developed from a range of aspects that covered the following issues:

- Accident prevention;
- The parameters of construction;
- Workers as customers of the industry;
- Management as creating risk to a certain extent;
- The aspects relating to design;
- The construction stakeholders, namely:
    - The design team, and
    - Clients, and
- The construction H&S practitioners, the CHSA, CHSM, and CHSO.

The instrument was used on two occasions, with the questions differing slightly between the instruments. The initial instrument was applied during a training session conducted for the Department of Labour during April 2013, pre- and post the training session, and practicing construction H&S Agents in the Eastern Cape were requested to send out the second questionnaire to their contractors and CHSO's and CHSMs'. There were significant issues with the response rates, and the different mediums used to distribute the questionnaires.

A snowball method was used, as the number of projects and persons involved on each project were unknown. Most were typical of what is reflected in the literature regarding response rates and general apathy, which influences the outcome, reliability, and validity of the quantitative aspect of the research. The findings will be discussed in Chapter 4.

3.9 ASSEMBLY OF THE PROVISIONAL MODEL

The assembly of the provisional model was the culmination of the findings obtained from the literature and qualitative data. Fellows and Liu (1997) discuss the type of models used, namely material and formal models, as well as subcategories of models.

Models are generally either deterministic i.e. what happened in the past will likely be repeated; or stochastic or probabilistic, the laws of probability that governed past realisations will continue to apply in the future. The former, deterministic are noted as the simpler of the two. Models should reflect the purpose of the model, who it is for, to provide perspective and to suggest sources of data, forms of outputs to be used. The analytical stage looks at the operation of reality, permeability and boundaries.

ATLAS.ti is the software used by the Nelson Mandela Metropolitan University (NMMU) for qualitative analysis. The researcher noted that the programme is a very powerful software package, and could be used to analyse all means of qualitative information, using photographs, video material, voice recordings, and text (literature and transcriptions). The researcher's limited experience using the software did hamper the extent to which the programme could be used, and obviously the outcome. However, the use of the transcriptions and voice recordings, as well as the IDMS toolkit were used, and constituted the basis of the draft model. The qualitative data sets were assessed by an independent reviewer from NMMU.

3.10 VERIFICATION AND VALIDATION OF THE PROVISIONAL MODEL

Verification of the model involves determining whether the structure of the model is correct, that feedback is required to validate the research work completed, and to 'test' the validity of the model. The model is verified if the outputs are appropriate, they meet the expectations of what a good model would produce. Validation occurs following verification where the model is tested for consistency over a range of conditions, and may well be theoretical. The model may be iterated so that inferences could be considered and the model be appropriate for use (Fellows and Liu, 1997; Creswell and Clark, 2011; Goldswain, 2014).

A validation questionnaire was developed and sent to participants whose details were available, to obtain their comments, and to validate the model. The model validation questionnaire is provided in Annexure 8.

3.11 ETHICAL ASPECTS

It was not deemed that any of the content to be dealt with in this research would require formal ethical approval to proceed. All the instruments, quantitative and qualitative assured participants of anonymity, and that all data would be treated as confidential and principals of ethical pre-requisites would be adhered to during the research. All the statements to that extent are included on each of the documents and correspondence to participants.

3.12 SUMMARY

A mixed methodology of research method has been utilised in this research, recognising that H&S occurs in a framework, with many variables, that include legislative requirements and general practice. Zou and Zunindijo (2015) state that much research has been done in H&S that has focused on 'what' has happened, rather than why or how H&S problems occur in the sector.

A total of three FGs' were held out of a possible four during June 2015, at provincial and district level of the Department of Public Works in the Eastern Cape, in the building and civil sectors, across a range of stakeholders.

A total of two surveys are reported on that provide quantitative information across a range of stakeholders, through the DoL, and construction H&S practitioners on projects with the ECDPRW projects.

The debate regarding the most appropriate methodology of research prevails across the wide range of society. Quantitative or qualitative methods, mixed or triangulated have rigorous methods that should be applied depending on the preferred outcome, and often personal preference. Quantitative research relies on objectivity and precise measuring of variables, and tests hypotheses, whereas qualitative research is interpretive, with the emphasis on a more natural flow, and 'soft' data.

The findings of the quantitative studies will be discussed in Chapter 4, and the qualitative studies in Chapter 5.

CHAPTER 4: QUANTITATIVE SURVEY RESULTS

4.1 FOREWORD

Chapter 3 outlined the methodologies used and the development of the instruments used in the research. The quantitative survey results are reported on in this chapter. Overall, two instruments were distributed among two different groups of participants over a three-year period, between 2013 and 2015. The instruments included several aspects that were common on all, with the challenges instrument including a greater section on CHS, as an area of research. Questionnaires sought to link many S-Ps' and hypotheses. The analysis of these quantitative data was undertaken by the Department of Construction Management, NMMU.

Chapter 4 interrogates the quantitative results of surveys that were generated to determine whether the S-Ps' and hypotheses could be supported or not. The findings and recommendations will be discussed in Chapter 9.

The objective of the surveys was to determine the respondents' perceptions and challenges regarding the four sub-problems identified in Chapter 1, namely:

4.1.1 Research Sub-problems

- Contractors are exposed to hazards that could have been mitigated during design;
- Contractors lack the necessary resources for H&S during construction;
- Contractors do not comply with statutory and contractual H&S requirements, and
- Stakeholders do not comply with statutory and contractual H&S requirements.

4.2 LINKING QUANTITATIVE INSTRUMENTS TO SUB-PROBLEMS

The research instruments were designed to cover a range of aspects aligned to the title: 'The Effect of the Integration of Design, Procurement, and Construction relative to Health and Safety' sub-problems. The aspects have been divided into themes, and each heading contains a broad description of the links to the sub-problems. There are several aspects included that could fit into multiple themes. Themes were selected to present the quantitative data, *inter alia*:

- The General theme;
- The Workers theme;
- The Management theme:
  - Supervisors, and
  - Responsibilities and Pricing;
- The Stakeholders theme;
  - Project Managers;
  - Design and Designers, and
  - Client, and
- The Construction H&S theme;
  - Construction H&S Agent, and
  - CHSM and CHSO.

4.2.1 The General Theme

The 'General' theme addresses a range of eight 'myths' that exist within the sector. Aspects such as 'Accidents are preventable'; 'Accidents are planned events'; 'Construction is inherently dangerous'; 'Accidents are part of the job'; 'I am my brother's / sister's keeper'; 'Cost, quality, and time are more important than H&S'; 'There are financial benefits to investing in H&S', and 'Evaluation of project performance should include H&S' are grouped under this heading. The 'General' theme further cuts across all the S-Ps'.

4.2.2 The Workers' Theme

The 'Workers' theme could be deemed to cut across all the S-Ps'. The statements, *inter alia*: 'Workers knowingly take risks'; 'Workers are adequately trained in H&S'; 'Workers have adequate resources relative to H&S' and 'Workers are included in decisions relative to H&S'.

Workers are the main or key recipient of the construction sector. Decisions made in terms of design, complexity of design and constructability are determined during stages 1-3, from the client and designer. Further decisions relative to programme, pricing, general management styles, plant, equipment and materials are determined from stages 4 to 6. The worker therefore has the potential to be positively or negatively affected during the entire life cycle.

4.2.3 The 'Management' Theme

Management is constituted of several levels that range from direct supervision at worker level, to the executive, or Chief Executive Officer (CEO). Each has a role to play, from corporate to site management, incorporating many management styles. Management further 'sets the tone', tenders decides on how projects will be managed on a day-to-day basis and managed financially. This section of the instrument is divided into the themes 'Supervision', and 'Management H&S Responsibilities and Pricing'.

Much of the actual, physical construction work is done during stage 5, where the contractor determines the methods and processes to be followed to deliver the end product. The 'Management' theme cuts across six of the eight, or 80% of the sub-problems being researched as follows:

- Contractors are exposed to hazards that could have been mitigated during design;
- Contractors lack the necessary resources for H&S during construction;
- Workers are injured, become ill and often fatally injured at work;
- Contractors do not comply with statutory and contractual H&S requirements, and
- CHSOs' and CHSMs' do not fulfil their statutory roles.

4.2.3.1 Management: Supervision

The following statements regarding supervision on site that could relate to work, workers and activities that have any level of risk include, *inter alia*: 'Supervisors knowingly take risks'; 'Supervisors are adequately trained in H&S'; 'Supervisors are given adequate resources relative to

H&S', and 'Supervisors are involved in H&S'. Site supervision could be made up of any of the BEP levels, or not have any formal construction training. Supervisors are also responsible for design and procurement during the stages 4-6 as they apply to the project. They are responsible for ensuring that plant, equipment and materials are available, as well as complying with statutory requirements.

4.2.3.2 Management: Responsibilities and Pricing

Irrespective of the level or grade of contractor, there is a level of responsibility to adhere to statutory and contractual requirements during a project. The design risk assessment, and project specific H&S specification is generally contained within the tender document developed from stages 1-3, and discussed during the tender briefing. The CHSO or CHSM then need to price a BoQ during Stage 4, develop project and activity HIRAs, develop a H&S plan, and then develop and evolve documentation through the project as it progresses through stages 5 and 6. To do so, at each stage information is required from management, and site supervision to determine the programme and planning. Management has a choice at many levels, and has several opportunities to positively, or negatively affect H&S during the project life cycle.

The following aspects were included in this section of the instrument, namely: 'Management knowingly takes risks'; 'Management is responsible for planning H&S'; 'Management ensures adequate resources relative to H&S'; 'Management is directly involved with H&S'; 'H&S is solely the responsibility of the H&S Manager / Officer'; 'H&S is an integral part of site management responsibilities'; 'H&S is adequately priced for projects', and 'Adequate H&S information is available for projects'.

4.2.4 The 'Stakeholders' Theme

The 'stakeholders' component is a theme that is applicable with the qualitative and quantitative themes, and therefore reported on in both areas. The management of a building or civil project is marginally different in terms of the management thereof. However, all do project management and are not differentiated in the research. Differences are further delineated in the form of contractual document. The construction stakeholders, would generally include the contractor, however for the purposes of the research the contractor is dealt with separately. The aspects included in the stakeholder's theme include 'Project Managers', (PMs); 'Design and Designers', and the 'Client'. The construction stakeholders have several opportunities to positively or negatively affect H&S

during the project life cycle. The qualitative information will be reported on relative to the Participants and their comments that relate to the questions asked in the focus groups.

4.2.4.1 Stakeholders: The Project Managers

Any of the BEPs' could practice as PMs, and lead the project life cycle through stages 1-6. The role of PMs was not included in the initial research, however was included in all the other instruments. The following aspects were included in the research, *inter alia*: 'PMs can positively influence H&S'; 'PMs can negatively influence H&S'; 'PMs can mitigate hazards during all the stages of projects'; 'PMs can eliminate hazards during all the stages of projects'; 'PMs can quantify risk during all the stages of projects', and 'H&S is related to constructability'. PMs have several opportunities to positively or negatively affect H&S during the project life cycle.

4.2.4.2 Stakeholders: Design and Designers

Design is completed by a range of BEPs', who are then deemed 'designers'. Designers may not be involved throughout all the stages, but could be part of either the client's stakeholders, or the contractor. Design occurs mainly through BEPs'. Aspects included for this group included, *inter alia*: 'Design can positively influence H&S'; 'Design can negatively influence H&S'; 'Design contributes to accidents'; 'Designers can identify hazards at design stage': 'Designers can quantify risk at design stage'; 'Designers can mitigate hazards at design stage'; 'Designers can eliminate hazards at design stage'; 'Quantity surveyors' / cost engineers can influence H&S', and 'Designing for H&S' should be a designer competency'. Quantity surveyors or cost engineers are responsible for ensuring stakeholders ensure that contractors are resourced, the requirements for which commence in stages 1-3. Designers influence design, and have several opportunities to positively or negatively affect H&S during the project life cycle.

4.2.4.3 Stakeholders: Client

The client directs and provides the funding for projects, in both the public and private sector. Clients' further directly or indirectly affect complexity relative to constructability. Aspects considered included, *inter alia*: 'Clients directly affect project H&S'; 'Clients' can positively influence H&S'; 'Clients' can negatively influence H&S'; 'Clients' can identify hazards during the conceptual phase', and 'Clients' can identify hazards during the feasibility phase'.

4.2.5 Construction H&S Theme

The construction H&S categories are a further theme that is reported on in the quantitative and qualitative areas. The construction H&S categories could be deemed the H&S catalyst in a project, a link between all the stakeholders and workers. Many of the roles of the identified practitioner H&S categories are categorized in statute. The theme cuts across all the sub-problems, as the interface is between all role players through the life cycle. The two specific sub-problems that address construction H&S, include, *inter alia*:

- CHSAs' do not fulfil their statutory roles, and
- CHSOs' and CHSMs' do not fulfil their statutory roles.

The construction H&S categories in terms of the CHSA were included in all the instruments. The CHSO and CHSM were not included in the initial and second instruments. However, the third instrument, which explored the 'Challenges of Registration' included aspects that related to the CHSO and CHSM. The aspects considered in the 'Challenges to Registration' were phrased differently to reflect the ability to do the work, and the extent to which the respondent agreed or disagreed.

4.2.5.1 Construction H&S: The CHSA

The CHSA is the construction H&S professional category, involved from stages 1-6. The CHSA is appointed by the client, and has statutory roles relative to project H&S. The interface between all role players is to assess and assist the design process relative to H&S, and consider the life cycle as part of the process. The aspects included in the instruments were, *inter alia*: 'CHSA should be procured during the feasibility phase'; 'CHSA can influence H&S during design'; 'CHSA influence H&S during construction'; 'CHSA are given adequate information to perform their duties at each phase of the works'; 'CHSA can play a positive role during construction'; 'CHSA should be an integral part of the design team', and 'Designing for H&S' should be a CHSA competency'. The CHSA is reported on in Chapter 4, regarding perceptions of the CHSA role, and Chapter 5 regarding the links to the construction stages; levels of confidence, their roles and practice.

4.2.5.1.1 Construction H&S: The CHSO and CHSM

The CHSO and CHSM are appointed by the contractor, and are required to compile the required H&S documents from stages 4-6, keep them updated, and in line with the project. The standard services and deliverables for all categories are statutory. CHSOs' are often not permanently

employed, specifically with smaller contractors who do not have continuous work, or not enough work to employ a CHSO or CHSM on a full-time basis. The impact of such practice is that the CHSO is only employed once the contract has commenced. Corporate organisations are generally large enough to employ CHSMs', who may, in turn, have several CHSOs' reporting to the CHSM. The CHSO generally manages and oversees the H&S activities on site, and could work alone for an organisation, on a single or multiple projects. The wider range of aspects reflect the possible challenges to practice in terms of the CHSO or CHSM being able to fulfil their statutory obligations. The aspect regarding the CHSM and CHSO related in the instrument link to the H&S aspects of Management, as a part of the team, and that H&S is the sole responsibility of the CHSM or CHSO.

4.3 INITIAL RESEARCH: MULTI-STAKEHOLDER CONSTRUCTION HEALTH AND SAFETY PERCEPTIONS

The initial research completed was among a group of DoL Inspectors undergoing a two-day construction H&S training module. The training was part of the DoL Inspectors' ongoing internal continuing education, with the training completed over five-days in Johannesburg, during April 2013. The requirement for the training was that pre- and post-test measurement be done. The purpose of doing the pre- and post-test measurement by administering a questionnaire was to determine the perceptions relative to a series of H&S issues, and whether any transfer of knowledge had taken place. At the time of the training, the participating Inspectorate could be considered as 'generalists', with many not having had any built environment training, or a construction H&S background.

Perceptions regarding the practice of H&S engender the culture and attitude toward the sector. The DoL are the statutory enforcement agency, visit all sectors of industry, and investigate fatalities and injuries. In all cases, where liability or negligence is identified, the Inspectorate would take the matter to court for prosecution. Therefore, it could be expected that the Inspectors were well educated, with a specialised interest in the sector, and more importantly have an understanding of the critical issues peculiar to the sector.

According to Sibthorp, Paisley, Gookin and Ward (2007) the use of the 'pre-test / post-test' design is one of the more common ways to evaluate the impact of a programme. However, the 'pre-test / post-test' design method is not without limitations. Sibthorp *et al* (2007) state that where the same

questionnaire is administered pre- and post-training, the measure of comparability relies on the assumption that the scale of measurement or 'metric' is the same pre- and post-intervention. The 'metric' lies within the participants, and therefore could be directly affected by the 'metric'. Where there is change in learning, then the metric should in fact also shift, and therefore, where this does not happen, the ability to measure the comparison pre- and post-test is problematic.

Where participants mark off at the same point of the scale used in both tests, there could well have been substantial learning, but the 'eyes' through which the aspect is seen is different, but could still be the same score when doing the post-test evaluation. Therefore, the results could have significance, even though there is little or no change in the overall score. The form of the aforementioned outcome is noted as 'response-shift bias'.

4.3.1 Impact of DoL Inspector Construction Health and Safety (H&S) Training (pre-and post-training)

Each question included a statement relating to the topic at hand that linked to the identified S-Ps'' of the research, noted in Chapter 4. The respondents were afforded a choice of answers that included: 'unsure' (U), 'strongly disagree' (SD), 'disagree'(D), 'neutral'(N), 'agree' (A), and 'strongly agree'(SA). The responses to both the pre- and post-training questionnaires are included in Table 4.1 for ease of reference. Further inferential analysis was conducted on the outcome of the two data sets. The outcome indicated some shift of thinking. Further inferential analysis was conducted on the outcome of the two data sets. The outcome indicates some shift of thinking. Table 4.1 below illustrates the mean score ranges and the degree of concurrence (DoC), or definition of the ranges, based upon the responses to the questions included in the questionnaires.

Table 4.1 Mean Score and associated DoC.

Mean Score range ($\bar{x}$)	**Degree of concurrence**
$4.20 < \bar{x} < 5.00$	agree to strongly agree / strongly agree
$3.40 < \bar{x} < 4.20$	neutral to agree / agree
$2.60 < \bar{x} < 3.40$	disagree to neutral / neutral
$1.80 < \bar{x} < 2.60$	strongly disagree to disagree / disagree
$1.00 < \bar{x} < 1.80$	unsure

4.3.2 Inferential Statistical Analysis

Other statistical analysis was done for the initial research, as it was a comparative analysis. An inferential two-sided t-test and Cohen's d were applied to the differences between the pre- and post-test MSs' for each statement. A two-sided t-test determines whether the mean scores of two samples are significantly different. A t-test calculation obtains a probability value that indicates the likelihood of having obtained the results by chance. The results of the two-sided t-test are presented.

The sample size included a total of 102 Inspectors, from all categories within the DoL. Each Inspector completed the same questionnaire pre- and post-training. The response rate was 100%. The findings are separated into cross cutting themes that link to the S-Ps' and hypotheses, and which are aligned to the other studies reported on, namely the workers, supervisors, management, the client, designers, and the construction practitioner H&S categories.

Table 4.2 DoL Inspectors' Pre- and Post-training Multi-Stakeholders' Construction Health and Safety (H&S) Perceptions (General).

No	Statement	Pre-training response (%)							Post-training response (%)						
		U	SD	D	N	A	SA	MS	U	SA	D	N	A	S/	MS
1	All accidents are preventable	0.0	10.0	34.0	11.0	25.0	20.0	**3.11**	0.0	4.0	24.8	3.0	30.7	37.6	**3.73**
2	Accidents are planned events	1.0	46.0	46.50	2.0	3.0	1.0	**1.64**	0.0	44.6	31.7	5.0	15.8	3.0	**2.01**
3	Construction is inherently dangerous	0.0	5.1	18.2	9.1	43.4	24.2	**3.64**	1.0	7.8	21.6	3.9	49.0	16.7	**3.46**
4	Accidents are part of the job	1.0	32.0	29.9	6.2	24.7	6.2	**2.43**	0.0	29.0	35.0	6.0	26.0	4.0	**2.41**
5	'I am my brother's / sister's keeper'	5.2	14.4	8.2	6.2	34.0	32.0	**3.64**	0.0	3.9	8.8	2.9	37.3	47.1	**4.15**
6	Cost, quality, and time are more important than H&S	0.0	66.0	19.6	1.0	5.2	8.2	**1.70**	0.0	60.4	25.7	0.0	5.9	7.9	**1.75**
7	There are financial benefits to investing in H&S	1.0	4.0	5.9	4.0	32.7	52.5	**4.25**	0.0	3.0	2.0	1.0	40.4	53.5	**4.39**
8	Evaluation of project performance should include H&S	0.0	2.0	0.0	1.0	36.0	61.0	**4.54**	0.0	0.0	0.0	0.0	44.4	55.6	**4.56**

Table 4.2 indicates that there was support in the post-training results to the responses relating to the statements 'All accidents are preventable', 'I am my brother's / sister's keeper', 'There are financial benefits to investing in H&S', and 'Evaluation of project performance should include H&S'. Aspects such as 'Accidents are part of the job', 'Accidents are planned events', and 'There are financial benefits to investing in H&S' were noted in the 'unsure' responses, and where there was significant shift when responding in the post-training questionnaire, relative to other categories.

Table 4.3 DoL Inspectors' Pre- and Post-training Multi-Stakeholders' Construction Health and Safety (H&S) Perceptions (Workers).

No	Statement	Pre-training response (%)							Post-training response (%)						
		U	SD	D	N	A	SA	MS	U	SD	D	N	A	SA	MS
9	Workers knowingly take risks	2.0	7.9	18.8	14.9	39.6	16.8	**3.39**	0.0	7.8	21.6	8.8	44.1	17.6	**3.42**
10	Workers are adequately trained in H&S	2.9	27.5	48.0	8.8	9.8	2.9	**2.10**	2.0	16.7	38.2	12.7	27.5	2.9	**2.61**
11	Workers have adequate resources relative to H&S	1.0	13.7	55.9	13.7	10.8	4.9	**2.37**	0.0	14.9	48.5	16.8	16.8	3.0	**2.45**
12	Workers are included in decisions relative to H&S	0.0	32.0	45.0	8.0	13.0	2.0	**2.08**	0.0	24.0	40.0	12.0	17.0	7.0	**2.43**

Table 4.3 indicates the responses regarding aspects relating to workers. There was a positive reduction in the 'unsure' responses between pre- and post-training, and a marginally lower shift in the 'neutral' responses. Only statement No. 12, relative to the 'neutral' response increased post-training. Respondents shifted from disagreeing that 'Workers knowingly take risks', to agreeing that they do. There was a negative shift in the statement 'Workers are adequately trained in H&S', including that of 'Workers are included in decisions relative to H&S'.

Table 4.4 DoL Inspectors' Pre- and Post-training Multi-Stakeholders' Construction H&S Perceptions (Management: Supervisors).

No	Statement	Pre-training response (%)							Post-training response (%)						
		U	SD	D	N	A	SA	MS	U	SD	D	N	A	SA	MS
13	Supervisors knowingly take risks	2.0	5.9	20.6	19.6	41.2	10.8	**3.31**	1.0	4.9	17.6	9.8	48.0	18.6	**3.58**
14	Supervisors are adequately trained in H&S	1.0	13.7	49.0	17.6	16.7	2.0	**2.44**	1.0	10.9	33.7	19.8	29.0	5.0	**2.84**
15	Supervisors are given adequate resources relative to H&S	2.0	14.9	49.5	19.8	14.9	4.0	**2.58**	1.0	10.0	34.0	18.0	29.0	4.0	**2.71**
16	Supervisors are involved in H&S	2.0	8.0	45.0	16.0	44.0	5.0	**3.54**	2.0	5.9	37.3	11.8	49.0	9.8	**3.68**

Table 4.4 indicates responses relating to supervision. There was no significant shift from the respondents in the 'unsure' and 'neutral' categories pre-training. In most of the statements the group only shifted positively with respect to 'Supervisors knowingly take risks', where the MS increased, but the DoC remained in neutral to agree / agree.

Table 4.5 DoL Inspectors' Pre-and Post-training Multi-Stakeholders' Construction H&S Perceptions (Management).

No	Statement	Pre-training response (%)							Post-training response (%)						
		U	SD	D	N	A	SA	MS	U	SD	D	N	A	SA	MS
17	Management knowingly takes risks	1.0	6.0	25.0	14.0	44.0	22.0	**3.88**	1.0	2.0	21.8	5.9	49.5	26.7	**3.99**
18	Management is responsible for planning H&S	1.0	3.0	12.9	4.0	36.6	51.5	**4.49**	1.0	1.0	14.7	1.0	41.2	51.0	**4.57**
19	Management ensures adequate resources relative to H&S	2.9	10.8	3.9	14.7	27.5	17.6	**2.69**	0.0	6.9	4.9	7.8	36.3	17.6	**2.74**
20	Management is directly involved with H&S	0.0	7.8	26.5	5.9	37.3	25.5	**3.55**	0.0	4.0	32.0	4.0	52.0	24.0	**4.08**
21	H&S is solely the responsibility of the H&S Manager / Officer	0.0	53.5	23.8	5.9	10.9	5.0	**1.87**	0.0	45.5	15.8	2.0	11.9	5.0	**1.55**
22	H&S is an integral part of site management responsibilities	0.0	4.0	25.0	9.0	40.0	40.0	**4.41**	0.0	8.8	35.3	2.9	41.2	42.2	**4.64**
23	H&S is adequately priced for projects	8.2	24.5	7.1	13.3	16.3	10.2	**2.12**	1.0	19.2	5.1	10.1	31.3	11.1	**2.43**
24	Adequate H&S information is available for projects	6.1	12.1	27.3	11.1	28.3	12.1	**2.91**	0.0	13.9	26.7	12.9	37.6	11.9	**3.16**

Table 4.5 considers the perceptions relating to managements role in construction H&S. The shift from the 'unsure' responses indicated some shift, specifically on aspects No. 19, 'Management ensures adequate resources relative to H&S', No. 23 regarding pricing for H&S, and No. 24 regarding H&S information. Similarly, those that responded reagarding the 'neutral' categories reduced, but none completely. There was a marginal increase in the post-training MSs' in the 'neutral' category for No. 24. There were more positive shifts in agreeing that 'Management is responsible for planning H&S' and 'Management knowingly takes risks'.

Table 4.6 DoL Inspectors' Pre- and Post-training Multi-Stakeholders' Construction H&S Perceptions (Designers).

No	Statement	Pre-training response (%)							Post-training response (%)						
		U	SD	D	N	A	SA	MS	U	SD	D	N	A	SA	MS
25	H&S is related to constructability	5.1	1.0	30.3	16.2	49.5	21.2	**4.36**	1.0	3.0	23.8	2.0	61.4	27.7	**4.45**
26	Design can positively influence H&S	1.0	0.0	6.9	5.0	48.5	37.6	**4.15**	0.0	0.0	4.9	1.0	47.1	51.0	**4.56**
27	Design can negatively influence H&S	3.0	11.0	8.0	11.0	40.0	24.0	**3.51**	0.0	4.9	1.0	2.9	39.2	42.2	**3.83**
28	Design contributes to accidents	4.0	4.0	10.9	13.9	45.5	16.8	**3.47**	1.0	5.9	10.9	4.0	47.5	35.6	**4.12**
29	Designers can identify hazards at design stage	1.0	0.0	15.7	4.9	59.8	31.4	**4.42**	0.0	2.9	5.9	0.0	45.1	51.0	**4.50**
30	Designers can quantify risk at design stage	2.9	2.0	2.9	9.8	55.9	23.5	**3.78**	0.0	1.0	1.0	6.9	52.0	36.3	**4.13**
31	Designers can mitigate hazards at design stage	3.9	2.0	5.9	9.8	52.9	26.5	**3.87**	0.0	1.0	3.9	0.0	53.9	42.2	**4.35**
32	Designers can eliminate hazards at design stage	2.0	3.9	4.9	11.8	52.0	22.5	**3.70**	0.0	2.0	3.0	1.0	51.5	41.6	**4.25**
33	'Designing for H&S' should be a designer competency	1.0	4.0	8.0	11.0	43.0	36.0	**4.05**	0.0	1.9	3.8	1.9	46.2	47.1	**4.36**
39	Quantity surveyors / cost engineers can influence H&S	1.0	2.0	6.1	4.1	57.1	29.6	**4.03**	1.0	0.0	5.9	3.0	53.5	36.6	**4.18**
40	The design team ensures adequate H&S information in tender documentation	5.9	5.9	5.9	12.9	35.6	17.8	**2.88**	3.0	8.0	6.0	5.0	44.0	23.0	**3.26**

Table 4.6 indicates the role of designers' relative to H&S. A significant number of respondents shifted from 'unsure' to 'agree / strongly agree' stance post-training. Overall, there was a reduction in the 'neutral' category post-training. The responses indicate that designers have a very strong influence on the risk identification, mitigation and elimination processes. The statement 'The design team ensures adequate H&S information in tender documentation' shifted in the pre-test from a MS of 2.88 to a post-test MS to 3.26 indicating an increase in the support of the statement.

Table 4.7 DoL Inspectors' Pre- and Post-training Multi-Stakeholders' Construction H&S Perceptions (Clients').

No	Statement	Pre-training response (%)							Post-training response (%)						
		U	SD	D	N	A	SA	MS	U	SD	D	N	A	SA	MS
34	Clients' directly affect project H&S	3.0	2.0	5.0	15.8	48.5	23.8	**3.72**	1.0	2.0	2.9	3.9	52.0	33.3	**3.94**
35	Clients' can positively influence H&S	3.0	1.0	6.9	10.9	50.5	31.7	**4.08**	0.0	2.0	7.8	1.0	60.8	33.3	**4.30**
36	Clients' can negatively influence H&S	4.0	7.0	3.0	15.0	38.0	26.0	**3.40**	0.0	4.0	3.0	4.0	50.5	26.7	**3.57**
37	Clients' can identify hazards during the conceptual phase	4.0	1.0	10.0	14.0	54.0	20.0	**3.79**	1.0	2.0	14.7	7.8	60.8	24.5	**4.21**
38	Clients' can identify hazards during the feasibility phase	3.0	1.0	7.1	16.2	57.6	16.2	**3.75**	0.0	1.0	4.0	5.0	65.0	23.0	**3.99**

Table 4.7 reflects on the impact of the client on construction H&S. There were a high number of respondents who were 'unsure' in the pre-training questionnaire, which reduced in most cases as noted in the post-training results. It was noted that the 'neutral' did shift to 'agreeing'. Many of respondents scores increased relative to the aspects relating to the role of clients' and the positive effect on project H&S through the life cycle. Clients' affect the design processes with the appointment of competent designers and contractors. The statements regarding clients' identifying hazards during stage 2 (Concept and

Feasibility) of the construction life cycle shifted notably in the post-test survey. The high MSs' across all the 'client' statements indicate the respondents support for the statements.

Table 4.8 DoL Inspectors' Pre- and Post-training Multi-Stakeholders' H&S Perception (Client Construction H&S Agent).

No	Statement	Pre-training response (%)							Post-training response (%)						
		U	SD	D	N	A	SA	MS	U	SD	D	N	A	SA	MS
41	Client H&S Agents should be procured during the feasibility phase	3.0	1.0	22.2	17.2	53.5	23.2	**4.27**	2.0	1.0	17.0	1.0	61.0	32.0	**4.42**
42	Client H&S Agents can influence H&S during design	4.0	0.0	2.0	11.9	50.5	23.8	**3.60**	1.0	1.0	2.9	2.9	57.8	29.4	**3.94**
43	Client H&S Agents influence H&S during construction	3.0	0.0	9.9	7.9	59.4	23.8	**4.00**	0.0	1.0	7.8	3.9	59.8	29.4	**4.15**
44	Client H&S Agents are given adequate information to perform their duties at each phase of the works	5.9	6.9	5.9	14.9	35.6	12.9	**2.70**	1.0	5.9	5.9	14.9	40.6	19.8	**3.24**
45	Client H&S Agents can play a positive role during construction	0.0	0.0	23.8	2.0	56.4	40.6	**4.82**	0.0	0.0	17.8	2.0	60.4	37.6	**4.71**
46	Client H&S Agents should be an integral part of the design team	1.0	0.0	1.0	8.8	45.1	40.2	**4.10**	0.0	0.0	0.0	2.0	52.5	42.6	**4.29**
47	'Designing for H&S' should be a client H&S Agent competency	2.0	0.0	5.0	9.9	46.5	34.7	**3.99**	0.0	0.0	2.9	2.9	49.0	38.2	**4.02**

Table 4.8 indicates that those who were ‘unsure’ reduced significantly between the pre- and post-training. In terms of those who were ‘neutral’, the post-training scores also reduced significantly, except for ‘Client H&S Agents can play a positive role during construction’, which increased from an MS of 2.70 to 3.24 post-training, and therefore is supported. Regarding the role of the CHSA in general, the majority ‘agree’ to ‘strongly agree / strongly agree’. All the other MSs’ indicate a high degree of concurrence, being ‘agree to strongly agree / strongly agree’.

4.3.3 Discussion of findings

The findings of the initial survey were notable, but at the same time, perhaps not. Perceptions are just that, and given the background described in the introduction to the initial research, the two-day training programme clearly had some impact, but not relative to every sphere investigated. The shifts in perceptions were not reported on per respondent, or per respondent per area of shift. The respondents were not given an opportunity to comment or feedback on their experience of the training. The significant areas of responses to the ‘negative end of the ‘correct’ answers indicate the typical training those in the H&S sector are exposed to, and as reported in the literature review. The aspect ‘Accidents are planned events’ was not supported, which is contrary to the current literature where the statement becomes true. A person placing material in a walkway, for example, consciously does so, thereby creating an opportunity for an accident to occur.

The aspect ‘Construction is inherently dangerous’ was also not supported. The word ‘inherently’ used in this aspect, indicates that the sector is highly dangerous, and there is essentially no way of reducing the risks. Workers are not, in many cases included in decisions around work, and do not necessarily know whether a decision being made relative to a specific activity is incorrect or correct. This is particularly true where workers are from a community, and inexperienced in terms of construction work. Workers could be considered as indispensable in some cases, and if they argue against more senior staff the risk is that the worker may lose their job. DoL Inspectors visiting site may meet with workers as per their statutory roles of enforcement, but the aforementioned could influence the workers level of honesty or participation.

Respondents did not support many of the aspects relating to supervisors and managers. The aspects regarding managements involvement with H&S and providing resources is not supported, but the role of sharing H&S responsibility on site is however supported.

The latter aspect was noted as a contrast to the statement that H&S is integral to site activities, pricing, and the level of H&S information available. In these areas while there were shifts in the 'unsure' responses, there was not a significant decrease in the 'neutral' responses. The minimal shift from 'neutral' could be an indication that the respondents were unable to reach a conclusion with respect to the specific aspect. It is the experience of the researcher that workers may be trained, however, the level of training is aligned to the management approach, and their commitment or resourcing allocated to H&S. Respondents did not support the notion of supervisors and management knowingly taking risks relative to H&S, training of workers and ensuring adequate resources. The finding is contrary to the number of fatalities, injury and disease rates. Such rates would be lower if greater attention to training, resources and planning of activities were adequate. The minimal shift in the 'unsure' and 'neutral' categories in several areas could be an indication that further training is needed, as the information provided was insufficient, or too short in duration as it did not allow for a decision to shift in any direction. In contrast, aspects considering the roles of the designer, client, and the CHSA were very well supported.

The t-test results for the pre- and post-training is shown in Table 4.9.

Table 4.9 t-Test: Two-Sample results.

t-Test: Two-Sample - Assuming Unequal Variances	**Pre-training**	**Post-training**
Mean	3.427446809	3.661914894
Variance	0.690741166	0.703685384
Observations	47	47
Hypothesised Mean Difference	0	
df	92	
t Stat	-1.361240444	
P(T<=t) one-tail	0.088381256	
t Critical one-tail	1.661585397	
P(T<=t) two-tail	0.176762511	
t Critical two-tail	1.986086317	

The results of the two-tailed T-test did not show any significant differences. The t value (t Stat) is less than t critical, and $p > 0.05$, therefore the results are not statistically significant.

4.3.4 Conclusions

The results and the lack of significant statistical differences in the inferential testing could be that there is a response-shift bias. All the respondents were not familiar with all the construction H&S issues and the training programme could (and should) be repeated to provide further information for respondents to facilitate a further shift in their perceptions.

The mostly negative responses to general H&S perceptions, workers, supervisors, and managers relating to the aspects posed could lead to complacency in the Inspectorate, in that that workers are well taken care of, trained and given all the resources needed. The lack of such aspects is contrary to the statutory requirements, increases project risk, and the potential that workers could be injured or killed.

Overall, responses were positive regarding the aspects relating to the roles of the designer, client, and CHSA, with the greatest level of 'shift'. The training relative to this aspect was very graphic, with discussions around specific projects, and how the design aspect impacted on the project. The consideration is that many of the respondents may not have any experience in construction, and could not necessarily visualise the extent of the hazards, and the possible ways to reduce them, which may well have influenced them in terms of their perceptions.

4.4 SECOND RESEARCH ACTIVITY: MULTI-STAKEHOLDER CONSTRUCTION HEALTH AND SAFETY PERCEPTIONS

The ECDRPW was requested to participate in the multi-stakeholder survey, as they were involved with projects across all districts in the Eastern Cape. Following consent from the ECDRPW a total of five practicing CHSAs' in the areas of East London, and Port Elizabeth assisted with the dissemination and collection of questionnaires. The questionnaires were limited to ECDRPW projects. The purpose of the approach for this research was to determine the perceptions of all stakeholders who could be involved on the project. The questionnaires were to be presented at site progress meetings, using a snowball approach. All of those attending the meetings were requested to participate and complete the questionnaire. The facilitators were requested to report on the numbers of meetings or projects attended, as well as submit an attendance register to determine the response rates and participation, and area of the project.

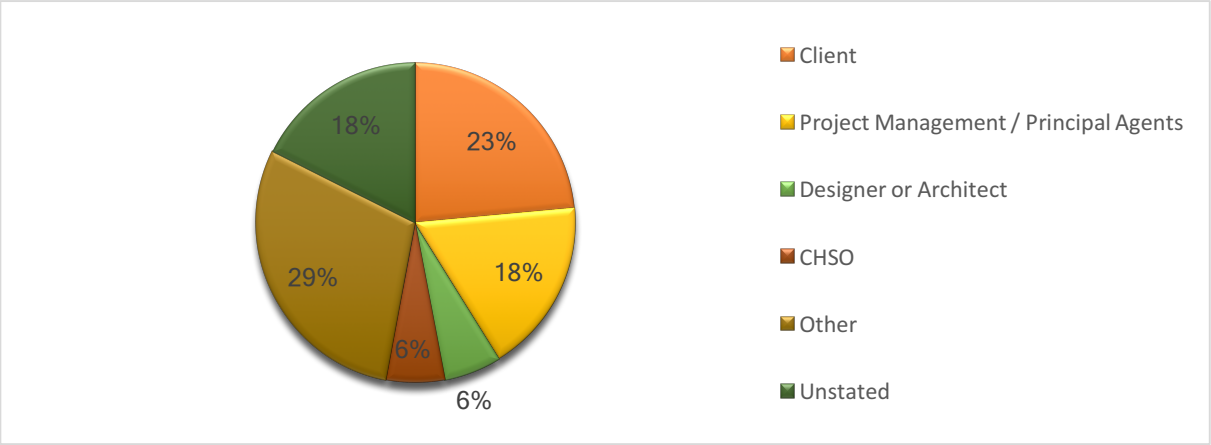
Generally, project progress or technical site meetings are attended by the client, designers, community members, the principal contractor (PC), social facilitators, the environmentalist and other interested parties from the community or local government. Therefore, the outcome could provide a broad range of perceptions regarding the stakeholder roles relative to H&S.

4.4.1 Discussion of Findings

The preliminary findings from a total of 32 questionnaires received from the adapted instrument are discussed, for the various general to specific construction H&S, and construction and project management categories. As the total number of questionnaires distributed by the facilitators was unknown, and no response rate could be determined, the results of the survey can only be noted as exploratory.

The mean months of experience across all categories were 189.4 months. Figure 4.1 indicates the disciplines and distribution of respondents. There are many 'Other' and the lack of recording of the source of the respondents. Given that the attendance of site meetings is generally by stakeholders from the community and interested parties, it is unfortunate that a more diverse set of results could not have been reported on. However, it is possible that the 'Other' are community and interested parties.

Figure 4.1 Disciplines of respondents.



The DoC is represented in terms of percentage responses to a scale of 1 (strongly disagree (SD)) to 5 (strongly agree (SA)), and a corresponding MS between 1.0 and 5.0. The DoC relating to the scale is presented in the table below.

Table 4.10 Mean Score Range and DoC.

Mean score range ($\bar{x}$)	**Degree of concurrence**
$4.20 < \bar{x} < 5.00$	agree to strongly agree / strongly agree
$3.40 < \bar{x} < 4.20$	neutral to agree / agree
$2.60 < \bar{x} < 3.40$	disagree to neutral / neutral
$1.80 < \bar{x} < 2.60$	strongly disagree to disagree / disagree
$1.00 < \bar{x} < 1.80$	unsure

MSs' > 3.00 in Table 4.10 indicates that there is agreement as opposed to disagreement. The evaluation of project performance should include H&S; that there are financial benefits to investing in H&S; the sector is inherently dangerous, and all accidents are preventable. The respondents identified the sector as 'inherently dangerous', which implies that the respondents perceive that there is nothing that can, or could have been done to reduce the project H&S risk. Given that it is not inherently dangerous, the MS should be ≤ 3.00.

Table 4.11 Multi-Stakeholders' H&S Perceptions (General).

Statement	Response (%)						MS
	UU	SD	D	N	A	SA	
Evaluation of project performance should include H&S	0.0	0.0	0.0	4.5	68.2	27.3	**4.23**
There are financial benefits to investing in H&S	0.0	0.0	7.1	16.7	54.8	21.4	**3.90**
Construction is inherently dangerous	0.0	2.3	20.9	4.7	58.1	14.0	**3.60**
All accidents are preventable	0.0	6.8	29.5	9.1	34.1	20.5	**3.32**
'I am my brother's / sister's keeper'	4.9	12.2	19.5	9.8	36.6	17.1	**3.28**
Accidents are part of the job	5.0	15.0	32.5	10.0	35.0	2.5	**2.76**
Cost, quality, and time are more important than H&S	0.0	26.2	45.2	9.5	11.9	7.1	**2.29**
Accidents are planned events	4.7	27.9	46.5	7.0	9.3	4.7	**2.12**

A further significant aspect is that the statement 'Accidents are planned events' is deemed not important, with the respondents concurring with the statement.

The MS of 'Cost, quality, and time are more important than H&S' contrasts with the MS relative to 'All accidents are preventable.' There were many 'neutral' responses, which indicates respondents neither agree, or disagree with the general issues.

Table 4.12 Multi-Stakeholders' H&S Perceptions (Workers).

Statement	Response (%)						MS
	U	SD	D	N	A	SA	
Workers knowingly take risks	0.0	4.9	12.2	19.5	56.1	7.3	**3.49**
Workers have adequate resources relative to H&S	9.3	0.0	30.2	20.9	37.2	2.3	**3.13**
Workers are included in decisions relative to H&S	9.8	7.3	26.8	19.5	36.6	0.0	**2.95**
Workers are adequately trained in H&S	6.8	4.5	38.6	22.7	27.3	0.0	**2.78**

Table 4.12 indicates the perceptions relative to risk taking behaviour, training and resources and H&S decision making. It appears if respondents have the perception that workers deliberately and knowingly take risks. The respondents agree that workers are provided with adequate resources to do their work on site, that workers are included in decision making and that there is adequate training. However, there is a very high score relative to 'neutral', indicating they neither agree or disagree, and 'unsure' responses, which could indicate the respondents lack of knowledge on the aspect.

Table 4.13 Multi-Stakeholders' H&S Perceptions (Management: Supervisors).

Statement	Response (%)						MS
	U	SD	D	N	A	SA	
Supervisors are involved in H&S	4.5	0.0	9.1	27.3	47.7	11.4	**3.64**
Supervisors are given adequate resources relative to H&S	2.3	2.3	18.6	16.3	53.5	7.0	**3.45**
Supervisors are adequately trained in H&S	6.8	0.0	18.2	20.5	52.3	2.3	**3.41**
Supervisors knowingly take risks	2.4	2.4	23.8	23.8	45.2	2.4	**3.22**

Table 4.13 indicates that site supervision is very involved with H&S, have the resources they need, and are trained in H&S. However, supervisors are also noted as risk takers. Of importance in the sector is the number of 'unsure' responses, indicating those that responded are lacking in knowledge or scope of work for supervisors, and 'neutral' statements, indicating they neither agree or disagree.

Three of the 4 statements regarding supervision are not supported by the respondents, but their taking risks is. The issue relative to the responses if true, would have an impact on the reduction of accidents, fatalities and diseases.

Table 4.14 Multi-Stakeholders' H&S Perceptions (Management: H&S Responsibilities and pricing).

Statement	Response (%)						MS
	U	SD	D	N	A	SA	
H&S is an integral part of site management responsibilities	0.0	4.8	2.4	9.5	57.1	26.2	**3.98**
Adequate H&S information is available for projects	4.7	0.0	20.9	23.3	44.2	7.0	**3.39**
H&S is adequately priced for projects	9.1	11.4	25.0	18.2	25.0	11.4	**3.00**
H&S is solely the responsibility of the H&S Manager / Officer	0.0	32.6	39.5	9.3	14.0	4.7	**2.19**

Table 4.14 indicates that respondents 'disagree', are "unsure', or 'neutral' regarding pricing for H&S on projects. Respondents are in many cases 'unsure' or 'neutral' regarding pricing, with the responses equally distributed across the 'agree', strongly agree' and 'disagree', 'strongly disagree' statements, indicating that they do not know what 'adequate' means, or are not involved with pricing.

Respondents agree with the aspect of H&S being an integral part of site management responsibility; but do not support the issue that H&S responsibility should be borne by the CHSO alone.

Table 4.15 Multi-Stakeholders' H&S Perceptions (Project Managers).

Statement	Response (%)						MS
	U	SD	D	N	A	SA	
Project managers can positively influence H&S	4.5	0.0	2.3	4.5	72.7	15.9	**4.07**
Project managers can mitigate hazards during all the stages of projects	2.3	2.3	4.5	4.5	75.0	11.4	**3.91**
Project managers can eliminate hazards during all the stages of projects	2.3	0.0	14.0	7.0	62.8	14.0	**3.79**
H&S is related to constructability	0.0	0.0	9.1	25.0	54.5	11.4	**3.68**
Project managers can quantify risk during all the stages of projects	4.5	0.0	4.5	18.2	61.4	11.4	**3.66**
Project managers can negatively influence H&S	2.3	2.3	14.0	7.0	67.4	7.0	**3.64**

Table 4.15 indicates the perceptions of the roles PMs' can play on a project relative to H&S. It appears that respondents consider that PMs' can have a positive influence on H&S, and can mitigate (reduce) risks through life cycle. It is notable the respondents record that PMs' can eliminate hazards through the construction life cycle, the link with H&S and constructability and the PM's ability to quantify risks. There is a high level of 'neutral' responses for these statements.

Table 4.16 Multi-Stakeholders' H&S Perceptions (Design and Designers).

Statement	Response (%)						MS
	U	S D	D	N	A	S A	
Design can positively influence H&S	4.5	0.0	6.8	15.9	61.4	11.4	**3.64**
The design team ensures adequate H&S information in tender documentation	2.3	2.3	15.9	13.6	56.8	9.1	**3.48**
'Designing for H&S' should be a designer competency	2.3	4.5	6.8	22.7	59.1	4.5	**3.45**
Designers can identify hazards at design stage	4.5	0.0	18.2	9.1	63.6	4.5	**3.41**
Designers can mitigate hazards at design stage	4.5	2.3	13.6	15.0	54.5	9.1	**3.41**
Design can negatively influence H&S	2.3	2.3	16.3	20.9	53.5	4.7	**3.35**
Designers can eliminate hazards at design stage	2.3	2.3	25.0	13.6	54.5	2.3	**3.23**
Designers can quantify risk at design stage	4.5	2.3	15.9	20.5	54.5	2.3	**3.25**
Design contributes to accidents	2.4	2.4	33.3	26.2	35.7	0.0	**2.90**

Table 4.16 indicates the respondents' perceptions regarding design and designers. Respondents indicated the positive influence of design in H&S, and but respondents noted that there is adequate provision of H&S information in tender documentation. There appears to be some ambivalence regarding the elimination of hazards and that design contributes to hazards. The statements 'design can positively influence H&S' MS of 3.64 indicates the DoC can be deemed to be between 'neutral to agree / agree'. The DoCs for the statements 'Design can negatively influence H&S', is 'neutral to agree / agree' and 'Designers can eliminate hazards at design stage', and 'Design contributes to accidents', 'disagree to neutral / neutral'.

Further responses indicate the role of identification and mitigation of risk during design. A significant issue is the relatively high MSs', therefore supporting the statements. It was noted a marginal level of 'unsure' responses indicating possible lack of knowledge in the aspect, and a fairly significant number of 'neutral' responses, indicating respondents neither agreeing or disagreeing.

Table 4.17 Multi-Stakeholders' H&S Perceptions (Client).

Statement	Response (%)						MS
	U	S D	D	N	A	S A	
Clients' can positively influence H&S	3.0	1.0	6.9	10.9	50.5	31.7	**4.08**
Clients' can identify hazards during the conceptual phase	4.0	1.0	10.0	14.0	54.0	20.0	**3.79**
Clients' can identify hazards during the feasibility phase	3.0	1.0	7.1	16.2	57.6	16.2	**3.75**
Clients' directly affect project H&S	3.0	2.0	5.0	15.8	48.5	23.8	**3.72**
Clients' can negatively influence H&S	4.0	7.0	3.0	15.0	38.0	26.0	**3.40**

Table 4.18 Multi-Stakeholders' H&S Perceptions (Client H&S Agent).

Statement	Response (%)						MS
	U	SD	D	N	A	SA	
Client H&S Agents can play a positive role during construction	0.0	0.0	0.0	4.5	75.0	20.5	**4.16**
Client H&S Agents influence H&S during construction	2.3	0.0	2.3	9.1	75.0	11.4	**3.89**
'Designing for H&S' should be a client H&S Agent competency	4.5	2.3	4.5	15.9	54.5	18.2	**3.68**
Client H&S Agents should be an integral part of the design team	4.5	0.0	9.1	15.9	54.5	15.9	**3.64**
Client H&S Agents should be procured during the feasibility phase	7.0	0.0	7.0	16.3	53.5	16.3	**3.58**
Client H&S Agents can influence H&S during design	4.7	2.3	4.7	18.6	62.8	7.0	**3.53**
Client H&S Agents are given adequate information to perform their duties at each phase of the works	4.8	0.0	11.9	23.8	54.8	4.8	**3.38**

Table 4.18 indicates the respondents' perceptions regarding the role of the CHSA. A large percentage 'agreeing' across most of the aspects. The larger percentage of respondents 'agree' that there is a strong influence of the CHSA on the client, the design team, procurement during feasibility, and their influence during design stage, and to a slightly lesser degree, the amount of information given to perform their duties during each of the stages of work.

The respondents were given an opportunity to make comments, however there were only two comments made:

- "*All H&S should be measurable by management*", and
- "*A good lesson/talk should be given before the questionnaire.*"

The second research effort, noted as exploratory research, among a broad range of stakeholders indicated a greater level of H&S support regarding statements for each of the aspects investigated. However, the number of respondents of 'unsure' and more significantly the 'neutral' (neither agreeing or disagreeing) group, indicates that the respondents could well be less informed regarding the roles and responsibilities of the stakeholders and H&S. The outcome of the aforementioned indicates that there is little or no sharing of H&S or H&S knowledge among several of the stakeholders. Furthermore, the aforementioned responses are indicative of perhaps the lack of involvement of the appropriate procurement, the service deliverables of the construction H&S groups and the overall impact on life cycle.

Respondents appear to have the perception that workers deliberately and knowingly take risks; workers are provided with adequate resources to do their work; they are included in H&S decision making, and receive adequate training. The four statements regarding supervision are not supported by the respondents, but supervisors taking risks is. The issue relative to the responses, if true would have an impact on the reduction of accidents, fatalities and diseases, which is not the case.

Respondents support the notion that pricing and H&S are an integral part of site management and part of their responsibility. The respondents further appear to believe there is adequate H&S information and pricing for projects, which are not supported in the literature. There is a paucity of literature regarding the notion of what adequate information is, and what constitutes adequate financial resourcing. The responsibility of H&S being only that of the CHSO is not supported, but

supports the issue that H&S responsibility should not be borne by the CHSO alone. Each of the aspects considered relating to the role of management and pricing are sourced from the CR's (RSA, 2014), so compliance in these areas are deemed statutory requirements.

Respondents indicated the positive influence of design in H&S, and but again as noted in the management and pricing of projects, that there is adequate provision of H&S information in tender documentation. There appears to be some ambivalence regarding the elimination of hazards and that design contributes to hazards by designers. All the responses regarding PMs could be deemed significant. The responses indicate that PM's can have a positive influence on H&S, and can mitigate (reduce) risks through life cycle.

Respondents perceptions regarding the role of the client and H&S indicate a high level of support. Clients' can have a positive effect on project H&S, and just as important is the issue of the potential negative influence clients' could have. There is concurrence regarding the role of the client, and that the client overall, is key to the H&S on the project.

Respondents appear to believe very strongly that the role of the CHSA is important, and their role has a positive influence in construction H&S.

4.4.2 Conclusions

Construction does not happen in isolation, or from an individual level. The findings indicate that respondents in this group are perhaps less informed of H&S, which could in turn have a negative effect on the project. The high level of 'unsure' and 'neutral' responses indicates that the respondents were quite honest in their reporting of their perceptions, but also that the other stakeholders who are involved in these projects need more information on H&S issues prior to participation to better support the process.

The concern regarding the level of H&S information and pricing as being adequate could be relative to the paucity of information available, specifically in the South African setting. As there has been an increase in the information and inclusion of pricing in the BoQs' within the ECDRPW over the past few years, role players may perceive the actions as adequate, and within statutory limits.

The findings therefore support the international literature included relative to roles, the stakeholders and the responsibilities of each during the construction life cycle.

Chapter 5 will present the qualitative surveys.

CHAPTER 5: QUALITATIVE SURVEYS

5.1 FOREWORD

The quantitative data was presented in Chapter 4. Several themes were selected to frame the data that included the respondents' perceptions of the multi-stakeholders that practice in construction.

The qualitative aspect of the research is presented in the themes initially in the same manner as the quantitative data was presented. Several themes are considered for the presentation of the qualitative data, that do not necessarily overlap the themes posited in Chapter 4, but do complement them in terms of the research. The methodology used and reasons for choices are found and discussed in Chapter 3.

The qualitative aspect of the research provides a deeper understanding, a human involvement that leads to obtaining rich data from the participants experiences. The discussions across the themes identified in the quantitative data analysis complement the quantitative data sets, and add to a greater depth of understanding that will contribute to the development of the theoretical model. The model will be discussed in Chapter 6.

The debate regarding the most appropriate methodology of research prevails across the wide range of society. Quantitative or qualitative methods, mixed or triangulated have rigorous methods that should be applied and is dependent upon preferred outcome. Quantitative research relies on objectivity and precise measuring of variables, and tests hypotheses, whereas qualitative research is interpretive, with the emphasis on a more natural flow, and 'soft' data.

5.2 INTRODUCTION

The qualitative aspect took the form of three FGs' held among one 'building' group, and two groups mainly working in the civil environment. The research sample was obtained from a range of stakeholders from the BEPs' and construction H&S sectors.

The range allowed for varied and dynamic discussions and extensive learning from the various groups. The questions posed for the qualitative research were marginally different for each of the three FGs'. Due to time constraints and the time that was needed to ensure understanding of the procurement process followed by each group the questions were reduced as a time limit was set for each FG.

The findings are presented 'together' as the narratives were analysed and coded as three documents, or one HU using ATLAS.ti. The researcher provides the extracts from the narratives across the FGs' to expand, or explain aspects where needed.

Research indicates that between 45 and 60% of injuries, diseases, and fatalities could be reduced where H&S is considered in the initial stages of a project. The inclusion of H&S with the appointment of the CHSA late in the design (stage 3), just prior to or during construction (stage 5) does not allow adequate risk reduction to the client, designer, and contractor. The inclusion of the CHSO / CHSM during stage 5 further limits the reduction of risk from the contractor's perspective. Therefore, where H&S is included as previously mentioned, the opportunity to limit liability and risk is imperative.

The construction process is not just about building a road or a building. A significant amount of planning that could span years before the first set of construction activities occur. As any public funds need to be accounted for, a series of procurement steps need to be taken during the planning stages of a project, and the IDMS sets out the National Treasury requirements that need to be followed to do so (cidb, 2011). The IDMS describes the multiple stages that precede the actual designs and appointment of contractors, the forms of procurement, and monitoring the asset during the entire life cycle.

A range of aspects such as political interference; a 'silo mentality'; incompetence, inexperienced stakeholders, and poor planning add challenges to a project progressing from start to finish. With the implementation of the CR's in 2003, construction H&S disciplines (CHSAs'; CHSMs', and CHSOs') were 'forced' on the sector to reduce the continued high rates of fatalities, injuries, and diseases prevalent in the sector. Further amendments to the CR's in 2014 increased the responsibilities, and thus, the liability of clients' and designers, due to the lack of a significant reduction in injuries and diseases as discussed in Chapter 2.

Procurement practice in the public sector appears to be swayed to 'pure' Treasury compliance, largely appearing to ignore H&S statutory requirements even though the procurement process is expected to include all statutory requirements.

Multiple stakeholders are involved in the construction life cycle, and each plays a role in the perceived success or failure of a project. There are further aspects that compound project success or failure included, *inter alia:* whether political interference, statutory requirements, lack of knowledge or education. The wide range of participants in the FGs' lent some of the aspects depth, relative to aspects that occur on projects.

The Researcher deemed it necessary to discuss and elaborate on the procurement process with each group, mainly for the benefit of the broad range of participants to better understand the complete 'cycle' of a project.

5.3 ACTION RESEARCH: FOCUS GROUPS

The questions posed for the AR section of the research sought to link the practices that currently occur in ECDRPW, which acts as an implementing agent for the Department of Education (DoE) (among other), for building work. The Roads section at Bhisho as well as district level maintain; build, and refurbish the thousands of kilometres of roads throughout the province.

5.4 STRUCTURING THE FG QUESTIONS

The original FG questions planned were limited to eight, as suggested in the literature. However, due to the detail and extensive discussion about the procurement process as applied in the areas, the questions were reduced to a total of six. It is possible, in hindsight, to have further reduced the questions, as they did appear to 'flow' into each other. Participants were guided and points made clarified, and this did have an impact, and was a challenge when attempting to draw information out of the narratives.

The following questions and prompts were used in the FGs':

- H&S has been a legal requirement across all 6 stages (that covers the construction life cycle) and applicable in construction for many years, how competent do you feel given your background about meeting the requirements of incorporating H&S?
- What would you suggest would be the most appropriate way of including H&S in the model for procurement that would fit the 6 stages and ensure legal compliance?
- Given the permit requirements, current procurement practice?
- A possible 30 days for DoL to approve permit and results of delays may have on claims?
- How could the mechanisms identified be included (in the current model drawn) to ensure appropriate H&S involvement during the 6 stages?, and
- Any other items for discussion, and feedback regarding the process and the discussion?

5.5 THE FG THEMES

As with the quantitative themes included in Chapter 4, the qualitative data is divided into three key themes, which adds depth to the research findings as an addition to the data obtained through quantitative means. While the FG questions were broad, the participants tended to 'collapse' the discussions, and the contents were quite similar in content throughout the three groups. Analysis of the data revealed the following three themes:

Theme 1: Stakeholder competence in H&S;

Theme 2: Procurement practices, linking H&S to the six stages, and

Theme 3: Procurement, H&S, and the Construction Work Permit.

5.5.1 Transcription Notes

The following information relative to the transcript has been captured to ensure the confidentiality of participants and specific projects:

- The voice recordings were transcribed verbatim, with use of South African vernacular and the grammar as spoken by the participants. Verbatim transcripts are utilised in the text;
- Each Participant is referenced with the code as noted in Table 37, which code also references which FG the participant was from;
- Words such as 'ja' (Afrikaans for 'yes'), are included;
- Any extract from a narrative is referred to as '(Excerpt)' which indicates that only a portion

of the discussion has been used to illustrate a point;

- Where there was general discussion, or consensus it is noted, with the participants who agreed grouped together;
- Where interruptions were noted, or sentences were not completed the use of '……' were used;
- Where the audio was inaudible, it is noted as '(inaudible)', and
- References to actual projects is marked within 'xxx'.

Table 5.1 indicates the distribution of the participants, and the coding used to reference each participant in the transcripts, and the title or category working in currently. The employer is broadly referred to in terms of whether for the DRPW or as a consultant, or contractor.

All participants were numbered sequentially, with the prefix of either 'P' for participant or 'R' for researcher. The researcher and the DRPW CHSM feature in each of the focus groups, and are referenced accordingly. Most participants were from the client, followed by contractors, and then consultants. Unfortunately, the civil group from the Sarah Baartman District did not participate due to confusion regarding the times. However, it was deemed that the data collected was adequate, as saturation of data had been reached, and no new information was obtained from the two Bhisho groups who were involved with civil works. There was no participation from the building group in Bhisho, despite having been invited. As previously noted, the information received from the Sarah Baartman district and the Bhisho groups was not dissimilar, and therefore the saturation point was deemed to have been reached.

Table 5.1 Focus group roles, Transcript Code, Title and Category, and Employer.

Reference number	Role	Transcript Code	Title / Category	Employer
Focus group 1				
1	Researcher	R1	Pr. CHSA	N/A
2	Participant	P2	Works Inspector	Client
3	Participant	P3	CHSO intern	Client
4	Participant	P4	CHSO	Contractor
5	Participant	P5	Pr. Architect	Client
6	Participant	P6	Contracts Works Inspector	Client
7	Participant	P7	Pr. QS	Client
8	Participant	P8	CHSA intern	Consultant
9	Participant	P9	CHSO intern	Client
10	Participant	P10	CHSM	Client
11	Participant	P11	CHSO intern	Client
Focus group 2				
12	Researcher	R12	Pr. CHSA	N/A
13	Participant	P13	CHSM	Client
14	Participant	P14	CHSO	Contractor
15	Participant	P15	CHSM	Contractor
16	Participant	P16	Pr. Eng	Client
17	Participant	P17	CHSO / CHSA	Consultant
18	Participant	P18	Chief Engineer	Client
19	Participant	P19	CHSA	Consultant
20	Participant	P20	Chief Engineer	Client
21	Participant	P21	CHSA	Consultant
22	Participant	P22	CHSA	Consultant
Focus group3				
22	Researcher	R22	Pr. CHSA	N/A
23	Participant	P24	CHSM	Client
24	Participant	P25	Civil Eng (Tech)	Client
25	Participant	P26	CHSO	Client
26	Participant	P27	CHSM	Contractor
27	Participant	P28	CHSO / CHSM	Contractor
28	Participant	P29	Civil Eng (Tech)	Contractor
29	Participant	P30	Pr. CHSA	Consultant
30	Participant	P31	QS / Site Agent	Contractor
31	Participant	P21	CHSA	Contractor

5.5.2 THEME 1: Stakeholder Competence in H&S

'Competent' refers to a person who is *qualified* to perform to a requisite standard of the processes of a job, whereas 'competence' means the condition or state of being competent, which in turn relates to the skill and standard of the performance that is reached. Competency refers to the behaviour by which the skill and standard are reached (Smallwood and Haupt, 2008). The definition of 'competence' amended in the CR's (RSA, 2014) indicated the inclusion of not only the skill and training of the individual, but included H&S knowledge. A further CR shift was apparent in the need for site supervision (and the CM specifically) to take responsibility for H&S during the project.

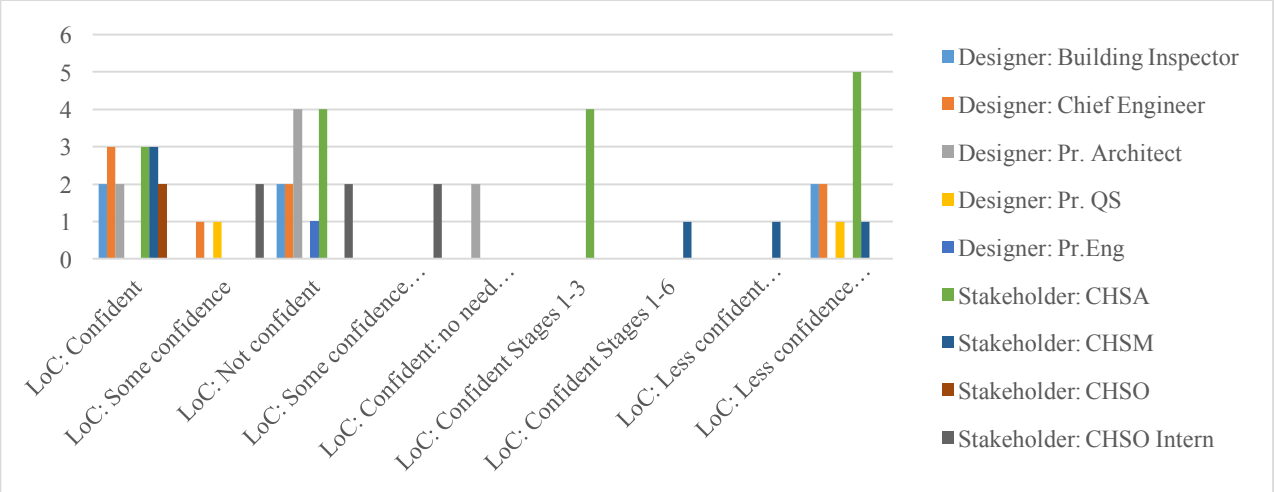
The CHSO therefore adopts a role of leading and co-ordination on site, with the site staff taking the overall responsibility for driving and applying H&S to the project. The client and designers have further prescriptive requirements to ensure the identification, mitigation and elimination of risk. Consideration for H&S is required when considering products, processes, and practices, through the life cycle.

Theme 1 followed the procurement process used within the two levels of investigation, namely 'Building' at district level, and 'Civils' at provincial level. While the questions regarding the procurement model and the linking of the 6 stages were separate questions, they were answered together. The narrative is discussed in sections as they relate to the theme.

The codes selected for the theme included the levels of confidence and the disciplines of participating stakeholders, constituted from designers, client and the construction H&S categories. Figure 5.1 indicates the level of competence (LoC) generated from the statements and code co-occurrence function within ATLAS.ti. Even though the various 'designers' are not noted as stakeholders, they are recorded as such to manage the coding in ATLAS.ti.

Multiple codes have been applied where the respondent had more than one level of confidence, against the number of times or 'density' of the code occurring in the narratives. The actual codes are grouped into 'families' such as 'stakeholders; and 'designers' to assist with the analysis of data.

Figure 5.1 Construction H&S and BEP Levels of Confidence.



Knowledge areas varied widely in terms of the experience in the field and the confidence level across the 6 stages of construction, opinions and understanding of H&S. Understanding roles and the IDoW are included to some extent in the narratives. The comments from the participants follow in the narrative format, from a range of construction H&S and BEC professionals that describe their own levels of competence in H&S, in the BEP or construction H&S categories.

5.5.2.1 BEC Professionals Levels of Confidence

Participant number 5 is a client and an architect. The participant appears to have a very strong opinion about H&S, that leans towards the perception of seeing H&S 'interfering' with the role of the designer. The participant further appears not to understand the role of CHS, or sees H&S as 'one', irrespective of the disciplines and scope of practice:

P5 (Excerpt) ... *I am going to put a different spin to this. I don't see the need for a H&S officer being involved till even stage 3 because what's the input going to be? You know we all know what materials are flammable blah blah blah blah…. what input is the officer going to have in the design stage?*

R1 *The officer or the agent?*

P5 *The agent.*

R1 *So your feeling is that they are not necessary. So what is your competency… so your feeling is that you are quite competent then to design out risks in terms of the architectural profession? That is essentially what you are saying, is that correct?*

P5 *Well you know, if you talk about risks, you know, if you want to design this table you put the legs on it, you need a crane to put the leg on blah blah, that is actually the competency of the*

contractor, however, being the competent contractor, the H&S officer will want the specification, we shouldn't be telling the contractor how to build. In my opinion the H&S officer should be the employee of the contractor. I dunno, this is my opinion, that's a cop out from government.

The Researcher attempts to point the participant toward the topic. The competency noted by the architect indicated that dealing with H&S was a subconscious action, and able to be translated into design:

P5 (Excerpt) *…I have been doing this all my life. Subconsciously.*

R1 *Subconsciously, but not consciously?*

P5 *No.*

R1 *Or are those thoughts, subconscious activities translating into design?*

P5 *Ja, for example you design a very steep church steeple. Now obviously you can hire a helicopter to put on… but you have to have scaffolding to put up there, you going to go higher on building …. Many architects I know - I am not defending them, don't even think about that. People die, fall off scaffolding and blah blah blah. Ok, well, that's one of those things, if you have to build, you have to build it. But when you do design things are of such a nature you have to think how you have to put things together. But I dunno. I still don't think we need the H&S officer.*

R1 *Ok, so essentially what you have learnt is learnt on the job, and through common sense?*

P5 *Common sense.*

The architect acknowledged no training in H&S during undergraduate training.

Participant number P6 practices as a Building Inspector for the client. Similar to the architect, no formal training at all, and relatively new to including H&S into the project. The statement was made that H&S should be involved from the start of the project:

P6 (Excerpt) *…Well for us in the built environment have never been really actually exposed to H&S. Planning has never been considered as that. For me, where I am sitting at now… it's an area that I have never… I have left it to the professionals to rather sort that out, and stages where we are now which changes everything, and what we are discussing this morning it is important to me, that while we are designing we should include H&S from the beginning*

because that will , in terms of putting out documentation together and the requirements, when we get to putting the BoQ, what that contractor has to price. For me that is, we need to have H&S come in at…. stage 4? Between 3 and 4, ja.

The building inspector indicates no formal training, but able to identify risks on site:

P6 (Excerpt) *…My competencies, no, I am not even close to it, I know what I have learnt on the job, and once I have read that document that comes down to me and I read it page from page and word for word, and basically it is what of what I get then, the rest of it, the practical part…when I get to the site I know, look, that's not what should happen on site.*

R1 *So you can in terms of your experience…, you know the difference between right or wrong? Say for example, they are doing a temporary works structure, they erecting scaffolding, you know whether it's the correct scaffold or not?*

P6 *I can interpret it…Trenching etcetera, shoring and the works, ja, I would know what is required. I often question you people about it!*

Participant number P7 is a client Pr. QS. The participant is not confident relative to H&S. The reference is made to the standardisation of documentation, as well as the standard 'one liner' referring to legal compliance. The participant notes exposure to integrated H&S during undergraduate training:

P7 (Excerpt) *…In terms of QS, I don't feel confident at all. Because up until 2 years ago we just used to slap a standard document in and put in an item 'comply with all aspects of H&S. So to actually go through and identify the risks and enumerate those risks, it's a very new thing.*

R1 *And there is nothing in your undergrad training?*

P7 *I can't say that, but we didn't have a formal subject called H&S, or anything like that.*

Participant number P16 is a client Pr. Engineer. The participant acknowledged lack of knowledge, but that the H&S information was available and obtainable. Site knowledge and risk identification also indicated as not knowing enough.

P16 (Excerpt) *... Yes, I know enough to know I don't know, and that there a lot of areas that I need to get construction H&S involved, but I hopefully I know where to, in what points I need to get them involved, and what I need from the, and.*

P16 *To be honest, I don't that I know enough to actually say that I would confidently would pick it up.*

Participant numbers P18 and P20 are client Chief Engineers. The comments are in a similar vein as participant number P16, is aware of their individual limitations:

P18 (Excerpt) *…Ja, I think from a practical perspective, you know, because on site you sees things, I would be able to during a construction phase see if something is amiss. If you're delineators has stones and so on, if your delineators are being held in place with stones. So that is why we basically P16 an P20 said, we employ consultants. But I would see if something is amiss on site, you know, from a practical point.*

P18 *Hmm, when you go through all these reports, something stick, ja, after years and years, something stick. Ja. Basically from a Stage 5.*

P20 *4 and 5.*

P18 *Stage 5 ja, construction.*

Participant P20, indicates why they use specialists as they are not at the 'cutting edge' but also the lack of site experience for the past 3 years, but prior to that would have seen hazards:

P20 (Excerpt) *…(Experience) Much the same, except that's why we appoint consultants, to assist with these things. Because we're not at the cutting edge of what's out there to pick it up. Yes, I am familiar with certain things…. but to say I would spot something missing, no, I don't think so. I am not at that point where my own eyes would necessarily spot it, you know……I haven't been to site for 3 years, I wouldn't know where to turn. I haven't been to site for a long time. And when I did used to go out to site, yes I was aware of what I was looking at. I was aware of potential hazards coming up before they happened, things like that. Ja.*

Participant number P25 works for a PM consultancy, with a civil engineering qualification. The Participant raises the issue of Stages within Stages, and the emphasis on 'sufficient information for all stakeholders:

P25 (Excerpt) *…Um…as well, myself, I'm much more involved in the tender, which is stage 4, and stage 5, but uh.. within our profession each stage has got almost these stages within, because each stage has got its initiation stage, you know uh.. planning and all those*

processes. But when it comes to our role is to make sure that the client has got sufficient information, sufficient specifications, sufficient standards for us to be able to incorporate those into our designs and to check the history of the client, whether they have been doing these kind of information, I mean projects, do they match with our standards that are within the company…that are within the (inaudible) standards. Yes.

R22 *Umm.. okay. You obviously, because you've been in H&S, would be quite comfortable to deal with any of those issues?*

P25 *Hmm…Ja, definitely. Definitely ja. Because I've been in H&S under the contractor and I've been in H&S under the consultants as well. Okay, so I will able to be comfortable.*

5.5.2.2 CHSA Levels of Confidence

The participants practicing as CHSAs, indicated varying levels of knowledge and experience.

Participant number P19 practices as a CHSA for a consultancy. The participant is confident about limitations and indicates the amount of learning on projects. The late appointment of the CHSA and a sense of acceptance for the way things are, are noted:

P19 (Excerpt) …. *I think Stage 4 onwards I am extremely confident, but currently learning and having input in Stage 3 is a lot to take in with the laws having changed and so on and so forth. So finding feet and becoming confident in Stage 3. One and 2, not really, well I would like to. Doesn't always happen that way though, unfortunately.*

Participant number P30 is a PrCHSA, and has their own consultancy. The participant indicates confidence to work and advise at all stages of construction, which is a pre-requisite for professional registration with the SACPCMP, and the IDoW. The issue of late appointments is raised again, and the 'loss' of opportunity to reduce risk:

P30 (Excerpt) …*Okay. According to…I'm supposed to be involved from stage 1. According to P24, we are appointed from stage 2, which , it doesn't happen that way. Normally in most projects, we're only sometimes appointed stage 4, sometimes even stage 5. Which would be, in an ideal world, terrific if we can be appointed, because it's a lot less…there's a lot of issues we can sort out from the... from especially the design phase. So ja, I'm comfortable with the stages.*

Participant number P22 practices as a CHSA, for a consultancy. The late involvement is notable, but indicates the influence from stage 4.

5.5.2.3 CHSM Levels of Confidence

The CHSM confidence levels vary as with the other levels, in experience across the stages and construction H&S IDoW.

Participant number P8 is a client CHSM, who has an engineering, and design management background. Aspects such as politics and stage 1 involvement are noted, as the lack of 'control' on a project, and the community influence:

P10 *(Excerpt) …Ok, I have been involved with H&S with the department for the past ten or eleven year… I have been involved from Stages 1 to 6, not so much in stage 1 because it's one of those things that particularly in the department, a lot of the stuff is dictated by the people, rather than the department itself, particularly where we have outside agencies working for, we are implementing agents. But where we are working directly, we are still governed by politics and we don't do feasibility studies, we are told: this is what is going to happen, go away and sort it out.*

Participant number P15 practices as a CHSM, but has a BEP background, with qualifications in civil engineering and building sciences, which is noted as part of the needs of the competencies of construction H&S practitioners in the literature (Smallwood and Haupt, 2008). The participant is very confident with all the roles, responsibilities and stages:

P15 (Excerpt) *…For me, I would say I am confident from stage 4, from tender stage, when the tender is out to put all the allowables as far as H&S is concerned up to Stage 6 on the project.*

R12 *Given your background though, which you said was civil engineering?*

P15 *Yes, I did a Diploma in Civil Engineering about 20 years ago, and then 11 years I did Building and Applied Sciences, and then 10 years ago I got involved in H&S. So, yes, I'm not confident from Stage 1, 2 and 3, but I do understand the processes.*

Participant number P27 works for a Contractor, and is a CHSM, but is not familiar with the areas of work as required by the SACPCMP, namely stages 4 to 6:

P27 (Excerpt) *…Ja, I think I'll be uh…I'll be able to participate in…definitely stage 3, 4…well I am doing currently, I'm doing stage 4 and 5. I think stage 3 up to 6.*

5.5.2.4 CHSO Levels of Confidence

The levels of confidence and knowledge varied among the CHSOs. Participant number P2 is appointed as a client CHSO intern. The participant has a Diploma in Building, but has no experience in H&S:

P2 (Excerpt) *…Ok, I haven't really done H&S, I only started with it here when I got to the department.*

R1 *What is your base qualification?*

P2 *Building Diploma.*

R1 *A Diploma in Building? Did you do any H&S in your undergraduate training?*

P2 *I didn't do any, anything related to H&S, like I said I only started it here, with the H&S Manager and we went around site identifying problems and trying to rectify those, but I haven't had any extensive training.*

Participant number P3 is a client intern practicing CHSO, who indicates a range of experience and confidence within construction H&S as agent, and CHSO:

P3 (Excerpt) *…Looking at the different stages that we went through* (the procurement process), *I would say that we start at stage 2 when you do the specification, whereby you draft the specification based on the scope of works, then moving through to stage 6, so yes I have been exposed to all those stages, so before of course I worked as a officer here …., where I was initially an agent of which I was exposed to everything until the final stages so I can say I am competent to do these things.*

Participant number P4 is a CHSO working for a contractor, on a current ECDRPW project. The participant raises issues such as completion time and how the lack of funding impacts on project H&S:

P4 (Excerpt) *I'm mostly involved in stage 5, 6. Most of the projects that we tendered on I was helping to do the BoQ for the H&S, so I will say I am quite confident in 5 and 6, 4. I am still getting used to, there's a lot of things to take into consideration when doing pricing for H&S.*

I mean, the current project I am working on has been extended it's been almost 3 years now, it should have been 2-year project, so the money that should have been available has run out, so now we at a point where we have to try and get more money to finish the project H&S wise.

Participant number P11 is a client intern practicing as a CHSO. The participant has a National Diploma in Building, and indicates that construction H&S is 'new thing of H&S':

P11 (Excerpt) ..... *for me I have a National Diploma in Building and I have just been appointed as an occupational H&S intern here in this department. Well I would say I am partially competent as I do have a background in the built environment, and I did do a short course from MBA of H&S on scaffolding, excavations and all that.*

R1 *Was all one-day courses?*

P11 *No it was four weeks, just a short course.*

P11 *Yes, but I am still learning, it goes down to what P5 said. If you are just knowledgeable, and you understand and what is going on, I think you are getting there. Most people are just ignorant of this new thing of H&S.*

R1 *H&S has been around a lot longer than you think it has.*

P11 *You just talk to some people then its…*

R1 *Yes, very new, absolutely.*

Participant number 14 practices as a CHSO for a contractor, and details the steps followed through the stages to do their work:

P14 (Excerpt) *…From stages 4 I get involved at specification stage, read through the specifications, and guiding management as to what steps are involved what steps they need to take to be able to reach the requirements that that spec asks for. To be able to put together the requirements at tender stage so they can meet the requirements at tender stage, and also once they have met that, when the contracts are awarded, to be able to meet the requirements at award stage and take it through to site stage, the administrative requirements and then also audit the administrative side and also the site safety practical side as well.*

Participant number 26 is an employee of the ECDRPW, working in H&S. The participant indicates where H&S becomes involved, that there is management involvement, but late in the project. The participant appears to be hesitant to make comments in front of colleagues attending the FG:

P26 (Excerpt) *…Just to go back to what I said, um.. I've never had a need, and I don't really see any coming from a design perspective. Because I've never worked for the client in the new.. new way. But from stage 4 onwards, obviously that's where the possibility of a role. Normally, so far, it's only been regular construction phase, once the tender has been awarded, then they involve the H&S guy.*

P26 *Where I see with the tender, there's a lot of H&S issues that do get dealt with, but my experience is that it's normally done by senior managers who are well versed in the requirements but…*

R22 *In H&S?*

P26 *Ja, in H&S. But I... I reserve the right to remain silent.*

General laughter.

R22 *There's no holy cows in this room. (Mumbling…)*

P26 *Well you've got cameras going so…*

Participant number 32 practices as a CHSO for a contractor, and indicates that he is competent to work from stage 4, but is not involved. It is interesting to note that the participant believes there is not enough H&S competence at levels 1-3. The participant appears almost uncomfortable about being honest:

P32 (Excerpt)… *With regards to being in the (H&S) department, honestly speaking, we are involved from stage 5. That is the honest, honest, truth. But ideally, I would be comfortable from stage 4, the first 3 stages, they need more technical people there. But from stage 4, I am comfortable. But, in reality, we only get involved from stage 5.*

5.5.2.5 Theme 1 Summary

Smallwood and Haupt (2008) identified that competence, competency, and being competent is imperative among all disciplines in the construction sector. Competency could be considered lacking among most respondents among all categories. Most of the construction H&S categories do not work in all the stages as identified in the IDoW, and express concern in this regard. Respondents were honest in their statements. Honesty is often cited as not being the case when management are present,

or being recorded. Only the architect appeared to not think H&S 'officers' should be involved on projects, and there should be no interference with designs. Other BEPs' did understand the issues, and albeit reluctantly in some cases, are introducing or including H&S and the disciplines on projects.

5.5.3 THEME 2: Procurement practices, and linking H&S to the 6 Stages of Construction

The second theme addresses the links between procurement, and the 6 stages of work. National Treasury requires the procurement of services and expenditure to be closely monitored, in line with infrastructure planning. The actual procurement processes are managed through the IDMS, by SCM at various levels of provincial, municipal and district levels. The proof of compliance, submission of documentation etc. is managed at project level between the client (or implementing agent) or their agents (BEPs'). However, procurement practices tend to occur in a silo and strictly according to the PFMA.

SCM who control and manage procurement processes are not necessarily BEPs', nor are they necessarily familiar with the construction process other than from the required sets of documents needed from a project. There is often technical representation on SCM committees, but it appears that the SCM and procurement requirements take precedence over aspects such as competence, and H&S. As such they may or may not ensure all statutory requirements such as required in the OHSA and Regulations are met. SCM would check that components are in the tender documentation, such as the H&S specification. The focus on tender documentation seem to be not whether they are adequate, but whether the documentation is technically correct. The following narrative indicates the role of SCM, with the procurement process followed, and the aspects considered, including time frames that are followed during the procurement process.

5.5.3.1 Stage 1: Initiation and Briefing

The ECDRPW (Bhisho) receives notification of projects differently for buildings and civil works. The district receives a form 'B4' that indicates the projects and budget allowed from Provincial Treasury, with no details of the project. The document would relate to the MTEF that is compiled for the province and devolved to district level. However, it is left to the district to determine what the project is likely to cost, and so the staff must 'thumb suck crazily', as that information is not included in the B4. There is also a discussion regarding the different terminology used among the

BEPs', for example stage 1 is also stage 0 for architects, indicating a more detailed split in their stages. The project brief referred to is a brief that occurs later in the process, once preliminary design work is undertaken, and the extent of the project is known. The second brief is between the client or 'user' department and the PSPs' to discuss the preliminary designs and the budget allocations and requirements.

R1 (Excerpt) …. *Inception is…?*

P5 *Stage 0.*

P7 *This is project brief; you know on the IDMS system.*

R1 *Is this not project brief?*

General comment…No

P6 *Project brief won't come now.*

P7 *We have to investigate.*

P6 *Lets put at it this way, once we get a 'B4', in other words education department has identified certain projects - a school for us, that is all we get. Thereafter, once there will be a basic brief, to say we will be building or replace a school building and they will give us a basic brief, to say 10 classrooms and whatever goes with it, but basically after that they give us a budget on which we can calculate those fees. Or, we sit, the two of us, and will say what the if it is going to be 'that' size we will more or less calculate that is what the costs are likely to be.*

P7 *Which is normally wildly inaccurate.*

P6 *Indeed, we thumb suck crazily*

P7 *Because we really don't know what is going to be done.*

At provincial level for civil works the notification for projects is via a system of 'triggers' based on conditions that exist in an electronic system called the Road Asset Management System (RAMS). The RAMS is noted as stage 1, and no feasibility is done, as this is like the 'B4' in the building sector in the District, that comes from National Treasury and the MTEF.

The various conditions would further trigger the type of project, and associated cost, namely rehabilitation, re-build or reseal of a road. What is notable is the reference to political interference that overrides the RAMS and the associated 'urgency' of the project:

P16 (Excerpt)... So the project identification comes through a couple of different routes. In the ideal world it would all come through your Road Asset Management System (RAMS), where the input of various criteria, road condition, traffic volume, current condition would trigger certain either periodic or capital works. So a reseal, a rehabilitation, or an upgrade. But in the real world there is a lot of politics in between. It is still largely used to try and trigger your periodic maintenance, but your upgrading has very limited input and we are still implementing projects which politician's promised sort of ten years ago. Twice it went in for prioritisation model, but we are still working through this list of projects, which are sort of on our shelf. And every now and then you get sort of, because of political things, projects down the list get pulled to the top, like this one I am signing off here.

P13 Its not really a feasibility study as such, its more an identification and budgeting issue. The fact that you are going to build that road isn't subject to are we or aren't we really, it's more a matter of 'this is the road we are going to build, and this is the budget, and we take it from there. So Stage 1, yes.

P12 So it is part of Stage 1?

P13 Ja.

5.5.3.2 Stage 2: Concept and Feasibility

The civil work for stage 2, like building, appears to be more of an administrative exercise, with a 'blurring' of the end of stage 1 and the start of stage 2, and a lack of having to conduct any level of feasibility study.

P16 (Excerpt) .... Basically all the projects we do are feasible. We don't have to do a cost benefit, return on investment kind of investigation to determine whether, if we will or won't do it. That's just the nature of the work we do.

R12 I think that's perhaps the difference if I can point out, from the building and a civil point of view, where from the building point of view you can look at the constructability or complexity of design, in this case it doesn't come into this area, or does it? That's really what you are looking at in terms of feasibility.

P16 You can do, look, you make a couple of decisions at this level, that will help you decide, you make an initial assessment on the specification you are going to use. Whether this is going to be a low volume road or have a high traffic volume, because you need to know that for your budgeting purpose, so basically the budgeting process is the feasibility discussions, because that's where the different project managers would be motivating different projects, and decisions would be made on projects to proceed with and which to postpone, what level,

what sort of investment we would be putting in... ja, but there's not a formal feasibility process.

5.5.3.3 Stage 3: Design and Development

Stage 3 discusses the broad aspects of the Stage, which includes the appointing of the PSPs, designing the project and preparing the form of contract to be tendered on, that includes a BoQ:

P13 *(Excerpt)…. Sometimes this whole process sort of blurs into one.*

R12 *So this is theoretical?*

P13 *Ja, final design report is...*

P20 *According to project management you have a design report.*

P13 *....And we hope its accepted. In the final design report there will be alternative routes, there will be alternative designs, for all sorts of things. So the next step in fact is to have a meeting or several meetings actually to finalise the design, not only the way the client wants it, but the way the client also can afford to do it.*

P16 *So you finalise, you've made certain choices and options during prelim design, but in detailed design there's further options that arise at a more detailed level, that you need to finalise.*

R12 *Right. So that's what happens to get through this process, and then you would go to finalisation as you say which matches what the options are from an affordability point of view, and a construction point of view.*

P13 *And budget.*

R12 *Okay, and optimised design, is that correct? Do you agree with that?*

P13 *Right.*

The issue of re-design is discussed, as well as the practice of the PSP fees for a project and the impact that the low fees have on the project. The issue of the 'informed' client is raised, and is clearly an advantage in terms of potential ethical issues relative to PSP fees and claims. The lack of financial incentives and 'Rolls Royce' standards in use when something far more basic would be required:

P20 *(Excerpt) ...Ja, there's a lot of design while works are going on as well.*

P16 *Ja, one of our issues as the client at the moment is that we appoint consultants on a lowest cost, so a lot of our consultants are not necessarily really optimising designs, they are giving us computer generated designs. And then the incentive is actually to increase construction cost, not decrease construction cost if they are appointed on a percentage package.*

R12 That's nasty.

P16 No it is, it's a big issue that we have. There's no.... let's put it... there's no financial incentive for the consultants to reduce costs. It's only ethical. We have to rely fully on their ethics and us being an informed client to...

P20 I mean if they can recommend a Rolls Royce for you, they will. It's up to you to decide and to work it out from there.

5.5.3.4 Stage 4: Tender document and Procurement

The procurement process, PFMA requirements and procurement in general are required to comply with the H&S laws of South Africa. The committees are made up of technical and SCM, but no mention of H&S other than the H&S specification being in the tender documentation. The tender documentation is a 'mix' of the technical, H&S and contractual specifications for the project. The excerpt indicates the technical contents, and a humorous approach to the inclusion of the site-specific H&S specification (SSHSS) required by the CR's:

R12 (Excerpt)…. So in this tender, in the tender documentation is made up of all the different components of the tender including the H&S documentation in one form or another. So it will be all the general contractor service level agreements, scope of works….

P16 Bill of quantities, drawings….

R12 Drawings, not the detailed drawings obviously, the general drawings?

P18 Ja, it's also the environmental, EIAs, the geotechnical reports also form part of that... those set of documents.

P13 And somewhere in there, there should be a H&S specification.

P20 What is that?

Laughter.

The issue of resourcing and the evaluation of the tender submissions during Stage 4 are discussed, a common issue appears that contractors submit a 'zero' bill for H&S items in the tender. Where a nil amount has been submitted, or a very low amount, given what the literature states about the amount for H&S that should be allowed, this is not an area that is given much attention by the SCM, even though the BEPs' and the CHSA are aware or have prepared the BoQ for the H&S items:

R12 (Excerpt)… Because then, in terms of the bid evaluations then, and the adjudication rather, then if the contractor submits a zero bill, the legal requirement is that the client has to

determine the contractor is adequately resourced and competent. So resourced could means there has been some sort of financial resource made, not only people, but obviously include...

P18 Look in terms of the bid evaluation, you know, it's extremely difficult.

The issue of evaluation of the BoQ was noted as an issue as the competency of the adjudication committee to assess the BoQ in terms of the appropriate rates.

R12 (Excerpt) …Or adjudication.

P18 Ja... evaluation because you need to have someone on board that is well versed with the bill and then can assess it, in terms of what is the impact gonna be, so it's, like I said rarely that it's been looked at in that detail, or that its even been looked at, it's just part of the price.

P16 Ja, part of the problem obviously is that contractors have different pricing strategies they bill certain costs in under certain items and so some will have some will have much more built into their Ps and Gs' (*preliminary and generals* in the BoQ) and some of the other costs are amortised across other rates. So, we couldn't legally eliminate a contractor for giving zero on H&S. I mean we would be taken to court immediately by the contractors "Oh, I spread the costs of H&S over everywhere else'. So, it does also gives us the legal issue.

The process of tender documentation and advertisement of the tender is discussed. The titles of the committees are the same as those used in the IDMS. The requirements of SCM is to ensure there is very close control over the process, and that every document required has been received:

P16 (Excerpt)… The consultants would prepare a tender document that would be taken to the departmental or organisation procurement process, usually a specification committee that looks at the tender documents. If the specification committee is happy with the document, then it gets advertised.

R12 And that committee, who is it made up of?... the consultants?

P16 Its a mixture of technical people and supply chain…. but in reality, really most of what the spec committee actually does is a compliance check that the documents meets the compliance requirements…. that all the necessary forms are there; that if we are asking for a grade 7CE that it is valid, that the project estimate does match the cidb level we are calling for, that the advert says everything it's supposed to that the document has all the necessary forms.

The specification committee merely checks for compliance, and not for the technical completeness of the information, so a concern would be relative the extent of legal compliance in submitted documents. As the technical knowledge of the BEPs' and SCM is noted as being very limited, the

submission of H&S documents would not be assessed unless a CHSA or another competent person was present. The Expanded Public Works Programme (EPWP) is a government initiative to uplift SMMEs and employment in the sector that includes labour intensive (LI) components to increase employment in communities. Once through the procurement processes, the tender period commences, with advertising, the tender briefing which provides an opportunity to tell tenderers the critical project issues. The time frames for tenderers to submit tenders is 23 days.

P16 (Excerpt) …The tender period, during which time there is a tender briefing, opportunity for clarification and thereafter a closing date after a set minimum number of days.

R12 What is the normal number of days?

P16 ....21 working days, not counting the day of the advert and the day of the closing.

P13 …23 days at the end result.

R12 Who makes up the bid evaluation committee?

P16 Again, a mixture of technical and supply chain.

5.5.3.5 Stage 5: Construction Documentation and Management

Discussions regarding stage 5 was limited across all the FGs', as this is where everyone was most comfortable and are very familiar with the stage. The aspect of re-design was discussed, as it is a known problem area and has the potential to increase project risk. Progress and technical meetings, and client involvement do occur, and the construction H&S categories are normally in place for both the client (CHSA) and contractor (CHSM or CHSO).

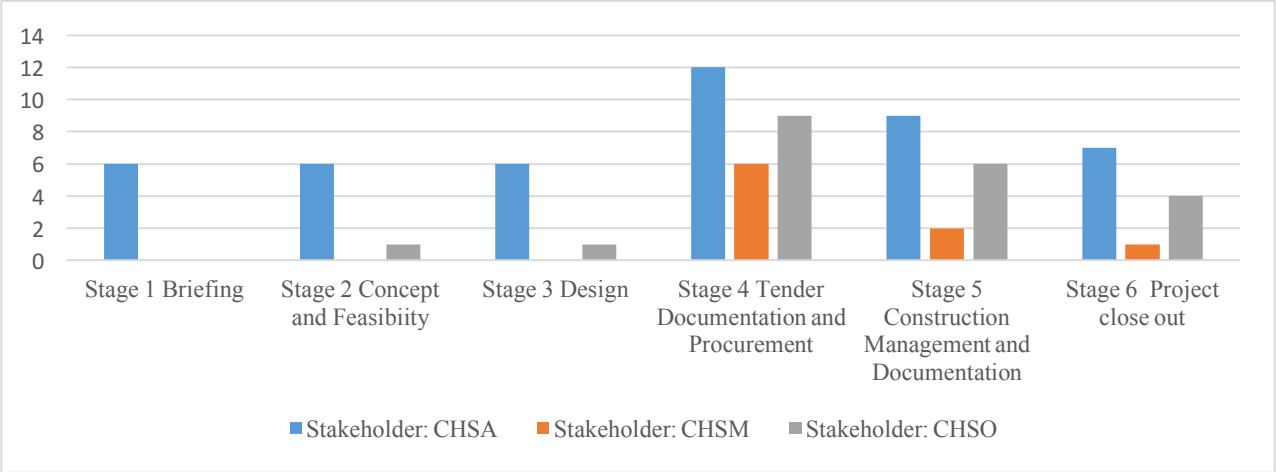
5.5.3.6 Stage 6: Project Close out

Like stage 5, stage 6 did not elicit much discussion. The discussion that evolved was the detail of the documentation required for the close out of the project, snagging and assuring the quality of the project and hand over of the asset to the client or as termed in the IDMS the 'user'.

5.5.3.7 Construction H&S involvement through the Stages

The discussions indicate where the CHSA should be involved, and various issues, the role of the CHSA pre-design, for the PSPs and the project. The narratives have not been repeated where the same aspects were saturated. Figure 5.2 indicates the code co-occurrence table generated relative to the construction H&S stakeholders and the references made across the 6 stages.

Figure 5.2 Construction H&S Stakeholders: code co-occurrences with the 6 stages of Construction.



5.5.3.7.1 Construction H&S involvement: Stage 1

Participants indicate there is no H&S involvement during stage 1:

P18 (Excerpt) *…From our side, as far as I know there's no input at that stage.*

5.5.3.7.2 Construction H&S involvement: Stage 2

The practice of appointing the CHSA during stage 2:

P16 (Excerpt)... *For practical purposes it would, it would need to come in there, at Stage 2.*
P20 *Ja.*

A further discussion regarding the appointment of the CHSA in terms of the requirements to prepare documentation for the design and the process as it currently stands. Current practice is the engineer or consultant appoints the CHSA rather than the client doing so directly. However, the participant cites what should happen and where the CHSA should be appointed. The participant indicated lack of competence previously, but understands the need for statutory H&S compliance.

P16 (Excerpt) *…. I would say that from a client's side, at stage 1, we as the client need to have certain policies and procedures in place, basically almost like a founding basis on which we work, and ideally, we should have a procedure whereby we now comply with the construction H&S requirements, which would then dictate that when we reached stage 2, the H&S agent*

is the first requirement. Either we appoint them separately up front, or at least simultaneously to the engineer. And the engineer cannot proceed until the H&S agent has done the baseline risk assessment. That would be the way of compliance.

R12 *So what you are saying is that you would still only appoint the CHSA at stage 2?*

P16 *Yip.*

5.5.3.7.3 Construction H&S involvement: Stage 3

The narrative for Construction H&S involvement for stage 3 that was frequently noted was regarding the current practice of being only appointed during stage 3, and later, and noted as a shortfall.

P21 (Excerpt) *...And I think that is where the shortfall is at the moment, is that we are only coming in sometimes at stage 2, stage 3, stage 4, and on quite regular occasions, the last stage* (stage 5).

5.5.3.7.4 Construction H&S involvement: Stage 4

The involvement of the CHSO and CHSM is assessed in terms of their involvement. The contractors and their 'pricing' strategy is noted as a risk and potentially not pricing adequately for the project. The 'correct' pricing noted as a factor in potentially losing the tender due to 'high' pricing. Several participants noted the lack of involvement or influence.

P4 (Excerpt) *…I would say we should be involved from stage 4. When the BOQ goes out to the PC, we should be involved there. Because there is normally a H&S BOQ at the back of the specification that they give us and sometimes the quantity surveyors, they just price the way they want to price, because if they make H&S too high, the project won't get awarded to the… and that is what happens*, and

P32 *With regards to being in the (H&S) department, honestly speaking, we are involved from stage 5. That is the honest, honest, truth. But, ideally, I would be comfortable from stage 4, the first 3 stages, they need more technical people there. But from stage 4, I am comfortable. But, in reality, we only get involved from stage 5.*

The reference to the 'one liner' is more peculiar to the building sector, and generally associated with a lump sum or total amount relative to H&S costs for a project. The result is the 'unfair' adjudication process where all contractors are provided with a detailed BoQ.

P10 (Excerpt) *... I think stage 4 certainly, for exactly the reasons P4 has put up, but I want to go a little bit further, expanding on what P4 is saying – if you have a BoQ, you price it, the other contractors price it, it is a far more even playing field than the one liner….*

5.5.3.7.5 Construction H&S involvement: Stage 5

As noted in the previous narratives, participants indicated that for CHSAs, they have in some cases only been appointed from stage 5, and for CHSMs' and CHSOs', that is where they mostly practice.

5.1.1.1 Summary for Theme 2

Theme 2 follows the procurement practices and links them to the 6 stages of construction. In most cases the participants noted that they are only appointed during stages 3, 4 and even stage 5. Stage 6 is not included as there was no discussion regarding construction H&S involvement. While that aspect or the broader components of it are known, a range of 'grey' areas exist as to where one part of a stage starts or finishes. The participants note that the inclusion of construction H&S at stage 1, Initiation and Briefing is highly unlikely as the information in the form of notification of which projects are going to be done is what is received. However, it was suggested that the appointment of the CHSA could be made during the latter half of stage 1, to prepare the BRA and a designers H&S Specification. All the appointments and requirements noted during the process are legal minimums and do not constitute better practice, or link with international practices.

The CHSMs' and CHSOs' indicate their involvement mainly during stage 5, but a number have indicated they have had experience during the tender preparation during stage 4, as well as issues with pricing of the BoQ.

In summary, there is H&S involvement in a 'fragmented' manner, or varying degrees of compliance. The 'gaps' in the procurement of construction H&S for legislative compliance places the client at risk should there be any accidents or fatalities that on investigation could be linked to the lack of inclusion during design. The information which is provided to the province or districts clearly have no information regarding risk from National Treasury, 'custodian' or 'user'.

5.5.4 Theme 3: Procurement, H&S and the Construction Work Permit

The amended CR's introduced the requirement of a construction work permit before any work can commence. At the time of the research, the permit wa only applicable to G9 contractors, for works equal to, or greater than R130million. Other cidb grades, namely G8 and G7 are to be phased in over

the next few years. The narratives and issues that were raised in Themes 1 and 2 apply to Theme 3, in terms of competence, as well as the procurement process.

The application for the CWP is required to be signed by a Pr. CHSA, which implies the needs to develop the appropriate documentation. The liability carried by the CHSA is significant, given the 'agent' status and is defined as representing the client. The development of the BRA and project specific H&S Specification, as well as the appointed contractors approved H&S plan are part of the main documentation to be submitted to obtain the CWP. The procurement process and time frames apply, as discussed in theme 2, as they have serious implications for the project.

The issue of competence of the DoL relative to the reviewing of the documentation was raised with the participant responding providing a:

P19 (Excerpt) *...Can I pose this question? Will DoL be able to do that? Because that's the question we get asked by contractors.*

And the response from the client that indicated a good understanding of the reasoning relating to the competency issue that was posed:

P16 (Excerpt) *...It would be the same as me accepting drawings from a structural engineer. I would want to see a professional engineer sign off on the structural see a professional engineer sign off the drawing. Even though I am a professional engineer myself, I am not a professional structural engineer, so I would want to see a structural engineer sign off on something I am going to accept as a client. So, the DoL wants to see that a professional construction H&S officers signed off. That then gives them the assurance that someone with a certain degree of competency has actually examined it, and is happy with it. Therefore, they don't have to have the specific competency.*

The issue of the 30-day DoL 'consideration' period, when discussed, raised the following issue of project cash flow for the project, which would have an impact on upstream planning at National Treasury. That avenue was not explored.

P16 (Excerpt)*...As it stands at the moment, if we just basically leave as is, we as the client need to factor an extra 30 days before we can get a contractor onto site, at least. So that we as a*

client need to understand that our cash flows are gonna be a month behind what we thought they were gonna be. That from the issuing of the letter of the award we have got 21 days to get the H&S plan, and only once we have got the H&S plan can we apply for a permit, then we have got another 30 days we have got to allow for a permit, um, so….

The Researcher introduced a topic of the option of pre-qualification, using an example of where it had been used with reasonable success on a project with the ECDRPW.

P16 (Excerpt)… *If you made it a functionality requirement, then you could basically force contractors to put in a lot more effort into compiling a project specific H&S plan…. But we know from, even when we tried asking for H&S plans, generic, quasi generic H&S plans, we had a lot of complaints from contractors.*

The issues of functionality and eligibility were raised by SCM, who deemed it problematic to use the pre-qualification aspect, especially with SMMEs and the issue of politicians not understanding the reasons for eligibility.

P20 (Excerpt)*...Because we made it an eligibility issue, not functionality.*

P16 That's right, eligibility, not functionality we had contractors saying, 'Oh, we are disadvantaging emerging contractors' because we are forcing them to cost that they can't really afford and they are not guaranteed of getting the job. They only want to do the H&S plan if they actually get the job, because then they can afford it.

P13 Unfortunately we are dealing with a lot of political perception here. That is always a problem.

P18 That is correct.

The narrative considers the time it should take to prepare an H&S plan for the project, and the CHSM and CHSO participants responded that the period required is on average 5 days, as they have H&S systems within their organisations, from which to develop the H&S plan for the project against the client H&S specification. The narrative essentially notes the lack of internal H&S systems within smaller contractors, SMMEs or emerging contractors, and the need to 'purchase' what amounts to an H&S system and plan for each project, which relates to the contractors not wanting to prepare H&S documentation at pre-tender stage.

P19 (Excerpt) *... Then they hire a consultant to do it for them.*

R19 I don't know, are you asking for the due price or the reasonable price?

R12 Whatever is happening in reality out there.

P19 In xxxxx, anywhere between 3 and 12 (thousand Rands).

There is an issue regarding the type and quality of the H&S plan completed by consultants, in that they are 'generic, and not project specific, which is a legal requirement. The practice is widely used and creates delays with the approvals as the 'cut and paste information does not always reflect the nature of the project, as per the example.

P19 (Excerpt) *…And 90%... and 70% are generic.*

P17 70%? I would say 90% are generic. They are all generic.

P19 Copy, paste and print. I am not trying to talk badly of other companies, I am just saying that is the general standard in xxxxx at the moment. And probably all around the country.

P16 And, unfortunately it's because they get away with it, most of the time.

P17 Guys who are laying pipes are getting 'working at heights'.

The narrative then moves to the integration of the timing of the application, within the current procurement process, and how they could be integrated. The other aspect of significance of this narrative is the understanding of the client of some of the H&S issues, and the issue of legal non-compliance.

P14 (Excerpt) *…June, July. So that's 60 days. We have round about 63 days.*

P19 ... I don't think we are ready for it. I know we are not.

R12 We can't, as the Department, as any client, the client can't afford to be non-compliant.

The interaction between the client and construction H&S noted is positive relative to the time required to develop the H&S plan if requested as a pre-qualification requirement. The outcome of the narrative is that where pre-qualification exists and can be made part of the tender requirements, and adjudication process, there could well be a reduction of the days needed to pass through the SCM requirements and limit the potential delays and cash flow for the client.

P16 (Excerpt) *…Since I have got the opportunity, ask the question here of the people ending up doing the plans. If there is a requirement in the tender document for a H&S plan, a*

submission of a H&S plan, does that speed up, if you then successful, does it speed up you being able to draw up a final H&S plan?

P15 I 'd say, most of the tenders they do request a pre-plan.

P16 Yip.

R12 Which clients' are those?

P15 Department of Public Works, and all of, most of the Departments, they do request a pre-plan, and even if they are not, like even the municipalities, they do. So, now what we are doing, even if it's not a requirement, we do it anyway.

P14 We give them a 'short form' sort of an abbreviated form of plan.

P15 Just a pre-plan.

P16 To show them you know what you are talking about.

P14 and P15 Yes.

P16 But, it doesn't actually speed up the process anymore?

P20 No, well, it would.

P16 Would it?

P14 Absolutely.

R12 But, if you are doing it at your leisure through the, and you have 90 days, or how many days have you got? Between the tender and the….

P16 Its even shorter, its normally 23 days of your tender.

R12 23 days to work it out, rather than 14 days following.

P15 Ja, but keep in mind the 23 days that you have put it out, you have advertised it, hhhmm, the boss has thought about it, Okay, and then it lies on his desk for another 5 days.

P16 Then he goes to the tender briefing.

P14 Then it goes to the tender briefing, then he will come to you on day 15, and say 'we're gonna tender on this job', now you are going to do the H&S (laughs). You see, I don't have 21 days.

P19 P16. I think to perhaps to help with your question you have asked there, is if it helps the contractor, to help the contractor, you as the client have to ensure that your specification is detailed, the scope of works is included.

The Researcher then requests 'closing' discussion on the issue of the pre-qualification aspect, and the need for SCM and the ECDRPW PMs to work together, however, the lack of guidelines, policies and procedures is required to ensure compliance. There are other actions required for the client and designers to ensure the tenders are adjudicated fairly and in line with the statutory requirement for competence and resourcing.

P16 (Excerpt) …*We maybe just need to handle those in our, a policy and procedure, must be able to pick those ones out. And have a process.*

R12 *So are you saying you need to have formal policies and procedures in place to actually guide the process?*

R12 *Yes. Absolutely.*

P16 *Yes. Absolutely.*

P12 *Because if you don't have one, there will have people who work their way around the process. The process will get ignored.*

P20 *There has got to be for the supply chain as well.*

P19 *But, also, R12, they may need to be in place but they have to be maintained.*

P19 *Applied and maintained. Anyone can write a policy.*

P16 *Ja, no, Government is very good at writing policies. Implementation, not so great.*

5.5.4.1 Theme 3 Summary

Theme 3 considered the notion of the links between SCM and procurement, H&S, and the CWP. The FGs' were completed in June 2015, just less than 2 months prior to the exemption period given for the industry to prepare for the implementation of the CWP. As can be noted in the narrative (apparent in all the FGs'), the ECDRPW, at provincial level, was not ready to comply and neither were they at district level. The client representatives noted the realisation of the pending lack of legal compliance as a concern.

The construction H&S participants clearly can and could assist with the submission of pre-tender H&S Plans as part of a pre-qualification process, that could reduce the risk and potential project costs and delays.

The lack of knowledge on the statutory permit requirements from SCM and procurement requirements currently increases the risk to the client and the project, leading to increased project costs and potential delays.

The need for policies, procedures and guides for all stakeholders clearly impacts on further support or actions relative to H&S from the SCM and procurement aspect. The effect of the lack of the information is the late appointment of the H&S stakeholders, as indicated in the previous themes, which increases project risk.

5.5.5 FG Participant Feedback

Participants responded positively following the FGs', comments from some of the first FG included:

P3 (Excerpt)*...I have actually learnt that, I have actually learnt all the stages, like he has said, and gotten on board with regards to how the Department actually works, because I have actually just started, so ja, it's been very fruitful;*

P2 *Ja, I just wanna say it's been very informative for me, all the stages from, 'cause you normally work from stage 4 to 6, but everything that happens pre that.....;*

P4 *It helped me to understand what happens, the process that it actually goes through before we get onto site, and*

P11 *I have grasped a lot, and I think we need a lot more of these kinds of discussions where we can share our thoughts and what we have discussed earlier.*

Comments from the 2nd FG regarding the process were a further indication of the usefulness of the process:

P17 (Excerpt)*...I have learnt a lot, and thank you very much;*

P18 *Ja it was just, you know one hear about professional, these companies, and you must be registered and so on I think it's not being taken as serious and it should be, because we can run into deep, deep trouble in a month or two, so ja, it was very helpful for me;*

P21 *...It is encouraging to note that at least we have been able to observe that at least now, you know that to be involved from stage 4 is not good enough…we have more specific things to say, considering that we should be starting from stage 1;*

P22 *For me, it was a fruitful intervention engagement to learn about the stages into the project cycle and be able to integrate H&S programme not only into stage 4, but from the initial stages, and*

P14 *Its been very informative for me from a contractor's point of view, to be able to see from both client and agents point of view, the various stages how and where everything slots into place, definitely been an eye opener for me. I have learnt a lot, thank you very much.*

FG 3 had mostly construction H&S categories attending, and the background section relating to the procurement processes was much shorter than the first two. The aforementioned was due to the client's Occupational H&S Manager who has vast experience in the ECDRPW in both the roads and

the construction H&S environment, so there was minimal debating and extended discussions with respect to points of interest.

P28 (Excerpt)....*It's what we were waiting for 20 years ago, 30 years ago when I worked first on Sasol 2 and 3, there was this what's happening now;*

P28 *Ja, but things that we were hoping for in the late seventies is materialising very quickly now;*

P29 *Um. Ja, P24, this was a very good breakdown even though there are different clients'', but this was just uh…on point if I can put it in that term. Um…with us, we've just got our different guidelines, our gazettes from government, you know, we just use those, you know. But, with this session that we had, what I liked was that um, it shows the importance of H&S, irrespective of the discipline that you're working on, you know? Whether, in your office, you're designing your role, you know, the H&S aspect must be at the top of the mind, you know, and also, the problem that most people are talking about, as R23 has just mentioned, is that reluctance to change, uh…'It has worked before, this is how we did it, why would we change it now?' You know? Yep, that's it from me, and*

P30 *Interesting to also get different people's opinions on different aspects, especially the client, certain stuff that we might get frustrated with, you can see that there is actually a reason for it. There are certain rules and procedures for that stuff.*

As can be noted from the feedback reported on, the respondents experience in understanding the SCM and procurement processes were extremely limited, and clearly, the debates and explanations, even for reasonably short time period was found to be beneficial. However, a number indicate the changes in H&S legislation 'were a long time coming' and all participants were positive and found aspects of interest or learning.

5.6 THEME CONCLUSIONS

The conclusions are presented in their themes as identified, as the focal points for the AR FGs'.

5.6.1 Theme 1: Competence of Stakeholders

Literature indicates that competency is lacking among all disciplines in the construction sector relative to H&S. The critical finding of FG Theme 1 supports the notion of the lack of competency, as the majority of respondents across all categories had noted their lack of confidence regarding H&S. Only the architect appeared to not think H&S 'officers' should be involved on projects, and there should be no interference with designs. Other BEPs' did understand the issues, and albeit reluctantly in some cases, are introducing or including H&S and the disciplines on projects.

5.6.2 Theme 2: Linking procurement and the 6 Stages of Construction

Theme 2 followed the procurement practices relative to H&S, and to link them to the 6 stages of construction. Issues noted from participants included appointment of the CHSA during stages 3, 4 and even stage 5. The CHSMs' and CHSOs' indicated their involvement mainly during stage 5, but a number indicated some level of experience during the tender preparation during stage 4, as well as pricing of the BoQ.

A range of 'grey' areas were noted, as to where one part of a stage starts, or finishes. The participants noted that the inclusion of the CHSA at stage 1, 'Initiation and Briefing' is highly unlikely as the information in the form of notification of which projects are going to be done is what is received. However, it was suggested that the appointment of the CHSA could be made during the latter half of stage 1, to prepare the BRA and a designers H&S Specification. All the appointments and requirements noted during the process are legal minimums and do not constitute better practice, or link with international practices. In summary, there is H&S involvement in a 'fragmented' manner, or varying degrees of compliance.

The 'gaps' in the procurement of CHSA for legislative compliance places the client at risk should there be any accidents or fatalities that on investigation could be linked to the lack of inclusion during

design. No overall risk information is supplied from National Treasury through the 'custodian' or 'user' to the ECDRPW.

5.6.3 Theme 3: Links between Procurement, H&S and the Construction Work Permit

Theme 3 considered the notion of the links between SCM and procurement, H&S and the CWP. The FGs' were completed in June 2015, just less than 2 months prior to the exemption period given for the industry to prepare for the implementation of the CWP. The ECDRPW, at Provincial and District level, clearly indicated it was not ready to comply. The realisation of the pending lack of legal compliance was noted as a concern by the client representatives.

The construction H&S participants clearly can, and could assist with the submission of pre-tender H&S plans as part of a pre-qualification process, that could reduce the risk and potential project costs and delays.

5.7 CONCLUSIONS

Three themes were selected for the qualitative data analysis. The themes did not replicate what had been done in the quantitative studies, but complemented them in terms of the competence of multi-stakeholders, linking procurement and H&S, and the stages of construction, and the impact of procurement on the issue of application for the CWP. The themes add depth to the roles and responsibilities among all stakeholders, including construction H&S.

Theme 1, examining the competence issue, identified competence across most of the participants, including the BEPs', supporting the literature.

Theme 2 identified the late appointment of the CHSA, namely during stages 3, 4 and even stage 5. The CHSMs' and CHSOs' indicated their involvement mainly during stage 5, with a number indicating their being familiar with the stages where they were required to operate. Lack of H&S information from the 'custodian' or 'user' were noted as having an impact on the project.

Theme 3 noted a range of ‘grey’ areas, where one part of a stage starts, or finishes. The participants noted that the inclusion of construction H&S at stage 1, is highly unlikely as the information in the form of notification of which projects are going to be done is what is received.

Feedback from the participants indicated the lack of knowledge from each of the stakeholders relative to each other. The positive interactions between construction H&S, clients’ and stakeholders could engender closer working relationships, trust and improved communication.

CHAPTER 6: INTERPRETATION AND DEVELOPMENT OF THE MODEL

6.1 FOREWORD

Chapter 4 introduced the quantitative research design of the research, and Chapter 5, the qualitative research design. The quantitative aspect constituted two surveys and the qualitative aspect included three focus group discussions conducted with the ECDRPW. The mixed method approach sought to identify key issues that exist within the sector and that could be included in a model for application in the construction industry. The qualitative data provided themes for the development of the model. The quantitative data were collected on aspects that informed the Researcher on the status quo on H&S in the construction industry.

The development of the theoretical model for the construction industry has been progressive. The FGs' were used to identify areas in the process that would be most suited to being incorporated into the model. The literature reviewed, and all the data that has been collected in the generation of this model. The following paragraph identifies the stages, IDMS and Treasury considerations.

6.2 THE CONSTRUCTION STAGES, IDMS AND TREASURY

Literature indicates that the success of the relationships between stakeholders depends on the level of mutual understanding (Alharthi *et al*, 2014). Fragmentation is exacerbated, as each party has its own priorities, creating silos within the sector. The need is thus, for all parties to improve the methods of procurement, ensuring cost based strategies, and the adoption of a systematic and strategic approach.

The principles of efficiency, accountability, and appropriate transfer of risk are some of the elements required to maximize the value and sustainability of construction activities. In the South African context, the statement made by Watermeyer (2012) is similar to that made more recently by Alharthi *et al* (2014), who state that a system is 'an established way of doing things', that provide order and a platform for methodical planning, all of which are required, to proceed with a project. Systems are underpinned by processes, procedures and methods, and in turn need to be documented, managed

and controlled. Systems are further required to comply with statutory requirements, standards and accepted practices.

The construction sector in South Africa has, for many decades operated in a silo, largely excluding H&S. Traditional construction practices such as architecture, civil and other forms of engineering, dovetail into the 'business of construction', following the 'rules' set by the built environment and statutory requirements, within each discipline and specialisation. The traditional silo relates to the traditional means of procurement practice, which in turn link into the National Treasury requirements and the PFMA requirements, to ensure state monies and assets are properly controlled and managed.

National Treasury has a total of 9 stages that 'overarch' the construction processes, setting the controls, or the framework for infrastructure delivery. The IDMS has 9 stages, with stages 6 and 9 having further subdivisions. The BEP stages identified and used by the BEPCs each have 6 stages.

Table 6.1 reflects a simplified, summary linking of the stages and their interactions. From the table it is clear there is hierarchy within the processes, as they feed, or flow dynamically into each other, with consequences and risk where not complied with. National Treasury stages controls and audits the processes, as they are set out in terms of the outputs and project deliverables at all levels of the public sector. The IDMS framework, could be deemed an 'intermediary' that is managed, for example at provincial or district level by SCM, project managers and the PSPs' or agents acting on behalf of the client. The BEP stages have a range of headings for each stage, but ultimately the broader information is not significantly different between the stages or as included by the BEPCs'.

The Department of Public Works is the 'custodian' of the built environment, with state owned departments, such as The Department of Education a 'user'. Each has an 'Asset Management Plan' (AMP), which translates into projects that are required to meet infrastructure development.

The term used to refer to the Custodian, or the User, and their AMP is 'C-AMP', or U-AMP. In most cases the Department of Public Works, SANRAL or Department of Roads will act as further intermediaries and manage the projects on behalf of the User Department or the Custodian Department to ensure the AMP is managed and delivered.

Table 6.1 Summarised IDMS Stages and Gateways, Information Flow.

C-AMP: NATIONAL TREASURY		U-AMP IDMS		BEP STAGES	
Stages		**Stages**		**Stages**	
1	Infrastructure planning	1	Infrastructure Plan	Not applicable	
2	Procurement planning	2	Procurement Strategy		
3	Package planning	3	Strategic Brief		
4	Package definition	4	Concept report	1	Project Initiation and Briefing / Inception / Inception Services
5	Design Development	5	Design development report	2	Concept and viability (preliminary design)
6	Design documentation	6a	Product information	3	Design Development (Detailed Design)
		6b	Manufacture, fabrication and construction information		
		6c	Logistics information	4	Documentation and Procurement
7	Works	7	Completed works	5	Contract Administration and Inspection
8	Hand over	8	Works handed over to user	6	Close out
9	Close out	9a	Updated asset register	Not applicable	
		9b	Completed contract or package order		

Literature indicates the serious results of legal non-compliance, which translates into the loss of life, injury or disease. The CR's (2014) introduced increased prescriptive requirements that apply to key stakeholders in the sector, namely clients', designers' and contractors'. The increase in requirements is because of the lack of reduction of accidents. Each stakeholder has clear roles and responsibilities, which interact and have a clear hierarchal flow in the CR's (RSA, 2014).

However, the CR responsibilities do not tie in with the stages of work or National Treasury's IDMS, rather it is required that the industry comply with the H&S legislative requirements, resulting in a fragmented approach.

6.3 INTEGRATING THE DATA

The FGs' and surveys across the quantitative and qualitative paradigms considered the stakeholders involved with the construction processes. Themes considered the delineation of the stakeholders' who could affect, or be affected by stakeholders' actions, or lack thereof, such as workers, at supervisory or management level. The qualitative themes considered aspects such as levels of competence in H&S, procurement, stakeholders and construction H&S, and how they link together to limit project risk.

6.3.1 Quantitative themes

The quantitative themes considered the 'myths' that surround the industry, such as accidents can't be prevented. Roles and responsibilities were encapsulated in the remaining themes in terms of limiting risk through design, potential influence and risk-taking behaviour. Themes were, *inter alia:*

- The General theme;
- The Workers theme;
- The Management theme:
    - Supervisors, and
    - Responsibilities and Pricing;
- The Stakeholders theme:
    - Project Managers;
    - Design and Designers, and
    - Client;
- The Construction H&S theme:
    - CHSA, and
    - CHSM and CHSO.

6.3.2 Qualitative themes

During the FGs', the other constant, present at each, besides the researcher was the ECDRPW CHSM for the Province.

The CHSM had extensive years in construction, procurement and H&S, and verified that the discussions were valid, such as:

P10 *I am very happy actually – the District office is one of the few regions that does things in the proper order.*

P5 *Hopefully! We do sometimes miss a few things, but we are only human hey?*

6.3.3 Model Development

The final generation of the model progressed through the primary and secondary data. Figure 6.1 indicates the co-occurrence table of codes attributed to the number of triggers, as well as the number of construction H&S stakeholders' identified per stage. The relevance relates to potential, and essential involvement of H&S through the 6 stages, as well as the number of triggers proposed that could be considered, and procurement practices by SCM. The distribution of the CHSO stakeholders, is across all stages, which relates to the roles within their organisations, as well as the roles within the IDoW as defined by the SACPCMP, and SCM. The following figure reflects the construction H&S roles, stages and SCM and the co-occurrences in the coding between each.

Figure 6.1 Code co-occurrence table indicating Construction H&S roles, Stages of Work and SCM.

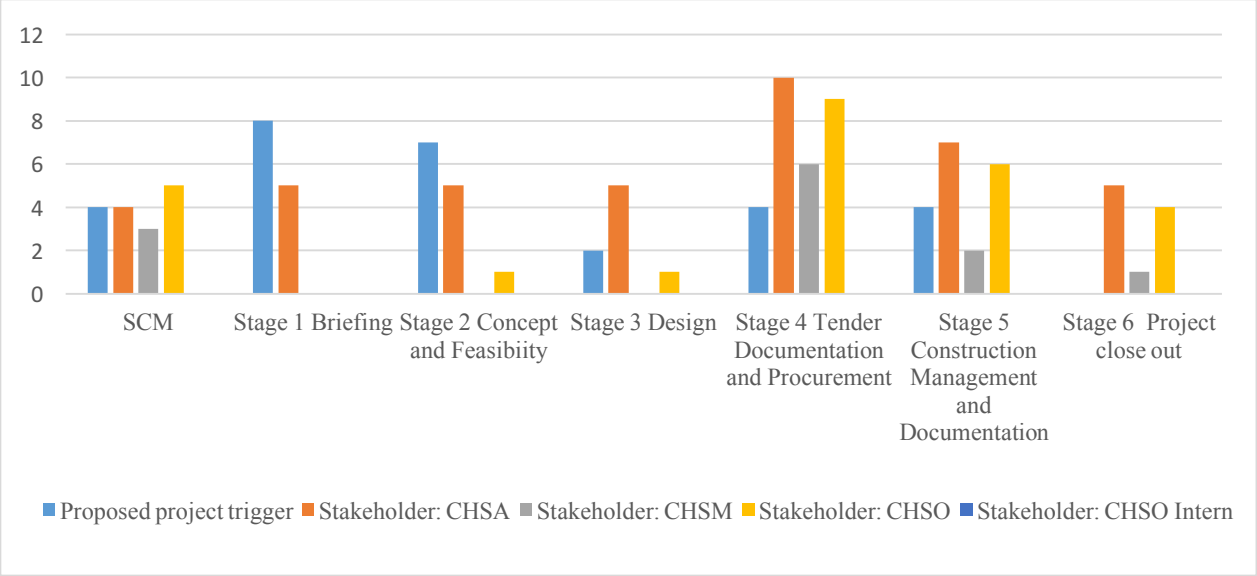
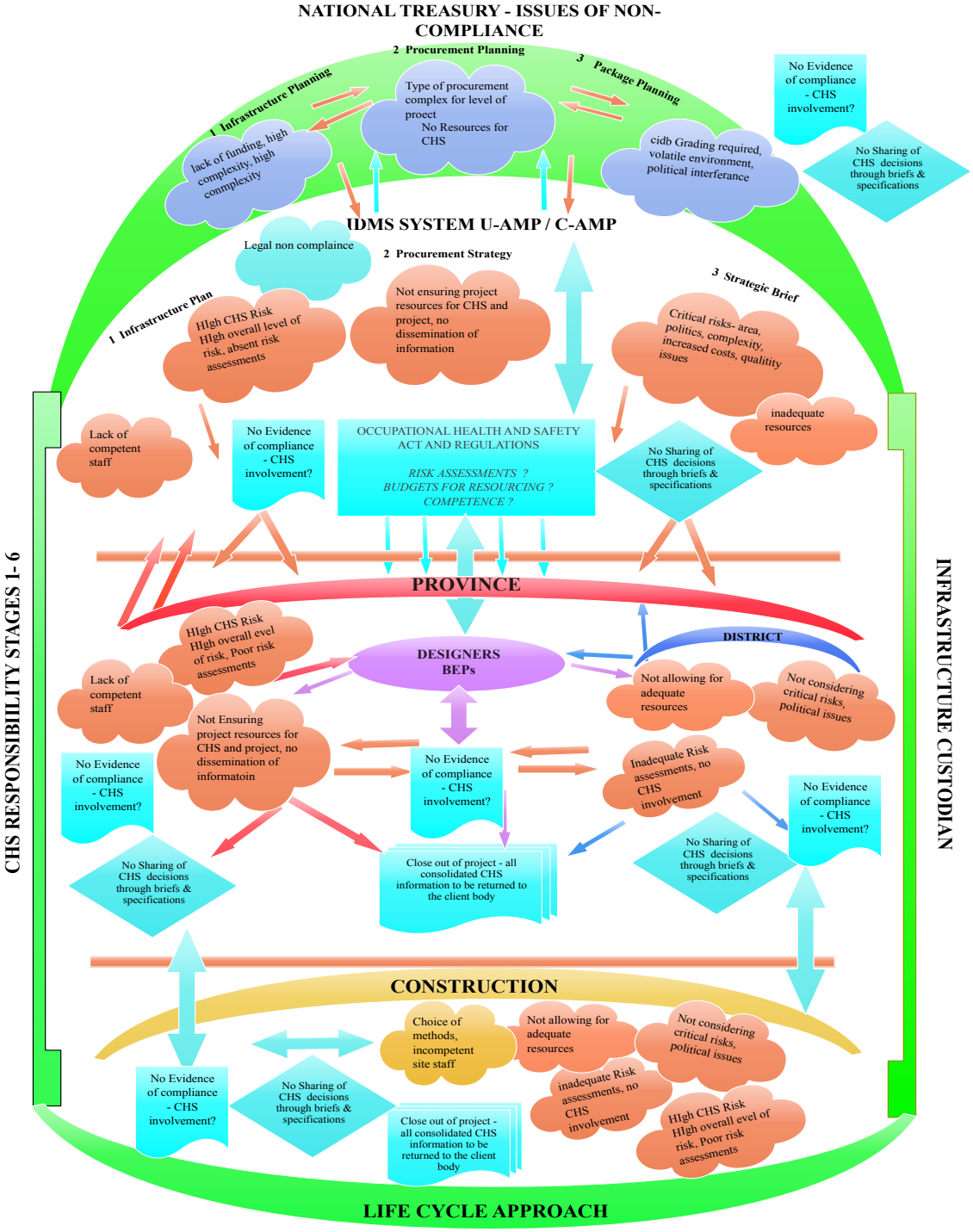


Figure 6.2 is a 'summary' of the flow of a project, from National Treasury, to the contractor. The figure indicates the 'controls' set by government at Treasury, provincial and district level, essentially a hierarchy, and summary of the issues that have been identified during the primary data collection,

and using the qualitative NCT approach. The framework indicates the life cycle approach, the legislation and encapsulation of all 9 stages of construction. Critical to the entire process is that of SCM and procurement methods, which if not linked to the OHSA and legislative framework, key statutory compliance will not be met. Where the stakeholder is not compliant, it has a 'boomerang' effect. The 'boomerang effect' meaning that the repercussions reverberate back and forth until there is an outcome such as a fatality, and corrective actions are taken to stop the repercussions from progressing any further. The figure further reflects the National Treasury framework and the cascading effect on each of the stakeholders and role players in the construction sector, as they relate to H&S non-compliance. The figure further identifies the need for ensuring the assessment of processes, or the statutory triggers that could place all parties at risk, including the increasing of project risk.

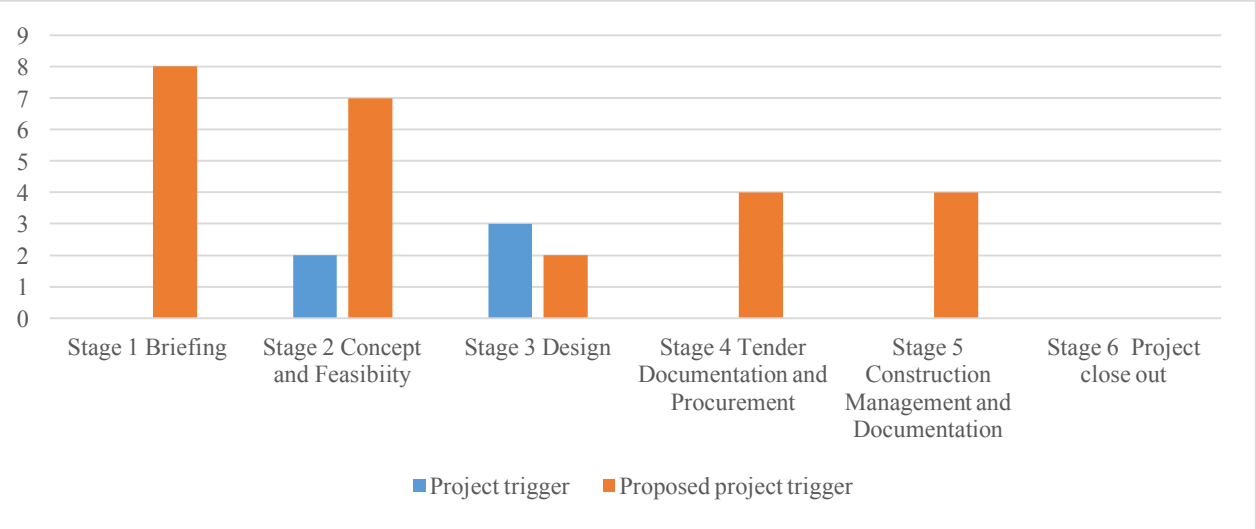
Figure 6.2 The National Treasury Framework, IDMS and H&S: Aspects of non-compliance.



To develop the model, the narratives were sorted into quotations coded 'project trigger' and 'proposed project trigger'. Figure 6.3 indicates the number of codes allotted to triggers that 'stimulate' the need for a project. The proposed project triggers are those codes generated against quotations from participants. Both project and proposed triggers are considered across stages 1 to 6. There were no project triggers for stage 1, or stages 4 to 6. The reason for this is that National Treasury 'issues' the project budgets via the MTEF and the project is then managed through the IDMS via the U-AMP or their intermediary.

In terms of proposed project triggers, there were several proposals, mainly for stages 1 and 2, and then to a lesser degree stages 3 to 5. There were no suggestions for stage 6. Figure 6.3 reflects project triggers and the proposed project triggers across the 6 stages.

Figure 6.3 Project triggers and proposed project triggers across the 6 Stages.



From FG 1 indicates the examples of perceptions from respondents about what the Researcher has termed 'triggers', that include the roles of where and how construction H&S would be involved, with examples of their possible contributions (indicated in **bold**). Several quantitative statements with the degree of concurrence or MS are added where there is benefit.

6.3.3.1 Model Development: Stage 1

Szymberski's (1997) model, presented and discussed by Gambatese (2013) indicates the life cycle approach and the optimum time to determine and identify project risks from start date to the end date of the project schedule. The ability to influence H&S, and to manage risks decreases as the project progresses. Therefore, if designers are aware of and responsive to the potential risks created by the

design, the inherent, residual, or embedded risks can be reduced. The HIFI (2008) states that the term risk identification is in fact, a misnomer, as the cause of accidents, or failure is due to ignorance, oversight, negligence, greed or criminal behaviour of some or all of those involved. Further literature from the key activities identified during Gateway 1 (HSE, 2004) for all stakeholders applicable during stage 1, include:

- The development of H&S policies;
- Developing the project strategic objectives;
- Identifying key project risks;
- Developing a risk register;
- Ensuring financial resources for the project, and
- Identifying communication channels.

CHAIR 1 (WorkCover NSW, 2001) indicates that the conceptual stage of design is the best opportunity to influence change, even though the design has not been developed it is not possible to know or foresee all the risks. Critical risks can be identified and controls can be introduced using the CHAIR study team, which enhances teamwork.

The role of the CHSA is often misunderstood by the BEPs'. However, the commentary was positive regarding their inclusion in general. The issue of the stages was at times difficult to determine, as the participants clearly did not understand the definitive separation points. Several stages and their associated activities were termed 'grey' areas in the coding, indicating 'blurring' relating to the difficulty from the client's point of view to incorporate the construction H&S discipline appropriately into the appropriate stage. The narrative for stage 1 indicates what participants deemed appropriate:

R1 *(Excerpt) ….what you would describe, what would the role be for stage 1 for H&S – for the agent? What input would they do at stage 1? Do you think?*

P10 *Um, Stage 1, not a lot, because its mostly appointing people and getting briefings done, the main effort comes at the end of stage 1 or beginning of stage 2 is difficult to define, but at that stage they should start drawing up the baseline risk analysis, which is a very general risk report on the type of work that is going to be carried out, and what the risks in that may be, both from the design point of view and construction, constructability point of view. They should at some stage get an opportunity to look at the site, which is something that happens*

very seldom because that site could contain risks which have to be dealt with at some stage another. An extreme example, it could be that we have managed to place the site on an old rubbish dump or a swamp, or something along those lines, and it is ***the agent's duty at that stage to point these things out, and discuss with the designer how they are going to get around this. Because it's not just a matter of making sure the foundations are ok,*** *there are other implications in there as well.*

The comment by a CHSO intern within the ECDRPW indicates a trigger:

P3 (Excerpt) ...Looking at the different stages that we went through (the procurement process), I would say that we start at stage 2 when you do the specification, whereby you draft the specification based on the scope of works, then moving through to stage 6.

The narrative then looks at the actual appointment of the PSPs, and what is already occurring within the department within SCM, but not consistently, as the discussion of late appointments for construction H&S was a concern for the CHSAs, and their not being able to fulfil their duties.

*P6 (Excerpt) ...That takes us to a different thing now again. Once the consultants are in, and they have been appointed because it really starts immediately there from the brief, what is required – in this project, project specific now is the geotechs, is the other investigations, it will just go on and on****. So, I would say initially at the appointment at that brief already your occupational H&S should be part of that full team and each and every discipline, they should be part of that as well.***

R1 So now would you then incorporate that into that process, if you now, and I think you mention it P6, when you send out your PSPs now you are incorporating the requirement for the H&S agent. Is that correct, is that what you are doing?

P6 Yes, that is correct, that is what we are doing.

R1 And that hasn't been a problem linking that into your procurement process?

P7 and 6 Agreement, no not at all.

R1 So then the phasing would be at the end of stage 1?

P5 Yes.

The qualitative narratives indicated a lack of confidence and knowledge among the BEP categories that participated in the research. Literature underpins the lack of H&S training, as well as the responsibility to ensure all aspects are considered.

P6 *(Excerpt) …**'Well for us in the built environment have never been really actually exposed to H&S. Planning has never been considered as that. For me, where I am sitting at now… it's an area that I have never… I have left it to the professionals to rather sort that out'.***

Despite the introduction of the CR's in 2003, H&S has not yet been fully integrated across the 6 stages of construction. The focus on cost rather than risk by contractors, requires attention from stakeholders, as workers are downstream and therefore affected by the type of design, and construction practices (Windapo, 2013).

Table 6.2 is a summary of the narratives relative to the triggers identified in the focus group discussions and literature, and lists the associated activities indicating the stakeholder.

Table 6.2 Stage 1 Triggers: Stakeholder role and activities.

Stage 1: Project Initiation and Briefing	
Stakeholder	**Stakeholders Initiatives**
• Client	• Appoint the CHSA, and • Financial resources for the project.
• CHSA	• Develop and maintain H&S policies and project strategic objectives; • Develop a risk register; • Visit site to assess potential issues and risks; • Develop Baseline Risk Assessment (BRA), and • Develop project H&S parameters for designers.
• Designer / Agent	• Ensuring financial resources for the project; • Identifying communication channels, and • Use parameters set by the CHSA.

6.3.3.2 Model Development: Stage 2

The Gateway system (HSE, 2004) cites roles that should be considered during stage 2, that include H&S performance, life cycle costing, value management, consideration for the operation and maintenance (O&M) requirements, and concept designs. Optimum pricing and project duration are critical at this point to allow for H&S as discussed by Goldswain (2014), as the design and resources needed are developing into more detailed design.

The CHAIR model (WorkCover NSW, 2001) states that once risks are identified, controls can be established to ensure the level of risk is as low, in line with hierarchical risk management. Activities during CHAIR 1 are cited as basic, but allow reasonable, and significant changes to improve H&S, as not all risks may be foreseen or addressed at any of the 3 stages. A CHAIR 1 study team includes technical and H&S stakeholders, and notes the diversity of the team decreases the likelihood of overlooking high risks. The debate continued in terms of what would be appropriate to include for stage 2. The narrative regarded the BRA, design support from the CHSA and considerations that could assist with the design development.

P4 (Excerpt) *... It's the **drafting of the baseline risk assessment, drafting of the baseline specification** according to the client's requirements, submitting it so that those documents can get to the principal contractor, that's what I'll say.*

P7 ***Advising on your design, and also even taking into account certain elements in the design for instance, future washing of the windows**, they must remember to put some sort of rail on top of the building and things like that. Just advising. P5 doesn't agree with me…*

P5 *What are we being paid for?*

P8 *My input there would be, you would look at **the investigation that will be taking place within this stage and I think it's the H&S agent's responsibility looking at if there is going to be traffic counts, if there is going to be drilling, if there is going to be going out in certain areas and you have high crime rates, you have people not taking care of themselves that could get ridden over, so that basic design risk assessment for the study that will be conducted from the agents point of view. All the functions that will make up the design must be considered and the risk involved with everyone's input must be considered.***

The summary of the narrative and supporting literature relative to the critical role of the construction H&S is reflected in Table 6.3.

Table 6.3 Stage 2 Triggers: Stakeholder Role and Activities.

Stage 2: Concept and Feasibility	
Stakeholder	**Stakeholders' Key Activities**
• All Stakeholders	• Value management; • Workshop the design aspects, and • Discuss O&M from the design perspective e.g. how washing or replacing of windows will be done.
• CHSA	• Include requirement for H&S pre-qualification in the SCM process of tendering; • Further development of the BRA; • Advising on the investigations to be done (from a H&S perspective), and • Link BRA into designer project specific H&S specification (DPSHSS).

6.3.3.3 Model Development: Stage 3

Gateway 5 considers the initial or preliminary design processes, to ensure legal compliance to continue with construction; the procurement strategy and detailed designs for the project, including partner or contractor selection aspects. The key information is set out in the project specifications and controls. The process during this gateway is to limit design changes from occurring during construction stage. Records are kept of the documentation developed in H&S files and construction H&S plan, which is developed by the client for the contract (HSE, 2004; Goldswain, 2014). Irrespective of the form of procurement chosen, SCM is a key factor, as is H&S for the project (HSE, 2004; Goldswain, 2014).

Data obtained revealed that not all departments integrate SCM with the construction H&S and H&S requirements. Linking to the requirements of the CWP, issued by the DoL, the time frames regarding the tender time frames and the DoL time frame is noted as an issue.

The general conditions of contract, generally accepted by SCM in terms of the number of days tenders are advertised, adjudicated and then awarded are 'fixed', which raises a timing issue considering that the DoL requires at least 30 days to 'consider' a CWP application. From a

contractual point of view, the extra time has cost implications for the client, given payment of the preliminaries and general (P&Gs) section of the BoQ commences from the letter of award to the contractor. Furthermore, where the integration is not there, the quality of the project will be affected, increasing fragmentation and decreasing optimum communication.

The narrative regarding the CWP and integration of H&S raised the possibility of the use of pre-tender H&S plans, as a form of pre-qualification that could be submitted with the tender documents. The requirement to ensure that contractors are competent is critical given the high-risk nature of the industry. The following quotations underpin this finding:

P30 *(Excerpt) …I know it's not site specific, but can't... if we, at tender phase ask for safety plans?* ***If we at tender phase ask for a H&S plan for adjudication, can't we use that one?*** *No?;*

R23 ***We've done it in the department before, but we have a problem with regards to the procurement process****, and*

P24 ***Our procurement process doesn't allow us to ask for pre-tender H&S plans****.*

The following excerpt from the narrative is regarding the preparation of the H&S plan, and the time it takes to prepare. The researcher, as well as several CHSMs' / CHSOs' indicated that large organisations use pre-qualification as a 'best practice' approach, and are audited against the standards set for pre-qualification. The participants were questioned regarding the amount of time it takes to prepare a H&S plan for submission. The time frames for the preparation for the H&S plan given in this narrative were similar for FG 3, and FG 2, therefore saturation of data was obtained on this aspect.

P32 *(Excerpt) ... Um.. (inaudible) …****a week.***

P27 *Um…****about 3 days.***

R23 ***3 days****.*

P28 ***Ja. It's normally done quickly at this stage.***

P27 *Yes.*

The discussion regarding the use of pre-qualification by way of pre-tender H&S plans relative to SCM approval or acceptance was discussed further, as the issue was clearly a barrier within the province. Ultimately perhaps, a positive unintended consequence of the CWP and its effect on SCM, could limit potential claims from contractors. The tender process, while having to comply with the

SCM requirements, could have further guidelines added, with no implications to the PFMA or other statutory requirements. The narrative indicates the frustration level of individuals within the department to introduce the pre-qualification aspect.

R23 Is it a provincial policy issue or is it a national policy issue?

P26 It's a departmental policy. It's specific to the DRPW.

R23 Those final lists, uh.. lists (referring to the 'short-lists of complying tenders)

P28 Hmmm.

R23 …Could be invited to submit a H&S plan.

P28 If it's not already in there already.

R23…. Then there could be a lot more interaction between the H&S um…agent and the officer for that contractor to get it through to the DoL. That way, by the time you get to your 21 days, maybe 28 days maximum, you've actually got your permit.

The aspect of ensuring adequate H&S resources for the project is a statutory requirement. However, literature notes that because of economic pressure and competitive tendering, contractors who take H&S into consideration are penalised if they have higher rates (Wells and Hawkins, 2010; Zou and Sunindijo, 2015). Competitive tendering, where the award is based on lowest price, results in a vicious cycle of cost cutting and claims generation. The cycle affects H&S, and cost, quality and time. The cycle further results in H&S suffering first with budget cuts. The narratives during chapter 5 indicate similar issues from the South African context.

Other models in use such as CHAIR (WorkCover NSW, 2001) incorporates the key stakeholders involved in design, that assists with risk identification and the appropriate considerations needed to limit or minimize the inherent risks in a structured and systematic manner. Table 6.4 indicates the roles that should be included with the triggers for stage 3.

Table 6.4 Stage 3 Triggers: Stakeholder Role and Activities.

Stage 3: Design and Documentation	
Stakeholder	**Stakeholders' Key Activities**
• All Stakeholders	• Detailed designs for the project by ensuring legal compliance to continue with construction, and • Selection of the procurement strategy and, including partner or contractor selection.
• CHSA	• Include H&S information in the project specifications and controls; • H&S pre-qualification in the SCM process of tendering (to reduce procurement time and potential contractor claims); • Reduce the time for developing the SSHS plan in contractual documentation to 7 days (unless extenuating circumstances) • Prepare BoQ against SSHSS for inclusion into the project specific H&S plan; • Finalise the SSHSS and BRA; • Assess the requirements and include criteria for the pre-qualification and pre-tender H&S Plan; • Ensure inclusion in the designers' tender documentation, and • Ensure all the H&S documentation is in the tender.

6.3.3.4 Model Development: Stage 4

The Gateway model, Gateway 6 addresses the H&S aspects relative to detailed designs and drawings, technical issues, with the focus on the life cycle, change management through the project, and again the documentation. Gateway 6 could also be a part of the construction stage (HSE, 2004; Goldswain, 2014).

The CHSO / CHSM function is considered for stage 4, as stages 4 to 6 are the area of practice in terms of the SACPCMP IdoW. The narrative included a discussion regarding the pricing of the project that the CHSO / CHSM should do during stage 4. Hence the issues that occur 'downstream' of design are due to the lack of adequate H&S consideration, and require upstream attention by stakeholders and the CHSA.

P4 (Excerpt)…***I would say we should be involved from stage 4. When the BOQ goes out to the principal contractor, we should be involved there.*** *Because there is normally a H&S BOQ at the back of the specification that they give us and* ***sometimes the quantity surveyors, they just price the way they want to price, because if they make H&S too high, the project won't get awarded*** *to the… and that is what happens.* ***You will find that on a lot of or some of the projects you will find there is not a lot of money made available for H&S, or not the amount that has to be made available.***

P19 (Excerpt)... *P16. I think to perhaps to help with your question you have asked there, is if it helps the contractor, to help the contractor,* ***you as the client have to ensure that your specification is detailed, the scope of works is included.***

P14 *Absolutely.*

P19 ***Your geo, if you haven't given them all the information, they can't speed the process up for you in return****.*

There are other actions stakeholders need to ensure, specifically that the tenders are adjudicated fairly and in line with the statutory requirement for ensuring the competent and resourced contractors. The stage 4 triggers are included in Table 6.5 indicates those triggers that are noted for stakeholders, key activities, and include the upstream and downstream activities.

Table 6.5 Stage 4 Triggers: Stakeholder Role and Activities.

Stage 4: Tender Documentation and Procurement	
Stakeholder	**Stakeholders' Key Activities**
• All Stakeholders	• Ensure inclusion of the CHSA as part of the technical SCM committees, and • Ensure contractors are adequately resourced and competent. • Support the client to limit liability with SCM.
• CHSA	• Assist with assessing competence and resources during tender adjudication and award, and • Ensure adequate information for CWP application.
• CHSO	• Prepare BoQ against SSHSS for inclusion into the SSHSP, and • Submit a H&S plan, and/or inclusion into the SSHSP.

6.3.3.5 Model Development: Stage 5

No specific discussion regarding stage 5 was noted regarding triggers other than re-design issues, or the late appointment of the CHSA by the client. The CR's require compliance monitoring through the construction stage, with the requirement to address any changes, similar to that included in the Gateway Model (Gateway 6) with a requirement to manage change management through the project (HSE, 2004; Goldswain, 2014). The CHAIR model indicates further activities that affect construction, and further workshops among the team could be undertaken.

The CHSO is included in terms of their own change management, and compliance monitoring. The comments regarding the CHSA, relative to their late appointment, impacts on the project as literature indicates (Gambatese, 2013). The CR's further require that the work is stopped should the lives of workers be at risk. Table 6.6 indicates the triggers for stage 5, and the stakeholders key activities.

Table 6.6 Stage 5 Triggers: Stakeholder Role and Activities.

Stage 5: Construction Documentation and Management	
Stakeholder	**Stakeholders Key Activities**
• All Stakeholders	• Ensure appropriate legal compliance through the project; • Stop any work placing workers at risk; • Ensure means of change management is included, and • Ensure monitoring and records relating to contractors and communication to ensure compliance.
• CHSA	• Ensure aspects of change management is included; • Stop any work placing workers at risk, and • Ensure monitoring of all contractors and communication to ensure compliance.
• CHSO	• Ensure monitoring of all contractors and communication to ensure compliance, and • Stop any work placing workers at risk.

6.3.3.6 Model Development: Stage 6

The Gateway Model (Gateways 7 and 8) include aspects relative to project close out, or the end of the project Close out includes handover, and final completion. H&S documentation pertaining to the

project is required to be in place for the maintenance of the project, including lessons learnt on the project. A contract review forms part of gateway 8 (HSE, 2004; Goldswain, 2014). The CR's have similar requirements as a consolidated H&S file, which forms part of the O&M requirements for clients'. Consideration for future work should be based on particular inherent construction methods used, for example pre- or post-stressed concrete beams, confined spaces or where there are hazardous materials such as asbestos on the site (RSA, 2014). Table 6.7 below indicates the key activities for the groups of stakeholders.

Table 6.7 Stage 6 Triggers: Stakeholder Role and Activities.

Stage 6: Project Close Out	
Stakeholder	**Stakeholders' Key Activities**
• All Stakeholders	• Ensure legal compliance through the project; • Ensure monitoring and close out records are submitted. relating to contractors and communication to ensure compliance, and • Maintain performance reports.
• CHSA	• Ensure monitoring and close out records are submitted. relating to contractors and communication to ensure compliance, and • Reconcile hazards encountered with the BRA, SSHSS, and SSHSP; submit operational and maintenance (O&M) information, consolidated H&S information for maintenance.
• CHSO	• Ensure monitoring and close out records are submitted. relating to contractors and communication to ensure compliance.

Table 6.8 illustrates the construction H&S interventions across the construction stages. '**The Deacon Procurement, Design and H&S Model'** that has emerged from South African and international literature, as well as the qualitative findings. The model focuses on the South African legislative framework of H&S, SCM and procurement practices among stakeholders, across the 6 stages of construction. While the basis of the model is legal compliance, it incorporates international better practice as indicated through the literature. The tendency of the industry is to adhere to minimum levels of compliance, not determining other aspects that could possibly reduce risk. Therefore, all

stakeholders need to work together, and for each stage each of the stakeholders is included in terms of their broad role. Reference to stakeholders in this context includes the client and the designer or person acting as their agent. The stakeholders could include any of the BEPs' as registered with the statutory built environmental councils, e.g. ECSA, SACPCMP, SACAP, and SASQSs'.

Table 6.8a The draft 'Deacon Procurement, Design and H&S Model'.

Construction H&S Interventions / Construction Stages					
1	**2**	**3**	**4**	**5**	**6**
Project Initiation and Briefing	**Concept and Feasibility**	**Design Development**	**Tender Documentation and Procurement**	**Construction Documentation and Management**	**Project Close Out**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers; CWP					
Key Activities per Stage and Stakeholder					
Client: • Appoint the CHSA, and • Provide financial resources for the project. **Designers:** • Ensure financial resources for the project; • Identify communication channels, and • Use parameters set by the CHSA.	**All Stakeholders**: • Feasibility or value management; • Workshop the design aspects, and • Discuss O&M from the design perspective e.g. how washing or replacing of windows will be done through the life cycle.	**All Stakeholders:** • Detailed designs for the project by ensuring legal compliance to continue with construction, and • Selection of the procurement strategy and, including partner or contractor selection.	**All Stakeholders:** • Ensure inclusion of the CHSA as part of the technical SCM committees, and • Ensure contractors are adequately resourced and competent.	**All Stakeholders:** • Ensure appropriate legal compliance through the project; • Stop any work placing workers at risk; • Ensure means of change management is included, and • Monitor and maintain records relating to contractors and communication to ensure compliance.	**All Stakeholders**: • Ensure legal compliance through the project; • Ensure monitoring and close out records are submitted, relating to contractors and communication to ensure compliance, and • Maintain performance reports.

Table 6.8b The draft 'Deacon Procurement, Design and H&S Model'.

Construction H&S Interventions / Construction Stages					
1	**2**	**3**	**4**	**5**	**6**
Project Initiation and Briefing	**Concept and Feasibility**	**Design Development**	**Tender Documentation and Procurement**	**Construction Documentation and Management**	**Project Close Out**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers; CWP					
Key Activities per Stage and Stakeholder					

CHSA:
• Develop and maintain H&S policies and project strategic objectives;
• Develop a risk register:
  • Visit site to assess potential issues and risks;
  • Develop Baseline Risk Assessment (BRA), and
  • Develop project H&S parameters for designers.
	CHSA:
	• Include requirement for H&S pre-qualification in the SCM process of tendering;
	• Further development of the BRA;
	• Advising on the investigations to be done (from a H&S perspective), and
	• Link BRA into designer project specific H&S specification (DPSHSS).
		CHSA:
		• Include H&S information in the project specifications and controls;
		• H&S pre-qualification in the SCM process of tendering (to reduce procurement time and potential contractor claims),
		• Reduce the time for developing the PSHS plan in contractual documentation to 7 days (unless extenuating circumstances);
		• Prepare BoQ against PSHSS for inclusion into the project specific H&S plan;
		• Finalise the PSHSS and BRA;
			CHSA:
			• Support the client to limit liability with SCM;
			• Assist with assessing competence and resources during tender adjudication and award, and
			• Ensure adequate information for CWP application.
				CHSA:
				• Ensure aspects of change management is included;
				• Stop any work placing workers at risk, and
				• Ensure monitoring of all contractors and communication to ensure compliance.
					CHSA:
					• Ensure monitoring and close out records are submitted relating to contractors and communication to ensure compliance, and
					• Reconcile hazards encountered with the BRA, PSHSS, and PSHSP; submit operational and maintenance (O&M) information, consolidated H&S information for maintenance.

Table 6.9c The draft 'Deacon Procurement, Design and H&S Model'.

Construction H&S Interventions / Construction Stages					
1	**2**	**3**	**4**	**5**	**6**
Project Initiation and Briefing	**Concept and Feasibility**	**Design Development**	**Tender Documentation and Procurement**	**Construction Documentation and Management**	**Project Close Out**
Key Activities per Stage and Stakeholder					
		• Assess the requirements and include criteria for the pre-qualification and pre-tender H&S plan, and • Ensure all the H&S documentation is in included in the tender documentation.			
			CHSO: • Prepare BoQ against PSHSS for inclusion into the site-specific H&S plan, and • Submit BoQ against PSHSS for inclusion into the project.	**CHSO:** • Ensure monitoring of all contractors and communication to ensure compliance, and • Stop any work placing workers at risk.	**CHSO:** • Ensure monitoring and close out records are submitted. relating to contractors and communication to ensure compliance.

6.4 SUMMARY

Chapter 6 presents the development, and the model that evolved through the AR and FGs' undertaken for the study. International and South African literature included in Chapter 2 pertaining to procurement, design, H&S, and stakeholders were included in the development of the model. Key legislation, namely the PFMA and the OHSA and its CR's (2014) were considered and applied within the broad context. The FG narratives that were coded as proposed project triggers were included in the model, as well as the upstream and downstream aspects that are affected, where applicable.

Chapter 7 discusses the processes followed for the verification of the draft model.

CHAPTER 7: VERFICATION OF THE MODEL

7.1 FOREWORD

Chapter 6, 'Interpretation and Development of the Model' resulted in the development of a draft of the '**The Deacon Procurement, Design and H&S Model'**. The model was developed from the primary and secondary data, namely national and international literature, and the AR FGs' held with the ECDRPW, Bhisho, and Sarah Baartman Districts. The quantitative data was not used directly for the development of the model, as those data have been mainly utilised for a range of S-Ps' and related hypotheses. The verification of the FGs' by the participants was considered appropriate, and to provide some 'closure' relative to being able to comment on the outcome of their time, knowledge and experiences.

Creswell (2013) states that qualitative researchers strive for 'understanding the deep structure of knowledge', probing and then cites Stake (1995) who at the end of a process asks: 'did we get it right'? There are several perspectives regarding, and means of validation, notwithstanding that, while using the usual research methods, the researcher is required to provide reliability. In qualitative research 'confirmability' and 'dependability' rather than objectivity through auditing of the research process. Creswell (2013) cites Eisner (1991) who states that corroboration, consensual validation, and referential adequacy are terms and means that lends confidence to observations, interpretations, and conclusions. 'Member checking' is one of the methods that are used and considered a critical technique in establishing credibility. In this research member checking was used by appointing an independent decoder to verify the findings from the qualitative data analysis, thus, enhancing trustworthiness and credibility of the findings. Furthermore, the data, interpretations, analysis and conclusions are taken back to the participants for their judgement on accuracy and credibility using a quantitative instrument and measurement (Hesse-Biber, 2010; Creswell, 2013).

7.2 VALIDATION OF THE MODEL COMPONENTS

The model proposed in the research is not meant to be 'complete'. Practices, statutory frameworks, and standards constantly evolve, and were factors considered for the potential use and outcome that formed the basis of the model.

7.2.1 Discussion

On completion of the draft model, a copy of the draft model, a 'model validation questionnaire', and a covering letter outlining the request for feedback was sent to the participants who responded to the questionnaire during the FGs' (Annexure 7). The 'model validation questionnaire', an eleven-point questionnaire containing pertinent questions was developed following the completion of the draft model. The distribution was done electronically, and participants were requested to provide responses electronically, directly to the researcher. Due to the time of year, the response rate was very poor, and a total of five responses out of a possible thirteen were received, resulting in a response rate of 38.5%. A total of two 'out of office' responses were received, and a further two 'bounced' back. Short message services (SMSs') were sent to those who had provided contact numbers, which resulted in a further two responses. One of the participants had left employment with the ECDRPW and excluded, as a forwarding address was not known. The findings can therefore be considered exploratory.

The degree of concurrence is represented in terms of percentage responses to a scale of 1 (strongly disagree (SD)) to 5 (strongly agree (SA)), and a corresponding MS between 1.00 and 5.00. The DoC relating to the scale is presented in the table 7.1.

Table 7.1 Model verification: Mean Score and Degree of Concurrence.

Mean Score range ($\bar{x}$)	**Degree of concurrence**
$4.20 < \bar{x} < 5.00$	agree to strongly agree / strongly agree
$3.40 < \bar{x} < 4.20$	neutral to agree / agree
$2.60 < \bar{x} < 3.40$	disagree to neutral / neutral
$1.80 < \bar{x} < 2.60$	strongly disagree to disagree / disagree
$1.00 < \bar{x} < 1.80$	unsure

The statements drafted for the validation of the draft model were directly related to the key activities identified by the respondents and literature, relative to the stakeholders. The stakeholders included

the client, designers, and construction H&S. The term 'all stakeholders' was included where the key activities included the client and the designers. Designers are noted as any of the BEPs' who are registered to practice with any of the statutory councils as noted in Chapter 2 and Chapter 6. The DoC for all the statements fall into the AtoSA/SA range, as indicated in Table 7.1, and therefore the model is supported.

Table 7.2 Concurrence with statements relating to the validation of the draft model.

Statement	Response (%)						MS
	U	SD	D	N	A	SA	
To what extent do you agree with the 6 Stages of work posed?	0.0	0.0	0.0	0.0	3.0	2.0	4.40
To what extent do you agree with the key activities of the 'Client'?	0.0	0.0	0.0	0.0	3.0	2.0	4.40
To what extent do you agree with the key activities of 'All Stakeholders'?	0.0	0.0	0.0	0.0	3.0	2.0	4.40
To what extent do you agree with the key activities of the 'CHSA'?	0.0	0.0	0.0	0.0	1.0	4.0	4.80
To what extent do you agree with the key activities of the 'CHSO'?	0.0	0.0	0.0	0.0	2.0	3.0	4.60
How useful would the model be relative to being used in your department/organisation?	0.0	0.0	0.0	0.0	3.0	2.0	4.40
To what extent do you believe the model applies to the construction sector?	0.0	0.0	0.0	0.0	2.0	3.0	4.60
To what extent do you believe the model applies to procurement?	0.0	0.0	0.0	0.0	1.0	4.0	4.80
To what extent do you believe the model applies to design?	0.0	0.0	0.0	0.0	3.0	2.0	4.60
To what extent do you believe the 'triggers' could be applied as H&S gateways in the IDMS?	0.0	0.0	0.0	0.0	1.0	4.0	4.40

The following comments included from two of the participants have been noted and are included below.

7.2.1.1 Respondent 1: Comments

Where changes or reviewed sections of the text in the model were adjusted or commented on, they were added. Semantic changes were proposed for stage 3 and an addition for stage 4 (noted in red):

- ***All Stakeholders:***
  - *Provide detailed designs for the project and ensure legal compliance to continue with construction*, and

- ***All Stakeholders:***
    - *Ensure that all contract documentation is complete and provides adequate information to the contractor.*

Comments included:

- *"Terminology to be changed from 'project specific H&S Specification' to 'Site specific H&S Specification";*
- *"Within Government departments procurement requires that all work is tendered for, as a consequence, the CHSA appointment must be the end product of a tender process. The CHSA contract cannot be awarded until finances are in place and this normally happens* during *stage 2, this means that the CHSA cannot be appointed in stage 1";*
- *"The H&S BoQ should not be part of the SSHSS, but included in the main Schedule of Rates. The payment item descriptions should be in the SSHSS";*
- *"As you know, the use of pre-tender H&S plans in DRPW projects is not allowed. Maybe it will get better after the move to Transport in April", and*
- *"It would help if you provided an explanation of abbreviations, i.e. CWP."*

The comment regarding the appointment of the CHSA at the end of the tender process, is an indication that the province and districts are restricted from compliance by the IDMS as required by National Treasury. The funding would therefore need to be made available for the appropriate client level to comply.

The item noted relative to the comment regarding the H&S BoQ and schedule of rates was noted, and included in the revised model.

The aspect relating to the pre-tender H&S plans not being allowed, again was noted in the FGs' as being specific to the province, and subject to developing policies and guidelines for SCM to follow to include the requirement in the procurement process.

7.2.1.2 Respondent 2: Comments:

Respondent 2 only had one comment:

"The initial involvement of CHSO in these 6 stages of work could be the solution in reducing and eliminating accidents and incidents in the working environment, but again one will ask himself or herself a question as who's going to monitor or make sure that CHSO are involve because CHSO are the valuable stakeholders in these processes. The should be a team that will be elected to monitor all these processes."

The comment is noted, with a few exceptions. The CHSO should indeed know, and be familiar with all 6 stages of the construction life cycle as the lack of appropriate actions at stages 1 to 3 directly impact on the area where the CHSO practices, namely stages 4 to 6. The respondent acknowledges the value of the CHSO, and solution to the elimination of accidents and incidents through H&S inclusion. The question of the monitoring of the H&S inclusion on the project would not be an issue should the proposed triggers be implemented, as the project would not progress if the requirements are not in place.

The recommended changes in semantics or terminology from the feedback obtained has been incorporated and is reflected in the final model the 'final' model (Table 7.3).

Table 7.3a The Final 'Deacon Procurement, Design and H&S Model'.

Construction Health and Safety Interventions / Construction Stages					
1	**2**	**3**	**4**	**5**	**6**
Project Initiation and Briefing	**Concept and Feasibility**	**Design Development**	**Tender Documentation and Procurement**	**Construction Documentation and Management**	**Project Close Out**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers (BEPs'); CWP					
Key Activities per Stage and Stakeholder					
Client: • Appoint the CHSA, and • Provide financial resources for the project.	**All Stakeholders:** • Feasibility or value management; • Workshop the design aspects, and • Discuss O&M from the design perspective e.g. how washing or replacing of windows will be done through the life cycle.	**All Stakeholders:** • Provide detailed designs for the project and ensure legal compliance to continue with construction, and • Selection of the procurement strategy and, including partner or contractor selection.	**All Stakeholders:** • Ensure inclusion of the CHSA as part of the technical SCM committees, and • Ensure contractors are adequately resourced and competent, and • Ensure that all contract documentation is complete and provides adequate information to the contractor.	**All Stakeholders**: • Ensure appropriate legal compliance through the project; • Stop any work placing workers at risk; • Ensure means of change management is included, and • Monitor and maintain records relating to contractors and communication to ensure compliance.	**All Stakeholders:** • Ensure legal compliance through the project; • Ensure monitoring and close out records are submitted, relating to contractors and communication to ensure compliance, and • Maintain performance reports.

Table 7.3b The Final 'Deacon Procurement, Design and H&S Model'

Construction Health and Safety Interventions / Construction Stages					
1	**2**	**3**	**4**	**5**	**6**
Project Initiation and Briefing	**Concept and Feasibility**	**Design Development**	**Tender Documentation and Procurement**	**Construction Documentation and Management**	**Project Close Out**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers (BEPs'); CWP					
Key Activities per Stage and Stakeholder					
Designers: • Ensure financial resources for the project; • Identify communication channels, and • Use parameters set by the CHSA.					

Table 7.3c The Final 'Deacon Procurement, Design and H&S Model'

Construction Health and Safety Interventions / Construction Stages					
1	**2**	**3**	**4**	**5**	**6**
Project Initiation and Briefing	**Concept and Feasibility**	**Design Development**	**Tender Documentation and Procurement**	**Construction Documentation and Management**	**Project Close Out**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers (BEPs'); CWP					
Key Activities per Stage and Stakeholder					

CHSA:
• Develop and maintain H&S policies and project strategic objectives, and
• Develop a risk register:
  • Visit site to assess potential issues and risks;
  • Develop Baseline Risk Assessment (BRA), and
  • Develop project H&S parameters for designers.
	CHSA:
	• Include requirement for H&S pre-qualification in the SCM process of tendering;
	• Further development of the BRA;
	• Advising on the investigations to be done (from a H&S perspective), and
	• Link BRA into designer project specific H&S specification (DSSHSS).
		CHSA:
		• Include H&S information in the project specifications and controls;
		• H&S pre-qualification in the SCM process of tendering (to reduce procurement time and potential contractor claims);
		• Reduce the time for developing the SSHS plan in contractual documentation to 7 days (unless extenuating circumstances);
		• Prepare BoQ against SSHSS for inclusion into the project specific H&S plan;
		• Finalise the SSHSS and BRA;
		• Assess the requirements and include criteria for the pre-qualification and pre-tender H&S plan, and
			CHSA:
			• Support the client to limit liability with SCM;
			• Assist with assessing competence and resources during tender adjudication and award, and
			• Ensure adequate information for CWP application.
				CHSA:
				• Ensure aspects of change management is included;
				• Stop any work placing workers at risk, and
				• Ensure monitoring of all contractors and communication to ensure compliance.
					CHSA:
					• Ensure monitoring and close out records are submitted. relating to contractors and communication to ensure compliance.
					• Reconcile hazards encountered with the BRA, SSHSS, and PSHSP; submit operational and maintenance (O&M) information, consolidated H&S information for maintenance.

Table 7.3d The Final 'Deacon Procurement, Design and H&S Model'

Construction Health and Safety Interventions / Construction Stages					
1	**2**	**3**	**4**	**5**	**6**
Project Initiation and Briefing	**Concept and Feasibility**	**Design Development**	**Tender Documentation and Procurement**	**Construction Documentation and Management**	**Project Close Out**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers (BEPs'); CWP					
Key Activities per Stage and Stakeholder					
		• Ensure all the H&S documentation is in included in the tender documentation.			
			CHSO: • Prepare BoQ against SSHSS for inclusion into the SSHSP, and • Submit 'generic' H&S plan with the tender (pre-tender).	**CHSO:** • Ensure monitoring of all contractors and communication to ensure compliance, and • Stop any work placing workers at risk.	**CHSO:** • Ensure monitoring and close out records are submitted relating to contractors, and • Communication to ensure compliance.

7.3 CONCLUSIONS AND RECOMMENDATIONS

The development of the theoretical model for the construction industry progressed through the analysis of the qualitative data collected from the FGs'. National and international literature were used to identify areas that would be most suited to being incorporated into the model along with the qualitative data. On finalisation of the model, a concise survey was developed and sent to several of the FG participants for validation, feedback, and comments. A response rate of 38.5% was achieved, with a very high DoC, namely agree to strongly agree / strongly agree. The response indicated support for the model, although it must be qualified as a small sample with a low response rate. Feedback from two of the respondents suggested a few semantic changes and additions to stages 3 and 4 'All stakeholders', which were included in the revised model.

The model proposed in this research is not meant to be 'complete'. Practices, statutory frameworks, and standards constantly evolve, and were factors considered for the potential use and outcome that formed the basis of the model.

Recommendations that resulted from the comments made by respondents include:

- Funding needs to be made available from National Treasury to comply with appointing the CHSA at stage 1;
- The H&S BoQ and schedule of rates to be included in the site-specific H&S Plan and BoQ;
- The development of policies and guidelines for SCM to include pre-qualification through the submission of pre-tender site-specific H&S Plans as a requirement in the procurement process. The change in policy would shorten the procurement process specifically where the CWP is required. A further advantage would result in the reduced potential for claims from contractors, and
- Further research relative to the refinement of the model.

7.2 SUMMARY

The '**Deacon Procurement, Design and H&S Model'** developed and presented in this research links the qualitative aspects into procurement, design, and into the H&S framework prevalent in South Africa. The validation, albeit noted as limited, indicates major support from 38.5% of the FG attendees that were invited to respond.

The comments received by respondents were valuable and changes incorporated into the final model were presented in Chapter 7. The findings included the need for funding allocation at National Treasury, the inclusion of a BoQ and schedule of rates in the tender for H&S, policies and guidelines, and further research to refine the model.

Chapter 8 will present the S-Ps' and the testing of the associated hypotheses presented in the research.

CHAPTER 8: TESTING OF THE HYPOTHESES

8.1 FOREWORD

The focus of the thesis is to determine '**The effect of the integration of design, procurement and construction relative to health and safety**'. The literature sought to identify previous studies pertaining to the sub-problems. Chapter 4 considered the quantitative data across themes, and Chapter 5 the qualitative data focusing on adding depth, nuances context to the data, particularly to develop a model for the construction sector. Chapter 6 constructed the model, and Chapter 7 used quantitative means to verify the model.

Contracting occurs downstream from the client, the design, and further choices made regarding the design, by all stakeholders. The burden of improving construction H&S does not rest on the shoulders of one stakeholder alone. All stakeholders have a role to play in minimising risk in a comprehensive, integrated and effective systems approach (Tau and Seoke, 2013; Smallwood, 2013).

Design is completed by a range of BEPs'. Designers may not be involved throughout the stages, but could be the client as a PM, CPM, or PA. The BEPs' most likely to be leading the project in terms of the BEPCs and IDoW is the CPM as PA, and the CM managing the construction process. Other BEPs' are part of the client's design stakeholders, or the contractor and their designers. Designers influence risk by level of complexity of design, choice of method, processes and the design. Stakeholders have several opportunities to positively, or negatively affect H&S during the project life cycle. The use of design HIRAs are an opportunity to identify, eliminate, or mitigate project risk by stakeholders, according to a well-established hierarchy of risk management. Critical aspects effect H&S during the construction life cycle as the focus is mainly on the 'golden triangle' of cost, quality, and time.

Chapter 8 presents the testing of the hypotheses evolved for the study. The testing incorporates both quantitative and qualitative data as the range of information was deemed appropriate during the research to cover the very broad scope of the research.

8.2 INTRODUCTION

Each is tested separately, and is grouped with each S-P. The MSs' presented where quantitative findings are used to indicate the DoC as noted in Table 8.1.

Table 8.1 Mean Score Range and Degree of Concurrence.

Mean Score Range ($\bar{x}$)	**degree of concurrence**	
$4.20 < \bar{x} < 5.00$	agree to strongly agree / strongly agree	(AtoSA/SA)
$3.40 < \bar{x} < 4.20$	neutral to agree / agree	(NtoA/A)
$2.60 < \bar{x} < 3.40$	disagree to neutral / neutral	(DtoN/N)
$1.80 < \bar{x} < 2.60$	strongly disagree to disagree / disagree	(SDtoD/D)
$1.00 < \bar{x} < 1.80$`	unsure	(U)

The S-Ps' identified for the research are that:

1. Contractors are exposed to hazards that could have been mitigated during design;
2. Contractors lack the necessary resources for H&S during construction;
3. Workers are injured, become ill and often fatally injured at work, and
4. Stakeholders do not comply with statutory and contractual H&S requirements.

8.3 THE SUB-PROBLEMS AND HYPOTHESES

The S-Ps' developed for the research are as follows and the associated HPs' are discussed.

8.3.1 S-P 1: Contractors are exposed to hazards that could have been mitigated during design

8.3.1.1 HP 1.1: Many hazards encountered during construction could be mitigated through design HIRAs

The perceptions of respondents were obtained across two multi-stakeholder surveys, and the selected statements are presented in Table 8.1 with the corresponding DoC. The statements relative to the adequacy of H&S information in tenders, the identification and management of hazards during the design stage were included, among clients', designers, and PMs'.

Clients' occur upstream of design, and could include the C-AMP or National Treasury, or the U-AMP, as well as the implementing agents at provincial or district level. Overall the respondents supported the mitigation of risk by conducting HIRAs'.

Table 8.2 Degree of Concurrence relative to HP 1.1 (Clients' and Designers').

Statement	Pre-training		Post-training		2nd Multi-stakeholder research	
	MS	**DoC**	**MS**	**DoC**	**MS**	**DoC**
Clients' directly affect project H&S	**3.72**	NtoA/A	**3.94**	NtoA/A	**3.72**	NtoA/A
The design team ensures adequate H&S information in tender documentation	**2.88**	NtoA/A	**3.26**	DtoN/N	**3.45**	NtoA/A
Designers can identify hazards at design stage	**4.42**	NtoA/A	**4.50**	AtoSA/SA	**3.41**	NtoA/A
Designers can quantify risk at design stage	**3.78**	NtoA/A	**4.13**	AtoSA/SA	**3.25**	NtoA/A
Designers can mitigate hazards at design stage	**3.87**	NtoA/A	**4.35**	AtoSA/SA	**3.41**	NtoA/A
Designers can eliminate hazards at design stage	**3.70**	NtoA/A	**4.25**	AtoSA/SA	**3.23**	DtoN/N

PMs' are often the BEP who acts as the PA, and therefore is a 'knowing' client, the PM has the ability to influence the level of H&S and preventative measures employed on a project. Statements were only included in the second multi-stakeholder questionnaire, and the statements included the PM's ability to mitigate, eliminate, and quantify hazards during all stages of the project. Table 8.2 provides the DoC with each of the statements.

Table 8.3 Degree of Concurrence relative to HP 1.1 (PMs').

2nd Multi-Stakeholder Research		
Statement	**MS**	**DoC**
Project managers can mitigate hazards during all the stages of projects	**3.91**	**NtoA/A**
Project managers can eliminate hazards during all the stages of projects	**3.79**	**NtoA/A**
Project managers can quantify risk during all the stages of projects	**3.66**	**NtoA/A**

The high number of NtoA/A MSs' could indicate that the participants are generally unsure of the HIRA process and / or the role of the clients', designers', and PMs' in the managing of risk. A comprehensive range of international literature relating to the role of limiting the risks during design and the role of stakeholders exists. Musonda and Haupt (2009), and Gambatese (2013), *inter alia*, indicates that between 45 and 60% of investigations identified design as being 'responsible' for accidents. International models such as CHAIR, PtD and the Gateway model are examples of using HIRA to identify critical risks, and realise alternatives and reduce the risk to contractors. Technological advances such as BIM are further means of identifying hazards, and thus, reduce risk during construction, and the life cycle.

Clients', CPMs' and designers who constitute the stakeholders therefore do have opportunities to employ the appropriate resources, conduct HIRA and mitigate project risk.

HP 1.1 is thus supported.

8.3.1.2 Hypothesis 1.2: Designers do not conduct effective design HIRAs, resulting in the non-mitigation of hazards

The qualitative narratives, specifically in Theme 1, indicated an overall LoC and knowledge among the BEP categories that participated in the qualitative research. Figure 8.3 in Section 5.5.2 indicated the construction H&S and BEP levels of confidence in H&S across the 6 stages. Given the lack of confidence it is then unlikely that design HIRAs' would be done effectively to adequately mitigate or eliminate risks. The following statement expands on the competence levels:

P6 *(Excerpt) …'Well for us in the built environment have never been really actually exposed to H&S. Planning has never been considered as that. For me, where I am sitting at now… it's an area that I have never… I have left it to the professionals to rather sort that out.'*

Literature indicates that competence, competency and being competent (Smallwood and Haupt, 2008) is critical among all disciplines in the construction sector. Most construction H&S categories do not work in all the stages as identified in the IDoW, and expressed concern in this regard. Furthermore, despite the CR's being promulgated and in use across the sector since 2003, H&S has not been integrated into practice. The client has a responsibility and a duty of care (Gambatese, 2013) to ensure that their PA and designers conduct effective HIRA across all stages of construction to mitigate hazards, project risk, and the downstream effect of fatalities, disease, and injury.

HP 1.2 is thus supported.

8.3.1.3 HP 1.3: Construction H&S Agents do not conduct effective design HIRAs resulting in the non-mitigation of hazards

Literature indicates the need to include H&S as early in the project as possible to positively influence H&S, and reduce project risk (Gambatese, 1998). The low LoC in H&S among the BEPs' adds to the lack of appropriate appointment of the CHSA results in a low likelihood of doing design HIRAs prior to the project commencing. The following excerpt indicates the late appointment of the CHSA:

P21 (Excerpt)….*But if you identify a project, let's say building a single-storey building. Before the designers even put pen to paper, we should be able to say here are some of the hazards and risks you will encounter, start preparing for them in your drawings, or in your design. And I think that is where the shortfall is at the moment, is that we are only coming in sometimes at stage 2, stage 3, stage 4, and on quite regular occasions, the last stage.*

The CHSA FG participants, in general, indicated a high LoC in being able to participate and assist in the mitigation of risks. Table 8.3 indicates the perceptions from the both surveys, where the procurement of the CHSA and their roles are considered.

Table 8.4 Degree of Concurrence relative to HP 1.3 (CHSAs).

Statement	Pre-training		Post-training		2nd Multi-stakeholder research	
	MS	**DoC**	**MS**	**DoC**	**MS**	**DoC**
Client H&S Agents should be procured during the feasibility phase	**4.27**	AtoSA/SA	**4.42**	AtoSA/SA	**3.58**	NtoA/A
Client H&S Agents can influence H&S during design	**3.60**	NtoA/A	**3.94**	NtoA/A	**3.53**	NtoA/A
Client H&S Agents influence H&S during construction	**4.00**	NtoA/A	**4.15**	AtoSA/SA	**4.16**	AtoSA/ SA
Client H&S Agents are given adequate information to perform their duties at each phase of the works	**2.70**	DtoN/N	**3.24**	DtoN/N	**3.38**	NtoA/A
Client H&S Agents should be an integral part of the design team	**4.10**	AtoSA/SA	**4.29**	AtoSA/SA	**3.64**	NtoA/A
'Designing for H&S' should be a client H&S Agent competency	**3.99**	NtoA/A	**4.02**	NtoA/A	**3.68**	NtoA/A

The findings of the FGs' indicate a high LoC relative to conducting design HIRA. However, the FG narratives and comments from the verification of the model indicate how difficult it is to ensure the procurement and appointment of the CHSA. The late appointment, at times only following commencement of the project, renders it impossible for the CHSAs' to fulfil the duties required of them.

HP 1.3 is thus supported.

8.3.1.4 HP1.4: Construction H&S Agents lack 'designing for construction H&S' competencies

HP 1.4 posits that the CHSA lack designing for construction H&S competencies. Theme 1 of the FGs' considered the LoC of CHSA relative to the stages, including stage 3. Many of the participants of the FGs' indicated they were inexperienced, rather than incompetent. An extract from the narrative indicates the aforementioned include both 'ends of the scale', with the majority indicating a high level of confidence:

P13 (Excerpt) …*Okay, I have been involved with everything from Stages 1 through 6 on quite a lot of projects,* ***so I am pretty confident that I can manage****, and*

P19 *I think stage 4 onwards I am extremely confident, but currently learning and having input in Stage 3 is a lot to take in with the laws having changed and so on and so forth. So finding feet and becoming confident in stage 3. One and 2, not really, well I would like to. Doesn't always happen that way though, unfortunately.*

The registration process required for construction H&S practitioners includes the requirement to prove competence in HIRA appropriate to the categories of work, in this case stages 1-3. In general, the ability to conduct HIRA is well done among construction H&S practitioners, and as indicated in the CHAIR model (WorkCover NSW, 2001), all stakeholders do not need to be experts in every sense, but be led by a stakeholder aware of requirements. The team approach from client, PA / CPM and designers' should therefore participate in design HIRAs' and the combined approach would not only increase competence, but reduce the risk of critical issues being overlooked.

HP 1.4 is not supported.

8.3.1.5 HP 1.5: Construction H&S Agents are generally not involved in the pre-construction stages (Stages 1-3)

HP 1.5 posits that CHSAs' are not involved early in terms stages 1, 2, and 3, as required from a statutory perspective. Currently the SACPCMP registration requires several outputs between stages 1 and 3, which in turn is supported by registration requirements noted in the CR's (2014) (RSA, 2014). However, practice generally indicates that CHSAs are only appointed during stage 3, or even when the project has commenced, as indicated in the narrative for HP 1.4. The following excerpts indicate the process and the current practices within the ECDRPW:

P19 (Excerpt) … ***So finding feet and becoming confident in stage 3. One and 2, not really, well I would like to. Doesn't always happen that way though, unfortunately.***

P21 *.... Where the shortfall is at the moment, is that* ***we are only coming in sometimes at stage 2, stage 3, stage 4, and on quite regular occasions, the last stage.***

One of the aspects noted from the client's perspective which constitute a barrier or challenge to appointment is the lack of policies and procedures at provincial and district level, as noted in the following excerpt. The excerpt implies that the early appointment of the CHSA is not done, which is supported by the statements made by the CHSA respondents:

P16 *(Excerpt) … I would say that from a client's side,* ***at stage 1, we as the client need to have certain policies and procedures in place, basically almost like a founding basis on which we work, and ideally, we should have a procedure whereby we now comply with the H&S requirements, which would then dictate that when we reached stage 2, the H&S agent is the first requirement. Either we appoint them separately up front, or at least simultaneously to the engineer. And the engineer cannot proceed until the H&S agent has done the baseline risk assessment. That would be the way of compliance.***

The literature indicates the role of the entire team being the most successful in ensuring the design issues are adequately dealt with, inter alia the CHAIR model (WorkCover NSW, 2001) as well as the Gateway model (HSE, 2004).

HP 1.5 is supported.

8.3.1.6 HP 1.6: H&S Specifications, design reports, and 'final' H&S specifications' generally do not schedule 'residual' risk

Du Toit (2012) suggests that all construction activities entail some level of risk, however the difference is the probability and severity, and how the potential outcome could be managed. The residual risk is communicated to the contractor initially through the H&S specification included in the tender. The FG findings did not mention residual risk specifically, but there are baseline risk assessments that accompany the project documentation in the ECDRPW when the appropriate appointments are made, at the appropriate time.

As discussed in HP 1.5, the late appointment of the CHSA, combined with the lack of H&S confidence by BEPs', there is a strong likelihood of their not being a complete set of specifically the 'final' H&S specifications not detailing the residual risk.

The procurement processes discussed in the FG, indicated that design reports are completed, at preliminary and detailed design stages, as noted by the following excerpt:

P16 (Excerpt) …. *So you finalise, you've made certain choices* ***and options during prelim design, but in detailed design there's further options that arise at a more detailed level, that you need to finalise.***

Therefore, given that there are specifications and design reports, the lack of H&S confidence among BEPs' to consider HIRAs', and the late appointment of the CHSA, there is likely to be no residual risk information at any level of documentation.

HP 1.6 supported.

8.3.2 S-P 2: Contractors lack the necessary resources for H&S during construction

The basis for S-P 2 is founded in statutes and literature. The client is required to ensure that contractors are 'resourced', which means client needs to ensure the project is resourced. Resources could be widely interpreted, in terms of requirements for labour, plant and equipment requirements, and financially. However, the term generally relates to the financial resourcing for the project, which stems from the BoQ developed for the project, and that indirectly and directly ensures overall resource requirements are met.

8.3.2.1 HP 2.1: Lack of resources for H&S experienced during construction is attributable to lack of H&S involvement during the preparation of tender documentation

Literature indicates that procurement practices inhibit H&S better practice, and competitive tendering, that ultimately results in legal non-compliance. The context is set for the project, of low price for the client is most often at the expense of H&S (Wells, and Hawkins, 2010). FG narratives regarding the tender specification committees indicated that they are composed of SCM and technical persons, and no H&S representation. Stages 1 to 3 of the construction life cycle prepare for the project. Given that the research has identified that the BEPs' mostly lack the competence and training to identify hazards, there is a strong likelihood of them then missing, or not identifying what H&S resources are required, that are risk relative and ensure inclusion in the BoQ. Furthermore, the late appointment of the CHSAs on a project will result in the lack of the BoQ, and more specifically a H&S BoQ, and inclusion in the schedule of rates. The aforementioned was noted as an issue in the development and finalisation of the '**Deacon Procurement, Design and Construction Model'** in terms of project risk and statutory compliance.

PCs appoint their own contractors on projects, and there the same statutory requirement discussed above relative to the ensuring such contractors are resourced. From a PC perspective, the pricing strategy is to tender low, or risk losing the possibility of winning the tender. The inclusion of H&S is noted in the following narrative:

P4 (Excerpt)…***I would say we should be involved from stage 4. When the BOQ goes out to the principal contractor, we should be involved there. Because there is normally a H&S BOQ at the back of the specification that they give us and sometimes the*** **(PC)** ***QSs', they just price the way they want to price, because if they make H&S too high, the project won't get awarded to the… and that is what happens. You will find that on a lot of or some of the projects you will find there is not a lot of money made available for H&S, or not the amount that has to be made available.***

Quantitative data indicates some of the hierarchy of involvement. Table 8.4 indicates the range of statements linked to the HP, and the DoC resulting from the two multi-stakeholders' surveys completed for the research. Respondents' DoC reflect the procurement of the CHSA, and the financial benefits to be gained and QSs' / cost engineers (in the post research). There is a lower degree of support regarding the resourcing the project, as it applies to all stakeholders. A further note is the domino or 'knock on effect' of the supervisors and workers not being resourced.

Table 8.5 Degree of Concurrence relative to HP 2.1 (Resourcing).

Statement	Pre-training		Post-training		2nd Multi-stakeholder research	
	MS	**DoC**	**MS**		**MS**	**DoC**
Client H&S Agents should be procured during the feasibility phase	**4.27**	AtoSA/SA	**4.42**	AtoSA/SA	**3.58**	NtoA/A
H&S is adequately priced for projects	**2.12**	DtoN/N	**2.43**	DtoN/N	**3.00**	DtoN/N
There are financial benefits to investing in H&S	**4.25**	AtoSA/SA	**4.39**	AtoSA/SA	**3.90**	NtoA/A
Workers have adequate resources relative to H&S	**2.37**	SDtoD/D	**2.45**	SDtoD/D	**3.13**	NtoA/A
Quantity surveyors / cost engineers can influence H&S	**4.03**	NtoA/A	**4.18**	AtoSA/SA	Not measured	
Supervisors are given adequate resources relative to H&S	**2.58**	SDtoD/D	**2.71**	DtoN/N	Not measured	

The inadequate provision of resources is indicated by the following FG narrative:

P14 (Excerpt) *… I am also involved with the costing as far as H&S requirements are, PPE that is required, or whatever training is required as far as H&S is concerned.*

R12 *…….That currently in line with the current Regulations, and you are not getting a bill? A H&S bill?*

P14 ***Yes, not necessarily.***

P15 ***Sometimes it's there, sometimes it not, sometimes not adequate.***

R12 ***So it's not standard inclusion.***

P14 ***Its not necessarily a billed item for any H&S related items.***

R12 ***Are you sometimes getting one liners still in your bill of quantities?***

P14 ***Yes, it will sometimes just say H&S, and you're like... 'Okay'... and you are wanting what?***

HP 2.1 is supported.

8.3.2.2 HP 2.2: Lack of resources for H&S experienced during construction is attributable to ineffective Construction Project Management

The CPM competencies are clearly defined in the IDoW and Scope of Services as published by the SACPCMP (SACPCMP, 2006a). Competencies are relative to the required knowledge and abilities to practice. The competencies noted in Section 2.21.2.1, Table 13, there is specific reference to H&S include aspects from stages 2 to 6, and noted that there is no role for CPM during stage 1 (Project Initiation and Briefing). No role for the CPM during stage 1 would indicate that the stage falls into the ambit of the client, as project resources are ultimately determined by National Treasury, and devolved to the provinces and districts. The CPM, as client would further be expected to comply with the provisions of National Treasury and the PFMA, which appears not to be supportive in terms of H&S compliance. Furthermore, it is widely accepted that construction project performance is generally based on the triangular model of cost, quality, and time, rather than including H&S (HSE, 2004; Hinze, 2006; Smallwood, 2009; Windapo and Oladapo, 2012; cidb, 2015b).

The CPM is most likely to be appointed as the agent for a client, assuming the role of client, as a PA. Literature indicates, as does the LoC in the FG narratives, that H&S responsibilities and knowledge is at best noted as limited among the BEPs', specifically in South Africa, as indicated by the following excerpt:

P20 *(Excerpt) …(Experience)…* ***Except that's why we appoint consultants, to assist with these things. Because we're not at the cutting edge of what's out there to pick it up. Yes, I am familiar with certain things…. but to say I would spot something missing, no, I don't think so.***

The limited knowledge relative to H&S has been identified at all levels of education. Minimal, if any, embedded H&S content and training is included in such training that is available to students at undergraduate and postgraduate levels.

Relative to the stage 4 descriptors in the IDoW, the CPM is required to '*Facilitate and monitor the preparation by the H&S consultant of the H&S specification for the project'*. The implication of the descriptor is that the CPM then needs to ensure the timeous inclusion of H&S, which in terms of the literature, is too late. The tender documentation is 'fixed' once the tender has been advertised, and to change its contents requires extensive activities in terms of the procurement process and SCM compliance. The significant statement relative to CPMs' positive influence on project H&S (Table 8.4).

Table 8.6 Degree of Concurrence relative to HP 1.3 (CPMs').

2nd Multi-Stakeholder Research		
Statement	**MS**	**DoC**
Project managers can positively influence H&S	**4.07**	AtoSA/SA
Project managers can negatively influence H&S	**3.64**	NtoA/A

The lack of resources for a project by National Treasury has an impact on the overall project. Should resources from the MTEF via National Treasury not be available, the focus of the CPM will be on the 'golden triangle' of cost, quality, and time, and largely exclude H&S resources.

HP 2.2 is thus supported.

8.3.2.3 HP 2.3: Contractors do not have the internal H&S competencies to determine the H&S needs during construction

Contractors' are downstream from design, and therefore inherit the risk 'created' during the design stage. Literature indicates that clients' have a pivotal role in the standard of H&S on projects as they are influential in terms of the tone, the form of contract, project budget and duration, and select the designers and contractors (Smallwood and Emuze, 2013).

The CM competencies are clearly defined in the IDoW and Scope of Services as published by the SACPCMP (SACPCMP, 2006a). Competencies are relative to the required knowledge and abilities to practice. The competencies noted in Section 2.21.2.1, Table 13, there is specific reference to H&S include aspects from stages 4 to 6.

Where non-standard procedures are undertaken, with complex designs, there is an increased potential for accidents. The use of 'labour-only' contractors, who are essentially employment agents hiring out labour to complete the works, results in the lack of trained workers, and has major implications for site H&S. The cyclical economic nature with unreliable profitability further exacerbates the risk to such workers (Rowlinson, 2004; Zou and Sunindijo, 2015). From an H&S perspective, competent construction H&S resources are required on site, as discussed in the FGs'. Discussions or comments relating to participants own competencies did not emerge other than in relation to LoC or practice area. LoC was low in general.

The second multi-stakeholder research included 'H&S is an integral part of site management responsibilities' for consideration, with the respondents supporting the statement.

HP 2.3 is thus supported.

8.3.3 S-P 3: Workers are injured, become ill and often fatally injured at work

The cidb (2009) indicates that the South African construction sector had the third highest number of fatalities per 100 000 workers among all industries, and that workers were six times more likely to die at work (Windapo and Oladapo, 2012; Musonda, Pretorius and Haupt, 2013). There is a higher loss of life and limb in developing countries, where larger parts of the population work in hazardous environments, and the poorest and least protected are most affected (Kheni, Gibb and Dainty, 2006; CIB, 2013; Windapo, 2013; ILO, 2013; Mustapha, Aigbavboa and Thwala, 2014).

8.3.3.1 HP 3.1: Contractors' non-compliance with statutory and contractual H&S requirements results in workers being injured, becoming ill, or fatally injured at work

Current statistics obtained from FEMA (2015), the construction sector insurance carrier for the CC, indicate a constant rate of accident statistics and fatalities. The AFR has reduced marginally between 2011 and 2014. Of significance are the rates of 'being struck by' (approximately 40%), 'fall onto different level' (approximately 12%), and 'motor vehicle accidents' (approximately 12%). Given that FEMA only provides cover for approximately 50% of the construction sector, and no other statistics are available from the CC themselves, the actual numbers of injuries, disease, and fatalities is largely unknown.

The multi-stakeholder surveys indicated that risk taking occurs at all levels, among management, supervisors, and workers. Workers are injured, become ill, and are often fatally injured at work where there is lack of competence, control, and resources provided by the contractor, as indicated in HP 2, and supported by the statistics available. The first and second S-Ps' and their HPs' all indicate the lack of identifying and managing risk, lack of ensuring adequate resources and competence.

The lack of inclusion of the CHSM or CHSO by the contractor during stage 4 as indicated in the FGs' results in a level of non-compliance with respect to ensuring the project is resourced. The lack of including an appropriate BoQ where provided in the tender document is a further opportunity that indicates the inability of the contractor to comply.

Contractors' are required to provide an H&S management system to drive the daily requirements on site, which is the basis for the development of a project-specific H&S plan. The H&S plan then further evolves into H&S specifications for their contractors. While the FGs' did not discuss the issue of contractor compliance per se, the following narrative raised the current practice prevalent among contractors, specifically SMMEs.

P19 (Excerpt) … ***The worst thing is, you have got two different contractors sitting here that take the time to draw up their own, and then you have the other contractor who goes and purchases one, and the risk assessment is from XXX and the inspections are done by XXX, and the specification is DRPW, but it's actually a SANRAL project,*** and regarding the pricing or resourcing of the project:

P13 ***My concern is not so much the guy who tenders zero, because then he very much in our hands as far as H&S is concerned. It's the guy who tenders extremely low and says that 'I didn't realise that a medical examination is going to cost me R700 because I only tendered R50'…. But the idea of having a bill of quantities is to avoid what happens is: 'Oh, I didn't know I had to do that, and so I didn't include it in my price'. To which the answer is 'ignorance of the law is not my problem it's your problem'. But all of this type of thing leads to a lot of ill-feelings on the part of the contractor, and that is something you really want to try to avoid. I mean you cannot prevent the contractor from committing financial suicide, but you can assist him to a certain extent, not as far as H&S is concerned. If he over prices for the removal of rock, that's entirely another story.***

HP 3.1 is thus supported.

8.3.3.2 HP 3.2: Stakeholders' non-compliance with statutory and contractual H&S requirements results in workers being injured, becoming ill, or fatally injured at work

Contracting occurs downstream from the client, the design, and further choices made regarding the design, by all stakeholders. Construction H&S does not rest on the shoulders of one stakeholder alone, and all stakeholders have a role to play in minimising risk in a comprehensive, integrated, and effective systems approach (Tau and Seoke, 2013; Smallwood, 2013).

The lack of H&S knowledge regarding construction H&S on the part of stakeholders is noted in the LoC discussed. The lack of competence that results from the lack of knowledge has a detrimental effect on the project, in as far as appointing competent CHSAs on the project, providing resources, and appointing competent contractors'.

Literature indicates that procurement practices inhibit H&S better practice, and competitive tendering ultimately results in legal non-compliance. As previously discussed in terms of tendering practices, a low price submitted to a client is most often at the expense of H&S (Wells, and Hawkins, 2010).

The lack of resources noted by the respondents during the validation of the model indicated that the client may not appoint the CHSA during stage 1, due to the lack of funding. However, as the appointment is the duty of the client, as implementing agent, the responsibility is then for National Treasury to ensure financial resources to do so, as indicated in Table 8.5.

Table 8.7 Degree of Concurrence relative to HP 3.2.

Statement	Pre-training		Post-training		2nd Multi-stakeholder research	
	MS	**DoC**	**MS**	**DoC**	**MS**	**DoC**
Clients' directly affect project H&S	**3.72**	NtoA/A	**3.94**	NtoA/A	**3.72**	NtoA/A

The IDMS indicates that there is a 'feedback flow' regarding performance between SCM and PMs'. However, given the current rate of AFRs', and the LoC among the BEPs' as stakeholders there is clearly non-compliance among stakeholders.

HP 3.2 is thus supported.

8.3.3.3 HP 3.3: The exclusion of appropriate construction H&S information through the project life cycle increases project non-compliance with statutory and contractual H&S requirements, and results in workers being injured, becoming ill or fatally injured at work

Projects vary from greenfields to brownfields, and in terms of complexity. The construction H&S information is slightly different when dealing with either one. The following excerpt indicates the difficulty that the client has due to the way the information is devolved from the province. The lack of construction H&S information:

P6 (Excerpt)… ***what I am trying to say is for them to give us stage 1, and to say we need to initiate a project, they will only give us basically a physical description, that's it…. we have to do everything****; and*

P5 *In other words* ***we don't know if we are going to demolish buildings, or whether we are going to refurbish buildings, or build new, that we don't know yet****.*

Stage 6 requires the compilation of a consolidated H&S File that is required to be used for O&M requirements, and while the discussions did not cover the stage in detail, the aspect is usually complied with. However, the extent to which the H&S aspects of the H&S file are used is an 'unknown'.

The supporting of HP 1 and 2 further support the appropriate construction H&S information available through the project life cycle, which could limit the loss of life, diseases and injuries experienced by workers.

HP 3.3 is supported.

8.3.4 S-P 4: Stakeholders do not comply with statutory and contractual H&S requirements

"I passionately believe in the importance of tackling the industry's health and safety problems. Pre-planned, well designed projects, where inherently safe processes have been chosen, which are carried out by companies known to be competent, with trained work forces, will be safe: they will also be good, predictable projects. If we are to succeed in creating a modern, world-class industry, the culture of the industry must change. It must value and respect its people, learn to work in integrated teams and deliver value for clients' money." Sir John Egan, Accelerating Change (Office of Government Commerce (OGC), 2007).

8.3.4.1 HP 4.1 Stakeholders non-compliance with statutory and contractual H&S requirements is attributable to a poor H&S culture

The construction sector has a range of procurement practices (Watermeyer, 2012; Alharthi, Soetanto and Edum-Fotwe, 2014). Procurement is an important means of achieving organisational goals, with clients continuously striving to assess and improve the efficacy of their procurement activities (Plantinga, Voordijk and Dorée, 2014; Alharthi *et al,* 2014).

Public procurement has its origins in the fiduciary obligation of government (Ambe and Badenhorst-Weiss, 2012). SCM and procurement practices do not include H&S in the specification and adjudication committees, nor does there appear to be any level of interrogation regarding the statutory requirements when submitting H&S documentation. Within the procurement practices are the conditions of contract, used by the BEPs' to manage the project, which generally do not comply with the terminology in the CR's (2014), and minimal reference to legal compliance. Non-compliance at such a high level is cascaded throughout the project, and given the aspects in terms of stakeholders' responsibilities, and influence on projects could lead to many non-compliant areas on the project.

The continued poor statistics relevant to the sector appear to indicate there are clearly issues (Figure 2.1). Issues have been noted relative to the poor culture of the sector on the part of contractors', as well as the lack of knowledge of designers' and clients' (cidb, 2009).

HP 4.1 is thus supported.

8.3.4.2 HP 4.2: Stakeholders' non-compliance with statutory and contractual H&S requirements is attributable to inadequate BEPs' identity of work

The H&S responsibilities among BEPs' have been noted as limited. The limited knowledge relative to H&S has been identified at all levels of education among BEPs', with minimal, if any, embedded H&S content and training being included at undergraduate and postgraduate levels (cidb, 2009; Smallwood, 2013). There are H&S responsibilities among most BEPs', each with a particular role in the various disciplines, leading, supporting, or doing construction work. The following underpins the HP relative to inadequate IDoW:

- None (0%) of the BEPs' include, or note stage 1 as part of their functions;
- A total of 66.7% of BEPs', namely CPMs', landscape architects, QSs', and engineers note they may advise the client that an H&S consultant is necessary during stage 2. The architects and property valuers have no such inclusion;
- Fifty percent (50%) of the BEPs' have H&S functions during stage 3, for CPMs' and CMs' as well as QSs' and the engineers. Both the CPM and CM have design related functions that relate to H&S, where input is required by the H&S consultant. Only 16% of the BEPs'

(CPMs' and CMs') have any requirements relative to H&S during stage 4, where preparation of the H&S Specification requirements would be facilitated and monitored by the CPM. The CM would manage and coordinate preparation and implementation of H&S into the tender documents;

- Three (50%) of the BEPs' include H&S relative to compliance, monitoring of H&S plans submitted by the contractor, and approvals by the H&S consultant. The CPMs' and CMs' note ongoing monitoring for compliance during the construction period. The landscape architects note there should be monitoring of landscape contractors in accordance with the requirements of the H&S consultant, and
- Only the CPMs' and CMs' (16%) have noted the finalisation of the H&S File during stage six.

A low LoC noted in the FGs' regarding the BEPs' regarding their training and understanding of the integration of H&S underpins the details included in this HP.

HP 4.2 is thus supported.

8.3.4.3 HP 4.3: CHSA involvement across all six stages of construction is limited due to lack of knowledge on the part of the CHSA, client and designer

The CHSA is expected to be able to work across the six stages and in terms of the knowledge areas, apply all the following relative to the six stages. There are nine knowledge areas, as listed below:

- Procurement Management;
- Cost management;
- Hazard Identification Management;
- Risk Management;
- Accident or Incident Investigation Management;
- Legislation and Regulations Management;
- Communication Management, and
- Emergency Preparedness Management.

While procurement and cost management could be deemed the only project management or PMBOK areas, each of the knowledge areas are required to be applied in the construction sector. The accompanying experience and education are further required to indicate the competence of the CHSA. However, the lack of training in the BEP among CHSAs' does mean there are knowledge areas that are perhaps lacking. However, the aspect of the CHAIR (Workcover NSW, 2001) indicates that not all members of the team need to be experts in every field, and to address H&S issues, the technical support in the stakeholders needs to be present.

The lack of knowledge regarding H&S and the LoC of the BEPs', and the SCM and procurement processes are however limiting in ensuring the CHSA is involved on the project across all six stages. The aforementioned is 'out of the control and influence' of the CHSA, who is, as usually a consultant, unable to influence the client and designer in this regard until physically on a project.

HP 4.3 is partially supported.

8.3.4.4 HP 4.4: CONSTRUCTION H&S practitioner statutory compliance is dependent upon planning and communication by the clients' and designers

Communication between parties on a project is embedded in statute and to a certain extent the contractual documentation for the project. Hindrances to include H&S during the design stage are relevant to the design team, and results in limiting the communication between them both inter- and intra-organisation interactions. Some designers do not believe that H&S and design go together, or apply to them. Other designers only do what they have been told to do or what was in the contract, and are not paid to design for H&S (Ulang, Gibb, Anumba and Gambatese, 2012).

Ulang *et al* (2012) further state that some designers do not believe that they have any impact on construction H&S, and it is the responsibility of the contractor. Hecker, Gibbons & Barsotti (2001) identify elements in design, planning, scheduling, and material specifications as probable contributors to working conditions that pose risks to musculoskeletal injuries during the actual construction process (Musonda and Haupt, 2009).

Aspects such as ergonomics in design are required to be included in HIRA, and if the construction H&S practitioner is unaware of the design, or the methodology of design, the outcome will be non-compliance. LoC among BEPs' and the client further exacerbate the lack of communication, as it is highly unlikely that appropriate information can be communicated if the potential source and statutory requirement is unknown.

The lack of the inclusion of a site-specific H&S specification was raised during the FGs', regarding the lack of a H&S BoQ, and the extent to which such an exclusion affects the pricing and construction stage (stage 5) for the project:

P15 *It does, I'll make an example now,* ***the tender documents coming out now are still refer to the old Regulations and once you try and address that you don't get anything form the engineer to put the, what do you call it, when they need to add another****;*

P16 *The addendum to the tender document?, and*

P15 *Ja. The addendum to the tender document, they don't do that when it comes to H&S, then what we usually do, is we, as we doing our plan, in black and white, in bold that the specification is still referring to 2003, whereas it is 2014, and then we have priced it according to the specification but we have to comply with the current Regulations,* ***so for us to be competitive, to our, to other bidders, because but if we put the right prices in might not get the job. And if we do get the job then we might fight it, to say we did mention at tender stage that these are the requirements, but you didn't, that's what we do... but yes, it does affect the cost.***

A further aspect that applies to the statutory compliance is the aspect of the application of the CWP. The application calls for the project BRA and SSSHSS, as well as a range of signatures and details regarding the CM and CHSO.

P19 ***It calls for the Construction Manager and the Officer****, and*

P14 ***Manager and* (CHS*) Officer, and the PC.***

Considering this HP, there is a strong need for the 'upstream' activities, which involve the client at National Treasury to ensure adequate resources, that cascades to the user, and the provinces and districts. The literature indicates shortcomings on the part of the BEPs', and the impact on the construction H&S compliance issues on a project.

HP 4.4 is thus supported.

8.3.4.5 HP 4.5: CHSO and CHSM participation and contributions are limited due to contractors' appointment practices

Further feedback in terms of research relative to the performance of CHSOs', is that they are, in many cases only part-time, or contractual appointments. The practice of appointing the CHSO during stage 5 could affect the CHSO's ability to ensure adequate H&S during a project (Smallwood, 2011). The FGs' indicated the various levels of CHSO and CHSM involvement in terms of stages 4-6:

R12 *How often are you actually involved with stage 4*

P15 ***All the time****. and*

R12 *P17, you said you don't get involved with stage 4 really, you only get involved at stage 5.*

P15 *Ja.*

R12 ***So you have got no control over the development of the tender requirements so you don't know if there is a zero bill or a you know a 10% for H&S?***

P17 ***No.***

HP 4.5 is thus supported.

8.3.4.6 HP 4.6: CHSO and CHSM involvement across stages 4-6 is limited due to lack of construction management competencies, and exclusion from the management of the construction process

The construction H&S competencies related research conducted by Smallwood and Haupt (2008) indicated that there has been minimal, if any, focus on including H&S in undergraduate or post-graduate tertiary training among BEPs', and training for construction H&S groups, noted as being haphazard and made up mostly of on the job training with short courses (cidb, 2009).

The preparation of the tender documentation to plan for a project is not an isolated activity, and it is unlikely the CHSO would need or be expected to work alone, as all the other complexities of the

project would need to be considered, that are technical. The lack of formal education does not mean that a CHSO would not know what is needed, as competency is tested with the current registration requirements of the SACPCMP and the CR's. The CHSM and CHSO are expected to be able to work across the stages 4 to 6 and in terms of the knowledge areas, apply all the following relative to the three stages. The nine knowledge areas, listed below, with the deliverables being more suited to on site activities:

- Procurement Management;
- Cost Management;
- Hazard Identification Management;
- Risk Management;
- Accident or Incident Investigation Management;
- Legislation and Regulations Management;
- Communication Management, and
- Emergency Preparedness Management.

However, the lack of training in the BEP among CHSAs' does mean there are construction related knowledge areas that are perhaps lacking. While it was not discussed in any of the FGs', the communication between the CHSA, the CHSO and CHSM is critical to ensure the project standards and requirements are met.

HP 4.6 is thus supported.

8.3.4.7 Designers lack 'Designing for Construction H&S' Competencies

'Designing for H&S should be a designer competency' was included in the initial DoL survey. The MS pre-test score of 4.05 and post-test score of 4.36, indicates an 'agree to strongly agree' / 'strongly agree' (post-test). Designers are also PMs who can mitigate and eliminate hazards during the construction life cycle. PMs can negatively influence H&S, not ensuring adequate design attention for construction H&S is given. The qualitative question regarding competencies indicated that many designers or BEPs' do not have the requisite skills needed to design out risk through the construction life cycle. The 'knock on' effect overlaps into increasing project risk, financially and in terms of other stakeholders on the project, financial requirements, and general resources.

Regarding competencies within the ECDRPW, several PMs and senior staff are qualified in the built environment and would be considered clients', and or designers. The following excerpt from the FGs' indicates some of the comments made regarding their competency as designers. The first comment from the PrArch indicates that H&S is a subconscious issue, however, one has to accept the risk. Therefore the respondent did not believe there was any need for H&S input:

P5 ***I have been doing this all my life. Subconsciously****, and*

P5 *Ja, for example you design a very steep church steeple. Now obviously you can hire a helicopter to put on… but you have to have scaffolding to put up there, you going to go higher on building ....* ***Many architects I know - I am not defending them, don't even think about that. People die, fall off scaffolding and blah blah blah. Ok, well, that's one of those things, if you have to build, you have to build it. But when you do design things are of such a nature you have to think how you have to put things together. But I dunno. I still don't think we need the H&S officer.***

The consideration of undergraduate programmes including H&S was confirmed:

R1 *There is often the thought or statement that built environment professionals, that's across the built environment now; all councils and so on, don't have any H&S training in their undergraduate programmes, so from a building perspective that is what you have confirmed – in your training you didn't have any….?*

P5 ***No.***

R1 ***Nothing at all?***

P5 ***No****.*

Given the quantitative and qualitative findings, and the range of literature (cidb, 2009), which indicates the lack of participation by designers, the HP is supported

HP 4.7 is thus supported.

8.4 SUMMARY OF TESTING OF HYPOTHESIS

A total of twenty-two sub-problems were determined for the thesis, with related HPs' (Table 8.8).

Table 8.8a Summary of the Sub Problems and Hypothesis

Sub-Problem and Hypotheses		**Supported / Not Supported**
S-P 1 CONTRACTORS ARE EXPOSED TO HAZARDS THAT COULD HAVE BEEN MITIGATED DURING DESIGN		
1.1	Many hazards encountered during construction could be mitigated through design HIRAs	Supported
1.2	Designers do not conduct effective design HIRAs, resulting in the non-mitigation of hazards	Supported
1.3	Construction H&S Agents do not conduct effective design HIRAs resulting in the non-mitigation of hazards	Supported
1.4	Construction H&S Agents lack 'designing for construction H&S' competencies	Not supported
1.5	Construction H&S Agents are generally not involved in the pre-construction stages (stages 1-3)	Supported
1.6	H&S Specifications, design reports, and 'final' H&S specifications generally do not schedule 'residual' risk	Supported
S-P 2 CONTRACTORS LACK THE NECESSARY RESOURCES FOR H&S DURING CONSTRUCTION		
2.1	Lack of resources for H&S experienced during construction is attributable to lack of H&S involvement during the preparation of tender documentation	Supported
2.2	Lack of resources for H&S experienced during construction are attributable to ineffective Construction Project Management	Supported
2.3	Contractors do not have the internal H&S competencies to determine the H&S needs during construction	Supported

Table 8.9b Summary of the Sub Problems and Hypothesis

S-P 3 WORKERS ARE INJURED, BECOME ILL AND OFTEN FATALLY INJURED AT WORK		
3.1	Many hazards encountered during construction could be mitigated through design HIRAs	Supported
3.2	Designers do not conduct effective design HIRAs resulting in the non-mitigation of hazards	Supported
3.3	Construction H&S Agents do not conduct effective design HIRAs resulting in the non-mitigation of hazards	Supported
3.4	Construction H&S Agents lack 'designing for construction H&S' competencies	Supported
3.5	Construction H&S Agents are generally not involved in the pre-construction stages (stages 1-3)	Supported
3.6	H&S Specifications, design reports, and 'final' H&S specifications generally do not schedule 'residual' risk	Supported
S-P 4 STAKEHOLDERS DO NOT COMPLY WITH STATUTORY AND CONTRACTUAL H&S REQUIREMENTS		
4.1	Stakeholders non-compliance with statutory and contractual H&S requirements is attributable to a poor H&S culture	Supported
4.2	Non-compliance with statutory and contractual H&S requirements is attributable to inadequate BEPs' identity of work	Supported
4.3	CHSA involvement across all six stages of construction is limited due to lack of knowledge on the part of the CHSA, client, and designer	Partially supported
4.4	Construction H&S practitioner statutory compliance is dependent upon planning and communication by the client and designers	Supported
4.5	Construction H&S practitioners' non-fulfilment of their statutory roles is attributable to inadequate related H&S competencies	Supported
4.6	CHSO and CHSM participation and contributions are limited due to contractors' appointment practices	Supported
4.7	CHSO and CHSM involvement across stages 4-6 is limited due to lack of construction management competencies and exclusion from the management of the construction process	Supported

8.5 CONCLUSIONS

Chapter 8 presents the sub-problems and hypotheses that were identified and presented in Chapter 1. Chapter 8 reviewed the qualitative and quantitative data while testing the hypotheses.

The S-Ps' are presented with their associated hypotheses, and Table 8.6, which indicates the S-P, the HP and the result of the testing applied to each HP. Only 1 HP was not supported, and 1 partially supported. Chapter 9 concludes the thesis and presents the recommendations.

CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS

9.1 FOREWORD

Untold numbers of construction workers continue to die, are injured, or become ill daily. Despite the advancement of education, legislation and technology, there appears to be no significant reduction in AFRs. Given the situation noted, the research determined to investigate the effect of the integration of design, procurement and construction relative to H&S. A mixed method research methodology was utilised for the thesis. Quantitative methods were used to develop recommendations for the sector that are appropriate, achievable, and engender an H&S inclusive multi-stakeholder approach. The qualitative methodology utilised in AR and a total of three FGs' sought to develop a theoretical model that would identify multi-stakeholder policies, practice and education requirements.

The research aim sought to provide evidence to stimulate a multi-disciplinary stakeholder approach to ultimately reduce fatalities, injuries and disease in South Africa.

The qualitative approach to determine the objectives and aim is as follows:

- To use action research and focus groups among construction stakeholders to determine the procurement practices at provincial and district levels of the Eastern Cape Department of Roads and Public Works, Eastern Cape (ECDRPW);
- To identify existing national and international models and the relevance of developing a model relative to the South African context, and
- To validate the model through the engagement of stakeholders that include procurement, clients', designers', contractors', and H&S.

The quantitative approach to determine the objectives and the aim includes:

- The use of questionnaires among various groups practicing in the sector that are based on the literature review, and
- Determine current practices, perceptions and aspects as they relate to the diverse stakeholders and affect the industry.

Currently the built environment, H&S, SCM, and procurement operate in silos. The result is an insufficient overlap of knowledge and expertise to impact on, and minimise project risk. The domino or 'knock on' effect impacts on construction workers, who are downstream of the choices made relevant to design, procurement, and construction processes. As such the research is deemed important, any life saved, injury or disease prevented will effectively improve the image of the industry, quality of workers lives, and the South African economy. The researcher considers this thesis to be the point of departure to further develop research with respect to the integration of design, procurement, and construction among all stakeholders.

Section 9.2 concludes the first eight chapters of this thesis, followed by a summary of recommendations.

9.2 REVIEW OF THE LITERATURE

Construction has followed the development of cultures and communities through the centuries. As technology, techniques, and complexity of construction increased, so did the number of fatalities, injuries and diseases, often of 'unknown' causes. Workers were deemed expendable, and often if injured, noted to be the fault of the worker, not the contractor. The development of the sector evolved from the master builder, who controlled an entire project, from design through to completion to the separation of skills and practices. The separation is what we know today as the built environment, with specialised training and professional categories in, for example engineering, architecture, and specialist contractors. The development of the specialised areas of construction has resulted in the separation of design and construction. Responsibility for project risk has largely been ignored by clients' and designers', and until recently, transferring risk to the contractor. Legislation has developed with minimum H&S standards across industries, specifically where high rate of fatalities is noted.

South Africa is deemed a developing country, and literature indicates that workers are six times more likely to be fatally injured at work. The legislative framework that protects South African citizens is encapsulated by the Constitution, and underpinned with the Occupational Health and Safety Act (RSA, 1993). There are a range of Regulations, including the recently amended Construction Regulations, which, *inter alia*, increased the liability of clients' and designers'.

Accurate accident statistics are not available. The Compensation Commissioner has not published updated statistics since 1999. The available frequency rates arise from approximately 50% of the sector, and mostly large contractors, who have better H&S systems in place, and lower fatality rates. The most frequent types of accidents are fall from height, from different levels, and being struck by plant or equipment, and motor vehicle accidents.

Practices regarding H&S, and standards of H&S across Africa and the developing countries are not encouraging. H&S standards are very varied, and in general, are beset with poor infrastructure to monitor and prosecute those who do not comply. The aspect of registration of construction H&S professionals was noted in countries such as Nigeria and Mauritius, where registration is a statutory requirement and guides practice. Nigeria, Mauritius, and South Africa appear to be the only three countries among those reviewed, with registration requirements. Professional bodies and organisations exist, and there are 'understandings' between countries to standardise practice, but not to the same extent as the statutory practices noted.

International literature indicates that approximately 40 to 60% of accidents could have been prevented if the method, materials, or processes had been considered during design. The identification of hazards and associated risks as early in the construction stages as possible have been identified in being the most effective manner of reducing project risk. South African research indicates that the direct costs relative to accidents contribute approximately 27% and indirect costs 73%, amounting to approximately 2% of the R3.5 billion attributed to the value of construction in South Africa, with the actual cost of accidents being approximately 5% of the value of construction.

Application of a hierarchal approach to risk management during the project life cycle in a multi-disciplinary manner has been tested internationally. Models to manage project risk exist in Australia (CHAIR), the United Kingdom (Gateway Model), and the United States of America (Prevention through Design, or PtD).

The use of the international models is multi-disciplinary in nature, and guide the process of risk reduction through a range of considerations. Such considerations include interrogating designs, products and processes, with the view to assessing alternatives in each, documenting and ensuring the application of the alternatives in the projects.

Although the processes are noted as multi-disciplinary, the underpinning knowledge of H&S among BEPS' is assumed when participating in any of the international models.

The UK OGC has integrated H&S into its procurement process, which ensures that H&S is considered at the appropriate times. The process has a total of seven Gateways included in the Gateway model used as 'triggers. The procurement process does not progress, unless appropriate triggers relative to activities, actions or processes have been completed.

The South African National Treasury has a similar gateway process, called the IDMS. The IDMS includes the SCM policies and procedures which manages the procurement processes used in the public sector. There is the notion of H&S compliance, but no H&S triggers such as used in the UK, the USA and Australia. The traditional approach to SCM and procurement in the construction industry is that of applying the 'golden triangle' of cost, quality, and time to manage and measure a project's success.

The need to regulate the built environment resulted in the development of statutory councils for each of the built environment categories. Each council manages their IDoW, disciplinary, and education requirements, as well as continuing professional development (CPD). All the councils bar the SACPCMP have between 0.0 and 50.0% H&S included in the scope of work or practices relating to H&S. There are minimal requirements to include H&S at undergraduate level or at CPD level among the BEPs'. The recent inclusion of the requirement to register construction H&S categories within two statutory areas has increased the attention to H&S, as well as the need to appoint professional CHSAs on projects requiring a CWP prior to commencing work. The development of the registration and practice was deemed necessary to 'force' H&S onto stakeholders upon the industry, and to ensure competence among those who practice in construction H&S.

The lack of the multi-disciplinary approach to reducing project risk, the lack of a 'duty of care' among BEPs' to those who construct, and the perpetual cycle of narrow paradigms have not served the interests of H&S in a high-risk environment.

To date, clients', SCM and BEPs' have resisted addressing their moral duty to protect the vulnerable, resulting in the unacceptable loss of workers currently experienced in South Africa. Literature further identifies that the construction stakeholders have minimal, if any experience, training, or experience in CHS.

9.1 THE RESEARCH PARADIGM AND METHODOLOGY

H&S research in the construction and engineering sectors are typically categorised as social research. The very nature of research is noted as a 'voyage of discovery', where outputs remain largely unknown until the research is complete, even then, the outputs may remain unknown. Outputs are considered in terms of the aim, objectives, and hypotheses.

The research adopted a mixed method research methodology for several reasons. There is a paucity of literature relating to the topic of the research, and the more traditional approach is to rely on quantitative research. However, while numbers can provide information or prove the extent of a problem, subtle nuances can only be gained through the engagement of those who practice or are affected. The qualitative approach facilitates more in-depth insight compared to quantitative research methodology. Quantitative instruments were used in the initial stages of the research, and AR using FGs' in the latter part, to obtain deeper and greater insight into achieving the aim and objectives of the research.

The data collected in the qualitative and quantitative surveys focused on differing points of practice. The AR aspects using the FGs' considered the procurement process that underpins a project, with some elements relative to the interface of H&S, design and procurement. The quantitative aspect considers the perceptions of those practicing or involved in H&S, the interface regarding the stakeholders and 'issues' experienced in the challenges relating to daily work.

The information sought to contextualise the South African paradigm and practices.

It was not deemed that any of the content to be dealt with in this research would require formal ethical approval to proceed. All the instruments, quantitative and qualitative assured participants of anonymity, and that all data would be treated as confidential and principals of ethical pre-requisites would be adhered to during the research. All the statements to that extent are included on each of the documents and correspondence to participants.

9.2 THE DATA: QUANTITATIVE RESEARCH

The FGs' and surveys across the quantitative and qualitative paradigms considered the stakeholders involved with the construction processes. Themes considered the delineation of the stakeholders who could affect or be affected by stakeholders' actions, or lack thereof, such as workers, at labour or management level. The qualitative themes considered aspects such as levels of competence in H&S, procurement, stakeholders and CHS, and how they link together to limit project risk. The qualitative aspects considered for the study.

A summary of the findings is presented for the two quantitative, multi-stakeholders' studies. The quantitative themes considered the 'myths' that surround the industry, such as accidents can't be prevented. Roles and responsibilities were encapsulated in the remaining themes in terms of limiting risk through design, potential influence and risk-taking behaviour. Themes were, *inter alia:* general; workers'; management (including supervision, responsibilities and pricing); a stakeholders' theme (including project managers; design and designers, and client), and the construction H&S theme (including the CHSA, CHSM and CHSO).

9.2.1 The First Multi-stakeholders' Perceptions Research: Pre- and Post-Training Research: DoL

The initial research relative to multi-stakeholders' perceptions of H&S was conducted among DoL inspectors attending continuing CHS training. The response rate was 100%. A questionnaire was completed pre- and post-training. Given the background described in the introduction to the initial research, following a two-day training programme the results indicated that there had been some impact, but not in terms of every sphere investigated. There were mostly negative responses to general H&S perceptions relating to the resources, training, and in decision making among workers, supervisors and managers. The perceptions could lead to a complacency in the inspectorate, which could in turn lead to their not investigating such issues following an accident or fatality. The lack of such aspects is contrary to the statutory requirements, and are known to increase project risk, and the potential of workers being injured or killed. Overall, the greatest level of 'shift', or positive aspects related to the roles of the designer, and client and CHSA, agreeing with the statements posed. The perception among stakeholders was relative to the aforementioned roles, and their ability to influence H&S on a project, the provision of resources and the identification and mitigation of project risk,

relative to H&S. However, the training for this aspect was very graphic, with discussions focusing on projects, and discussing how that design aspect impacted on the project. The consideration that many of the respondents may not have any experience in construction and could not visualise the extent of the hazards and the possible ways to reduce them, may well have influenced many of the aspects.

The results, and the lack of significant statistical differences courtesy of the inferential testing could be attributable to a response-shift bias. Not all the respondents were familiar with the construction H&S issues, despite being responsible for the sector. Therefore, further training programmes are required on a regular basis to provide further information for respondents to further shift their perceptions.

9.2.2 The Second Multi-stakeholders' Perceptions Research

The second research activity regarding the perceptions of multi-stakeholders' was conducted among stakeholders' involved in active projects of the ECDRPW. The research was noted as exploratory as the sample size could not be ascertained. The questionnaire was slightly altered for the second research activity to include project managers, or CPMs'.

Respondents' perceptions indicated that workers and supervisors deliberately, and knowingly take risks, that workers have adequate resources to do their work, are included in H&S decision making, and receive adequate training. The issue relative to the responses, if true, would have an impact on the reduction of accidents, fatalities, and diseases, which is not the case. Respondents support the notion that pricing and H&S are an integral part of site management and therefore a multi-stakeholder responsibility.

The respondents further perceive there is adequate H&S information and pricing for projects. The responsibility of H&S being purely a construction H&S function was not supported. Relative to the role of the PM or CPM, all the responses could be deemed significant. The responses indicate that PMs', and clients' can have a positive influence on H&S, and can mitigate (reduce) risks through the project life cycle. Respondents appear to believe very strongly that the role of the CHSA is important, and have a positive influence on project H&S.

The high number of ‘unsure’ responses indicated the lack of knowledge on the subject matter, and more significantly the ‘neutral’ (neither agreeing or disagreeing) group. Overall the findings indicate that the respondents were less informed regarding the roles and responsibilities of the stakeholders and H&S. A further outcome indicates that there is little or no sharing of H&S or H&S knowledge among many of the stakeholders.

Furthermore, the responses are indicative of perhaps the lack of involvement of the appropriate procurement, the service deliverables of the construction H&S groups and the overall impact on life cycle.

9.3 THE DATA: ACTION RESEARCH AND FOCUS GROUPS

A total of three AR FGs’ were held in the Sarah Baartman District (a building focus) and at the Bhisho offices (a civil engineering focus) of the ECDRPW.

The FGs’ participants reflected the multi-stakeholder nature of the industry. Participants representing the client, designers and contractors, were made up of BEPs’, namely architects, QS, engineers, CHSAs’, CHSMs’, and CHSOs'. The BEPs’ were mainly representatives of the client, with construction H&S representation mostly from industry.

The FG research questions were developed relative to the research S-Ps’ and hypotheses, and were broadly framed, as follows:

- Can we draw the current model of procurement used broadly outlining the processes used in the DRPW, linking the procurement model to the 6 stages generally used in the built environment?;
- H&S has been a legal requirement across all 6 stages (that covers the construction life cycle) and applicable in construction for many years, how competent do you feel given your background about meeting the requirements of incorporating H&S?;
- What would you suggest would be the most appropriate way of including H&S in the model for procurement that would fit the six stages and ensure legal compliance?;
    - Given the permit requirements, current procurement practice?;
    - Baseline design risk assessment, project specific H&S Specification, and an approved

H&S Plan must be submitted?;

- Possible 30 days for DoL to approve permit and results of delays may have on claims?

- How could the mechanisms identified be included (in the current model drawn) to ensure appropriate H&S involvement during the six stages?;
- Any other items for discussion?, and
- Feedback regarding the process and the discussion?

9.3.1 Qualitative Themes

The FG narratives were transcribed verbatim and imported to ATLAS.ti as a HU project. Codes, memo's and quotations were developed and analysed across the themes selected for the thesis, as well as across the stages of construction, SCM and procurement and stakeholders. The qualitative data were presented in the themes, with selected narratives to illustrate the objectives of the FGs'.

Three themes were selected for the qualitative data analysis. The themes did not replicate what had been done in the quantitative studies, but complemented them in terms of the competence of multi-stakeholders, linking procurement and H&S, the stages of construction, and the impact of procurement on the issue of application for the CWP.

Theme 1 examined the competence issue of all stakeholders, including H&S. The outcome identified the general overall lack of competence in H&S, among all participants, including the BEPs', therefore verifying the literature on the matter.

Theme 2 identified the late appointment of the CHSA, namely during stages 3, 4, and even stage 5. The CHSMs' and CHSOs' indicated their involvement mainly during stage 5, with a few indicating familiarities where required to operate.

Theme 3 noted a range of 'grey' areas, where one part of a stage starts, or finishes. The participants noted that the inclusion of construction H&S at stage 1, was noted as highly unlikely as the information in the form of notification of which projects are going to be done is what is received. The appointment of the CHSA at the late stages noted in theme 2, could be linked to the findings of theme 1. The outcome of theme 3 indicated that the ECDRPW would more than likely be non-

compliant when having to submit CWPs, and furthermore have project delays with cost implications and claims from contractors.

The qualitative data sets were assessed by an independent reviewer from NMMU.

9.3.2 Interpretation and a Provisional Theoretical Model

ATLAS.ti is the software used by the Nelson Mandela Metropolitan University for qualitative analysis. The model was developed using the transcriptions and voice recordings, as well as the IDMS toolkit, which constituted the basis of the draft model. Code co-occurrence tables were generated from the ATLAS.ti data analysis to enhance the development of the theoretical model. The coding used in the analysis of the data were used to select 'project triggers', and 'proposed project triggers' across the stages of construction and the literature to 'build' the draft theoretical model.

A summary of the IDMS requirements, through SCM and procurement processes from the 'custodian', National Treasury, cascading through the hierarchy of departments was presented in Figure 12 in Section 6.4.3. Figure 12 further indicates the flow of information that is required through the IDMS hierarchy, including the critical aspects relating to legal compliance, and the stages of work. The development of the model progressed using the six stages as the foundation of the model, and encapsulated the salient information from the literature, and the FG narratives relating to the code 'proposed project trigger' in ATLAS.ti.

'The Deacon Procurement, Design and H&S Model' emerged from South African and international literature, as well as qualitative findings. The model focuses on the South African legislative framework of H&S, SCM and procurement practices among stakeholders, across the 6 stages of construction. While the basis of the model is legal compliance, it incorporates international better practice as indicated, through the supporting literature. The tendency of the industry is to adhere to minimum levels of compliance, not determining other aspects that could possibly reduce project and financial risk. Therefore, all stakeholders need to work together, and for each stage each of the stakeholders is included in terms of their broad role. Reference to stakeholders in this context includes the client and the designer or person acting as their agent. The stakeholders could include

any of the Built Environment Professionals as registered with the statutory built environmental councils, e.g. ECSA, SACPCMP, SACAP, and SASQSs'.

9.3.3 Validation of the Provisional Model

The development of the theoretical model for the construction industry progressed through the analysis of the qualitative data collected from the FGs'. Verification of the draft model involved determining whether the structure of the model is correct, using the respondents feedback to validate the research work completed, and to 'test' the validity of the model.

On finalisation of the draft model, a concise survey was developed and sent to several of the FG participants for validation, feedback, and comments. A response rate of 38.5% was achieved, with a very high degree of concurrence namely, agree to strongly agree / strongly agree. The response indicated support for the model, even though deemed exploratory, given the response rate. Feedback was included in the revised model included in Chapter 7.

The model proposed in this research is not meant to be 'complete'. Practices, statutory frameworks, and standards constantly evolve, and were factors considered for the potential use and outcome that formed the basis of the model.

The model as proposed is further designed to be used for further research to build on the theoretical model for industry use, at National Treasury, 'user', provincial, and district levels.

9.4 TESTING OF THE HYPOTHESES

Testing the hypotheses is a requirement in quantitative research, and considering the quantitative approach was an integral part of the thesis, the results as tested in Chapter 8 are presented. However, qualitative data, including succinct sections of the literature were incorporated in the testing to further validate and provide the subtle nuances 'missing' from the quantitative findings.

A total of twenty-two hypotheses were tested. The hypotheses considered all the stakeholders, within the framework of the research. Only one hypothesis was not supported, and one partially supported.

9.5 SUMMARY AND RECOMMENDATIONS

The continued loss of lives, injuries, diseases, and economic burden cannot continue at the current rate. It is apparent that the statutory framework, the continual amendments thereto, and an increase in the level of construction H&S on projects since 2003 has been unsuccessful. Clients', designers' and SCM, and procurement operate in silos, not considering their upstream responsibilities in terms of reducing project risk.

Research, knowledge, and competence relative to construction H&S is limited in South Africa, and even more so with respect to the integration of design, procurement, and construction H&S among all stakeholders.

The research aims and objectives are deemed to have been met. The literature review included seminal work, existing standards, practices, and better practice, internationally, from Africa and South Africa. The data obtained from the qualitative and quantitative, and more especially the qualitative surveys, with the extensive literature review, has contributed to the development of a theoretical model. The 'Deacon Procurement, Design and H&S Model' was developed, presented for verification, and subsequently verified to guide an integrated approach to H&S in the construction sector.

The effect of the integration of design, procurement, and construction relative to H&S, therefore, is a multi-stakeholder approach that reduces project risk and ultimately saves workers from being killed, injured, or becoming ill at work.

9.6 RECOMMENDATIONS

The recommendations from the research are as follows:

9.6.1 Policy and Guidelines

- Propose policy documents, and guidelines to integrate with the IDMS to guide SCM and procurement committees;

- Propose the inclusion of the update of the IDMS with the inclusion of construction H&S Gateways, and
- Propose practice notes to support the policy documents and guidelines for provinces and districts.

9.6.2 Education and Training

- Ensuring the dissemination of the research to academic institutions for inclusion in undergraduate and postgraduate learning;
- The identification of further needs from the sector for curriculum development and adaptation for formal and informal courses at graduate and undergraduate level. To ensure that this information is incorporated, a copy of the framework will be distributed to all heads of departments involved with postgraduate and undergraduate courses;
- Proposing and submitting recommendations to the BEPCs to consider amending the EDoW for each of the BEP disciplines, and
- Assist SCM, BEPs', and construction H&S practitioners in terms of integrating SCM, design, and H&S through:
    - Workshops at provincial and district level of the ECDPRW;
    - Workshops providing feedback for FG participants, and
    - Workshops through SACPCMP Voluntary Associations (VAs) and interest groups for continual professional development (CPD).

9.6.3 Further Research

Given the paucity of research into the subject matter, further publications are recommended, Publication of the findings will be made available to the sector at national level, *inter alia:*

- Through accredited SCM and BEP journals, and
- Submitting publications and presenting at national and international conferences.

9.7 REFERENCES

Adeogun, B.K. and Okafor, C.C. (2013) Occupational health, safety and environment (HSE) trend in Nigeria. *International Journal of Environmental Science, Management and Engineering Research*. 2(1), 24-29

Alharthi, A. Soetanto, R. and Edum-Fotwe, F. (2014) The changing role of the public client in construction procurement. In: Raiden, A,B. and Aboagye-Nimo, E. (eds) *30th Annual ARCOM Conference*. *Association of Researchers in Construction Management, Portsmouth* 1-3 September 2014. Portsmouth: ARCOM, pp 403-412

Ambe, I.M. and Badenhorst-Weiss, J. (2012) Procurement challenges in the South African Public Sector. *Journal of Transport and Supply Chain Management* [online], 6(1), 242-261. Available from: http://www.jtscm.co.za/index.php/jtscm/article/view/63 [Accessed 25 August 2015]

Annan, J. Addai, E.K. and Tulashie, S.K. (2015) A Call for Action to Improve Occupational Health and Safety in Ghana and a Critical Look at the Existing Legal Requirements and Legislation. *Safety and Health at Work*. 6(2), 146-150

Asbury, S. and Ashwell, P. (2007) *Health and Safety, Environment and Quality Audits. A risk based approach*. 1st ed. Oxford, Burlington, MA: Elsevier

Behm, M. (2006) An Analysis of Construction Accidents from a Design Perspective. *The Center to Protect Workers' Rights*, pp 1-19 [online]. Available from: https://www.cpwr.com/sites/default/files/publications/krbehm_0.pdf [Accessed 15 February 2015]

Board of Canadian Registered Safety Professionals. (2014) About us [online], Available from: http://www.bcrsp.ca [Accessed 30 June 2015]

Boote, D.N. and Beile, P. (2005) Scholars Before Researchers: On the Centrality of the Dissertation, Literature Review in Research Preparation. *Educational Researcher.* August/September. 34(6), 3-15

Burke, R. (2014) *Project Management Techniques*. 2nd ed. (College edition). Hong Kong, China: Burke Publishing

Cameron, I., Duff, R. and Hare. B. (2004) *Integrated gateways: planning out health and safety risk. Research Report 263.* Health and Safety Executive [online]. Available from: http://www.hse.gov.uk/research/rrpdf/rr263.pdf [Accessed 7 January 2015]

Centers for Disease Control and Prevention. (2012) Prevention through Design. *NIOSH Workplace Safety and Health* [online]. Available from: www.cdc[.gov/NIOSH/topics/ptd. [Accessed 22 October 2015]

Chiocha, C., Smallwood, J.J. and Emuze, F. (2011) Health and safety in the Malawian construction industry. *Acta Structilia*, 18(1), 68-80

Finneran, A, and Gibb, A. (2013) CIB W099: safety and health in construction research roadmap: report for consultation. *CIB Publication 376* [online]. Available from: https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/12523/3/pub%20376.pdf [Accessed: 22 October 2015]

Construction Industry Development Board (cidb). (2009) *Construction Health and Safety in South Africa, Status and Recommendations*. Pretoria: Construction Industry Development Board

Construction Industry Development Board (cidb). (2010a) *Inform Practice Note #22a. cidb Infrastructure Gateway System – Stages. Version 2* (online). Pretoria: Construction Industry Development Board. Available from: http://www.cidb.org.za/publications/Documents/Practice%20Note%2022a.pdf [Accessed 22 October 2015]

Construction Industry Development Board (cidb). (2010b) *Inform Practice Note #22b. cidb Infrastructure Gateway System – Stages. Version 2* [online]. Pretoria: Construction Industry Development Board. Available from: http://www.cidb.org.za/publications/Documents/Practice%20Note%2022b.pdf [Accessed 22 October 2015]

Construction Industry Development Board (cidb). (2011) *Cidb Infrastructure Gateway System – Reviews. Version 1. Inform Practice Note #22c* [online]. Pretoria: Construction Industry Development Board. Available from: http://www.cidb.org.za/publications/Documents/Practice%20Note%2022c.pdf [Accessed 22 October 2015

Construction Industry Development Board (cidb). (2012) *Infrastructure Delivery Management Toolkit: Management Companion. Version 11*. Pretoria: Construction Industry Development Board

Construction Industry Development Board (cidb). (2015a) *The cidb Construction Industry Indicators: Summary Results: 2014.* Pretoria: Construction Industry Development Board [online]. Available from: http://www.cidb.org.za/Documents/KC/cidb_Publications/Ind_Reps_Other/ind_reps_cii_2014.pdf [Accessed 12 February 2015]

Construction Industry Development Board (cidb). [2015b] *Results of the 2014 Survey of the cidb Construction Industry Indicators.* Pretoria: Construction Industry Development Board [online]. Available from: http://www.cidb.org.za/Documents/KC/cidb_Publications/Ind_Reps_Other/ind_reps_survey_results_2014_CIIs.pdf [Accessed 12 February 2015]

Council for the Built Environment (CBE). (2007) P*olicy on the Identification of Engineering Work to be Performed by Persons Registered in Terms of the Engineering Profession Act 2000 (Act No. 46 of 2000)* [online]. Available from: http://www.cbe.org.za/upload/ECSA%20IDOW%20%20Policy.pdf [Accessed 12 July 2015]

Council for the Built Environment. (2011) *Identification of Work for the South African Council for the landscape Architectural Profession* (SACLAP) [online]. Available from: http://www.cbe.org.za/upload/SACLAP_IDoW_Policy.pdf [Accessed 12 July 2015]

Council for the Built Environment. (2015) *Final Research Report on Academic Curriculum on Health and Safety*. Johannesburg: CBE

Creswell, J.W. (2003) *Research Design, Qualitative, Quantitative, and Mixed Methods Approaches*. 2nd ed.. California: Sage Publications

Creswell, J.W. and Planco Clark, V.L. (2011) *Designing and conducting Mixed Methods Research*. 2nd ed. California: Sage Publications

Creswell, J. W. (2013) *Qualitative Inquiry & Research Design: Choosing Among Five Approaches*. 3rd ed. California: Sage Publications

Department of Labour. (1995) Guidelines for the Provision of Facilities and General Safety in the Construction Industry to Meet the Requirements of the Health and Safety in Employment Act 1992 and Regulations 1995. *Occupational Safety and Health Services*, New Zealand: Department of Labour

de Vos, A.S., Strydom, H. Fouché, C.B. and Delport, C.S.L. (2005) *Research at grass roots*. 3rd ed. Johannesburg: Van Schaik

Deacon, C.H. (2004) *The Health Status of Construction Workers*. (M Cur). University of Port Elizabeth

du Toit, W.J. (2012) *The Relationship between Health and Safety and Human Risk taking Behaviour in the South African Electrical Construction Industry*. (PhD Construction Management). Nelson Mandela Metropolitan University

Escalada, M. and Heong, K.L. (2009) Focus Group Discussion. [online]. http://ricehoppers.net/wp-content/uploads/2009/10/focus-group-discussion.pdf [Accessed 26 October 2016]

Emuze, F. and Smallwood, J.J. (2012) Infrastructure project performance in the South African construction sector: Perceptions from two provinces. *Acta Structilia* 19(2), 1-19

Republic of South Africa (2013) *Engineering Profession A*ct: *Guidelines for Services and Processes for Estimating Fees for Persons Registered in terms of the Engineering Profession Act, 2000 No. 46 of 2000, Board Notice 117 of 2013.* Pretoria: Government Printer

Federal Republic of Nigeria. (2011) Institute of Safety Professionals of Nigeria Bill. No. C656 [online]. Available from: http://nass.gov.ng/document/download/570 [Accessed 08 January 2016]

Federated Employers Mutual Assurance Company Limited (FEMA). (2016) *Accident Statistics* [online]. Available from: http://www.fem.co.za/Layer_SL/FEM_Home/FEM_Accident_Stats/FEM_Accident_Stats.htm [Accessed 07 January 2016]

Fellows, R, and Liu, A. (2003) *Research Methods for Construction*. 2nd ed. Blackwell Science Ltd. Oxford

Friese, S. (2014) *Qualitative Data Analysis with ATLAS.ti.* 2nd ed. Sage Publications Ltd. London. Kindle ed

Furter, E. (2014) *SHEQ Africa*. Construction corruption kills jobs and Workers. 23 September Update [online]. Available from: http://www.http//:Sheqafrica.com [Accessed 18 September 2014]

Ganah, A. and Godfaurd, J.A. (2014) Integrating Building Information Modelling and Health and Safety for Onsite Construction. Safety and Health at Work 6 [online]. 6(1), 39–45 Available from: http://isiarticles.com/bundles/Article/pre/pdf/68815.pdf [Accessed 18 September, 2014]

Gambatese, J.A. (1998) Liability in Designing for Construction Worker Safety. *Journal of Architectural Engineering*. 4(3), 107-112

Gambatese, J.A. (2013) Prevention through Design (PtD) Project 1: Benchmarking Management Practices related to PtD in the US and UK: Final Report – Activity 2: Assess the Effects of PtD Regulations on Construction Companies in the UK. *National Institute for Occupational Safety and Health (NIOSH)* [online] . Available from*:* https://designforconstructionsafety.files.wordpress.com/2017/07/niosh-ptd-in-the-uk-final-report-may-2013.pdf [Accessed 15 February 2015]

Gambatese, J.A. Hinze, J. and Behm, M. (2005) Investigation of the Viability of Designing for Safety. *The Center to Protect Workers' Rights* [online]. Available from: www.cpwr.com [Accessed 15 February 2015]

Geminiani, F. (2008). A model to improve the effectiveness of the occupational health and safety inspectorate function relative to South African Construction. (D. Tech). University of Port Elizabeth

Gibb, A. (1997). Focus Groups. *Social Research Update 19*. University of Surrey. Winter 1997. Ed. Gilbert, N.[online]. Available from: http://sru.soc.surrey.ac.uk/SRU19.html [Accessed 26 October 2015]

Goldswain, C.C. (2014) Architectural Design Interventions toward Improvement of construction Health, Safety and Ergonomics in South Africa. (PhD Construction Management). Nelson Mandela Metropolitan University

Hazard Information Foundation Inc. (2008). Construction Design Safety in the Marketplace. Research Report [online]. Available from: http://www.elcosh.org/document/1866/d000825/Construction+Design+Safety+in+the+Marketplace.html?show_text=1 [Accessed 7 January 2016]

Health and Safety Executive. (2014a) Health and safety in Great Britain, 2014. Health and Safety Executive. National Statistics. [online]. Available from: www.hse/gov.uk/statistics/ http://www.hse.gov.uk/Statistics/industry/construction/construction.pdf [Accessed 06 March 2015]

Health and Safety Executive. (2014b) Health and Safety Statistics. Annual Report for Great Britain. 2013/14 [online]. Available from: http://www.hse.gov.uk/statistics/overall/hssh1314.pdf [Accessed 23 January 2015]

Health and Safety Executive. (2015) Managing health and safety in construction. Construction (Design and Management) Regulations: Guidance on Regulations. HSE Books [online]. Available from: http://www.hse.gov.uk/pubns/priced/l153.pdf [Accessed 27 April 2015]

Heath, B.C. (2004) An Investigation into the Effectiveness of Partnering in Promoting Health and Safety Management on Construction Sites. In: Rowlinson, S (ed) *Construction Safety Management Systems* London: Spon Press, pp 124-136

Hecker, S. and Gambatese, J.A. (2003) Safety in Design: A Proactive Approach to Construction Worker Safety and Health. *Applied Occupational and Environmental Hygiene*. 18(5), 339-342

Hesse-Biber, S. (2010) Qualitative approaches to Mixed Methods Practice. *Qualitative Inquiry* July. 16(6), 455-468

Hinze, J.W. (2006) *Construction Safety*. 2nd ed. Prentice Hall Inc. New Jersey

Howe, W. (2015) CCOHS personal correspondence: H&S standards in Ontario, Canada

Hughes, P. and Ferrett, E. (2013) *Introduction to Health and Safety at Work*. 4th Ed. Butterworth-Heinemann. Oxford

Idubor, E.E. and Oisamoje, M.D. (2013) An Exploration of Health and Safety Management Issues in Nigeria's Effort to Industrialize. *European Scientific Journal*. 9(12), 154-169

Institute of Occupational Safety and Health. (2015) Why join IOSH? [online]. Available from: http://www.iosh.co.uk [Accessed 31 May 2015]

International Labour Organisation. (2015) Safety and health at work [online]. Available from: http://ilo.org/global/topics/safety-and-health-at-work/lang--en/index.htm [Accessed 29 January 2015]

International Labour Organisation. (2013) LEGOSH: Botswana [online]. Available from: http://www.ilo.org/dyn/legosh/en/ [Accessed 31 May 2015]

International Labour Organisation. (2013). National Profile on Occupational Safety and Health: Kenya. Programme on Safety and Health at Work and the Environment (SafeWork) [online]. Available from: http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/policy/wcms_187632.pdf [accessed 31 May 2015]

International Network of Safety and Health Practitioner Organisations (INSHPO) (2012) *Operating Guidelines* [online]. Available from: http://www.inshpo.org/about.php [Accessed 29 January 2015]

Jimoh, R., Ijigah, A. and Nuah, M. (2014) Health and Safety Management Practices Level on Construction sites in Ilorin Metropolis, Nigeria. In: Musonda, I., Aigbavboa C. (eds) *DII-2014*

Conference on Infrastructure Investments in Africa. 24-26 September 2014. Zambia: University of Johannesburg, pp 229-241

Joint Building Contracts Committee. (2014) Suite: *Principal Building Agreement*. 6.1st ed. Johannesburg

Jauhanger, Y. (2012) An overview of occupational health and safety in the Republic of Mauritius. *African Newsletter on Occupational Health and Safety. Economics in occupational health and safety*. 22(1), 20-22

Kabiri S., Hughes W. and Schweber L. (2012) Role conflict and role ambiguity in construction projects. In: Smith, S.D. (ed) *28th Annual ARCOM Conference*, *3-5 September 2012* Edinburgh, UK, pp 727-736

Kahn, M.I. (2014) *Understanding Triangulation. Management Science Context*. USA: Digital Publishing

Kheni, N.A., Gibb, G.F. and Dainty, R.J. (2006) The management of construction site health and safety by small and medium-sized construction businesses in developing countries: a Ghana case study. In: Boyd, D. (ed) *22nd Annual ARCOM Conference, 4-6 September 2006, Birmingham: Association of Researchers in Construction Management,* 273-282 [online]. Available from: http://www.arcom.ac.uk/-docs/proceedings/ar2006-0273-0282_Kheni_Gibb_and_Dainty.pdf (Accessed 29 January 2015)

King James Bible. n.d. Deuteronomy [online]. Available from: http://www.kingjamesbibleonline.org [Accessed 27 October 2015]

Leedy, P.D. and Ormrod, J.E. (2014) *Practical Research Planning and Design*. 10th ed. Pearson New International Edition. Essex: Pearson Education Limited

Lingard, H., Pirzadeh, P., Harley, J., Blismas, N. and Wakefield, R. (2014) Safety in Design. *Australian Constructors Association* [online]. Available from: http://www.rmit.edu.au/research/health-safety-research [Accessed August 2014]

Matiko, J. (2013) Health and safety regulatory framework in Tanzania: existing shortfalls and the way forward. *African Newsletter on Occupational Health and Safety. Construction*. 23(3), pp 63-65

Ministry of Labour, Ontario. (2015) Ministry of Labour Proposes to Strengthen Health and Safety Protection for Construction Workers. Ontario's Regulatory Registry [online]. Available from: http://www.ontariocanada.com/registry/view.do?postingId=16542&language=en [Accessed 3 January 2016]

Murray, M. 2004. The Use of Project Management Techniques in the Management of Safety and Health in Construction Projects. In: Rowlinson, S. (ed) *Construction Safety Management Systems*. London: Spon Press, pp 171-194

Musonda, I., Pretorius, J.H. and Haupt, T. (2013) Investigating the role of the external environment to influence clients' health and safety (H&S) performance in the construction industry. In:

Selected papers presented at the CIB World Building Conference. Brisbane 5-9 May 2013, pp 122-134

Musonda, I. and Haupt, T.C. (2009). A pilot study in Botswana's construction industry on designer's will and capacity to design for health and safety. In: *Conference proceedings of the CIB W099 Conference held in Melbourne, Australia, 21-23 October 2009*, Melbourne : RMIT University

Mustapha, Z., Aigbavboa, C. and Thwala, D. (2014) Construction Health and Safety Risk Management. In: Musonda, I. and Aigbavboa, C.O. (eds) *DII-2014 Conference on Infrastructure Investments in Africa. 25-25 September* 2014. Livingstone, Zambia: University of Johannesburg, pp 463-473

National Institute of Safety and Health. (2009) Construction Research at NIOSH. *Reviews of Research Programs of the National Institute for Occupational Safety and Health.* Washington: The National Academies Press

National Institute of Safety and Health (NIOSH). (2013) Prevention through Design [online]. Available from: http://www.cdc.gov/niosh/topics/ptd/other.html [Accessed 13 February 2015]

Neale, R. (2013) Ten factors to improve occupational safety and health in construction projects. *African Newsletter on Occupational Health and Safety. Construction.* 23(3), 52-54

New Zealand Construction Industry Council. (2006) Safety in Design in Construction: Research Report, New Zealand. *New Zealand Construction Industry Council* [online]. Available from: http://www.nzcic.co.nz/Safety_in_Design.pdf [Accessed: 03 October 2013]

Office of Government Commerce. (2007). *Health and safety. Achieving Excellence in Construction Procurement Guide*. 2010 [online]. Available from: http://webarchive.nationalarchives.gov.uk/20110601212617/http://www.ogc.gov.uk/documents/CP0070AEGuide10.pdf [Accessed 22 November 2015]

Olutuase, S.O. (2014) A Study of Safety Management in the Nigerian Construction Industry. *IOSR Journal of Business and Management,* 16(3) Vers. V, 1-10 [online]. Available from: http://www.iosrjournals.org/iosr-jbm/papers/Vol16-issue3/Version-5/A016350110.pdf [Accessed 13 February 2015]

Ontario Government. (1991) Occupational Health and Safety Act. Ontario Regulation 213/91. Construction Projects [online]. Available from: http://www.ontario.ca/laws/regulation/910213?_ga=1.241538242.1930663054.1452244458 [Accessed 08 January 2016]

Plantinga, H.E.C., Voordijk, J.T. and Dorée, A.G. (2014) Assessing Qualification systems: The relevance of replicating implicit reasoning. In: Raiden, A.B. and Aboagye-Nimo, E. (eds). *30th Annual ARCOM Conference, Portsmouth 1-3 September 2014,* Portsmouth, UK: Association of Researchers in Construction Management, pp 393-402

Project Management Institute. (2003) *Construction Extension to: A Guide to the Project Management Body of Knowledge*. Pennsylvania USA: Project Management Institute

Republic of Ireland. (2013) *Safety, Health and Welfare at Work (Construction) Regulations.* (S.I. No 291) [online]. Available from: http://www.irishstatutebook.ie/eli/2013/si/291/made/en/pdf [Accessed 08 January 2016]

Republic of South Africa. (1993a) *The Occupational Health and Safety Act.* (85). Pretoria: The Government Printing Works

Republic of South Africa. (1993b). *The Compensation of Occupational Injuries and Diseases Act*. (100). Pretoria: The Government Printing Works

Republic of South Africa. (1996) *Constitution of the Republic of South Africa.* (108). [online]. Available from: http://www.gov.za/documents/constitution-republic-south-africa-1996 [Accessed 11 February 2015]

Republic of South Africa. (2000) *Council for the Built Environment Act.* (43). Pretoria: The Government Printing Works

Republic of South Africa. (2004) South African National Standards. (10085-1:2004). *The design, erection, use and Inspection of access scaffolding Part 1: Steel access scaffolding*. Pretoria: SABS Standards Division

Republic of South Africa. (2008) *Amendments to the Standard for Uniformity in Construction Procurement*. *Construction Industry Development Board*. Government Gazette. (8). Pretoria: The Government Printing Works

Republic of South Africa. (2014) *The Construction Regulations* (84). Pretoria: The Government Printing Works

Republic of South Africa. (2011) *Identification of Work for the South African Council for the Landscape Architectural Professions (SACLAP)* [online]. Pretoria: The Government Printing Works. Available from: http://web.vdw.co.za/Portals/22/Documents/Downloads/SACLAP-IDoWAug2011Amendment220811.pdf [Accessed 16 July 2015]

Republic of South Africa. (2011a) *Architectural Profession Act* (44/2000). South African Council for the Architectural Profession: Interim Policy on the Identification of Work for the Architectural Profession [online]. Pretoria: The Government Printing Works. Available from: :http://c.ymcdn.com/sites/www.sacapsa.com/resource/collection/5977AAA5-CB89-46C1-9D5B-7A9496CD72E1/_IDOW_SACAP_Interim_IDoW_Policy._Part_1_of_2_(Board_Notice_154_of_2011)__.pdf [Accessed 11 July 2015]

Republic of South Africa. (2011b) *Architectural Profession Act* (44/2000): South African Council for the Architectural Profession: Interim Policy on the Identification of Work for the Architectural Profession [online]. Pretoria: The Government Printing Works. Available from: http://c.ymcdn.com/sites/www.sacapsa.com/resource/collection/5977AAA5-CB89-46C1-9D5B-7A9496CD72E1/DOW_-SACAP_Interim_IDoW_Policy._Part_2_of_2_(Board_Notice_154_of_2011).pdf [Accessed 11 July 2015]

Republic of South Africa (2013a) *South African Council for Project and Construction Management Professions (SACPCMP)*. Board Notice. (113). Project and Construction Management Professions Act. Registration Rules for Construction Health and Safety Officers in terms of section 18(1)(c) of the Act, 575(36525). Pretoria: The Government Printing Works

Republic of South Africa (2013b). *Project and Construction Management Professions Act (SACPCMP)*. Board Notice. (114). Registration Rules for Construction Health and Safety Manager in terms of section 18(1)(c) of the Act. Board Notices, 575(36525). Pretoria: The Government Printing Works

Republic of South Africa. (2013c). *Project and Construction Management Professions Act* (SACPCMP). Board Notice. (115). Registration Rules for Construction Health and Safety Agent in terms of section 18(1)(c) of the Act, 575(36525). Pretoria: The Government Printing Works

Schulte, P.A., Rinehart, R., Okun, A., Geraci, L, Heidel. and Donna, S. (2008) National Prevention Through Design (PtD) Initiative. *Journal of Safety Research*. 39, 115 – 121

Sibthorp, J., Paisley, K., Gookin, J. and Ward, P. (2007) Addressing Response-shift Bias: Retrospective Pretests in Recreation Research and Evaluation. *Journal of Leisure Research*. 39(2), 295-315

Smallwood. J.J. (2007) The Nature and Contents of Health and Safety (H&S) Specifications. In: *Proceedings of The Second Built Environment Conference*. *17-19 June 2007*. Port Elizabeth: Nelson Mandela Metropolitan University, pp 337-349

Smallwood. J.J. (2009) The Coordination of Health and Safety (H&S) and the Integration of H&S into South African Projects and the Construction Process. In: *CIB W099 Conference. "Working Together: Planning, Designing and Building a Healthy and Safe Construction Industry*. 21-23 October 2009. Melbourne: CIB, pp 12-21

Smallwood, J.J. (2011) Feedback Report on a Study Performance of Health and Safety (H&S) Officers. *Department of Construction Management, Nelson Mandela Metropolitan University*. Port Elizabeth: Nelson Mandela Metropolitan University

Smallwood, J.J. (2013) Construction health and safety (H&S): Key issues. *African Newsletter on Occupational Health and Safety. Construction*. 23(3), pp 59-62

Smallwood, J.J. (2015) A Historical Review of Construction Health and Safety. In: Bowen, B., Friedman, D., Leslie, T. and Ochsendorf, J. (eds*) 5th International Congress of Construction History, 3-7 June 2015. Chicago, Illinois*

Smallwood, J.J. and Emuze, F. (2013) Assessing the Contributions of a Public Sector Client to Contractor Health and Safety (H&S) Improvement in South Africa (ICIDA). In: Thwala, W., D. and Aigbavboa, C.O. (eds) *2nd International Conference on Infrastructure Development in Africa. March 17-19* 2013. Johannesburg, South Africa: ICIDA

Smallwood, J.J. and Venter D. (2002) The influence of Project Managers on Construction Health and Safety in South Africa. *The Australian Journal of Construction Economics and Building.* 2(3), 57-69

Smallwood, J.J. and Haupt, T.C. (2008) Competencies Required to Manage Construction Health and Safety. In: Proceedings: Rinker International Conference Evolution of and Directions in Construction Safety and Health., 9-11 March, Gainesville, Florida, USA: University of Florida, pp 227-24

South African Council for Project and Construction Management Professions (SACPCMP). (2006(a)) Construction Project Manager. Identification of Work and Scope of Services for Construction Project Managers Registered in terms of the Project and Construction Management Professions Act. 48(2000). Johannesburg: SACPCMP

South African Council for Project and Construction Management Professions (SACPCMP). (2006(b) *Construction Manager. Identification of Work and Scope of Services for Construction Managers Registered in terms of the Project and Construction Management Professions Act. 48(2000)*. Johannesburg: SACPCMP

South African Council for Project and Construction Management Professions (SACPCMP). (2013a) *Registration Rules for Construction Health and Safety Agents*. Johannesburg: SACPCMP

South African Council for Project and Construction Management Professions (SACPCMP). (2013b) *Registration Rules for Construction Health and Safety Managers*. Johannesburg: SACPCMP

South African Council for Project and Construction Management Professions (SACPCMP). (2013c) *Registration Rules for Construction Health and Safety Officers*. Johannesburg: SACPCMP

South African Council for the Quantity Surveying Professionals. (2013) *Amendment of Tariff of Professional Fees, Quantity Surveying Profession Act. 49(2000)* [online]. Available from: http://c.ymcdn.com/sites/www.sacqsp.org.za/resource/collection/62E54748-385B-4597-A72A-4BD2F97D3641/2013_Guideline_Tariff_of_Professional_Fees.pdf [Accessed 16 July 2015]

Social Housing Foundation. (2006) *Guidelines - construction management good practice*. Johannesburg: Social Housing Foundation

Tau, S. and Seoke, S. Y. (2013) An assessment of the implemented occupational health and safety practices in Botswana construction industry. *African Newsletter on Occupational Health and Safety. Construction,* 23(3), 55-58

The Hazard Information Foundation Inc. (2008) Construction Design Safety in the Marketplace. *ELCOSH* [online]. Available from: http://www.elcosh.org/record/document/1866/d000825.pdf [Accessed 15 February 2015]

The International Network of Safety & Health Practitioner Organisations. (2015) A Global Alliance Dedicated to Advancing the Occupational Safety and Health Profession. *International Network of Safety and Health Practitioner Organisations (INSHPO)* [online]. Available from: http://www.inshpo.org [Accessed 30 June 2015]

Tukuta, M., and Saruchera, F. (2015) Challenges facing procurement professionals in developing economies: Unlocking value through professional international purchasing. *Journal of Transport and Supply Chain Management*, 9(1), 152-161

Ulang, N. M. D., Gibb, A. G. F., Anumba, C. J. and Gambatese, J. (2012) Communication of Construction Health and Safety Information in Design. In: Tjandra, I.K. (ed) *CIB W099 International Conference on "Modelling and Building Health and Safety"* 10-11 September 2012. National University of Singapore: CIB, pp 230-239

Watermeyer, R. B. (2012) Changing the construction procurement culture to improve project outcomes. In: Michell, K., Bowen, P, and Cattell, K. (eds) *Keynote Address: Joint CIB W070, W092 and TG72 International Conference on Facilities Management, Procurement Systems and Public Private Partnerships*, Cape Town 23-25 January 2012. Cape Town: University of Cape Town, pp 2-10

Watermeyer, R., Wall, K. and Pirie, G. (2013) How infrastructure delivery can find its way again. *IMIESA* 38(3). March. pp 17-29

Wells, J. and Hawkins, J. (2010) *Promoting Construction Health and Safety through Procurement: A briefing note for developing countries*. Engineers against Poverty. London: Institute of Civil Engineers (ICE)

Windapo, A. and Oladapo, A. (2012) Determinants of Construction Firms' Compliance with Health and Safety Regulations in South Africa. In: Smith, S. D. (ed) *28th Annual ARCOM Conference. Association of Researchers in Construction Management.* Edinburgh 3-5 September 2012: Edinburgh: ARCOM, pp 433-444

Windapo, A. (2013) Relationship between Degree of Risk, Cost and Level of Compliance to Occupational Health and Safety Regulations in Construction. *Australasian Journal of Construction Economics and Building.* 13(2), 67-82

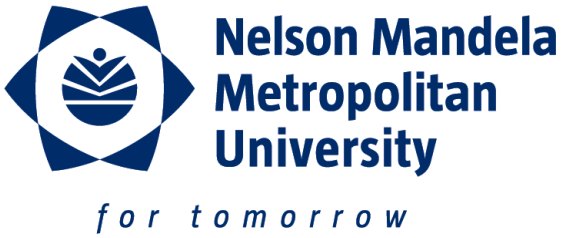
WorkCover New South Wales. (2001) CHAIR Safety in Design Tool [online]. Available from: www.workcover.nsw.gov.au [Accessed 30 June 2015]

Yi Man Li, R. and Wah Poon, S. (2013) Supply of Safety Measures in Developing and Developed Countries: A Global Perspective. *Risk Engineering, Construction Safety*. Berlin: Springer-Verlag

Zou, P. X. W. and Sunindijo, R. Y. 2015. *Strategic Safety Management in Construction and Engineering.* West Sussex: Wiley Blackwell

ANNEXURES

ANNEXURE 1: LETTER OF REQUEST FOR ECDRPW **TO** PARTICIPATE IN ACTION RESEARCH FOCUS GROUPS



• PO Box 77000 • Nelson Mandela Metropolitan University
• Port Elizabeth • 6031 • South Africa • www.nmmu.ac.za

SUMMERSTRAND NORTH
DEPARTMENT OF CONSTRUCTION MANAGEMENT

4 May 2015

Attention:
Mr Peter Castle
Construction H&S Manager,
Department of Roads and Public Works
Bhisho

Dear Sir

Re: Focus Groups: The Effect of the Integration of Design, Procurement, and Construction relative to Health and Safety

We are kindly requesting that the Eastern Cape (EC) Department of Roads and Public Works (DRPW) (ECDRPW) participates in a PhD study, entitled 'The Effect of the Integration of Design, Procurement, and Construction relative to Health and Safety'.

The study has qualitative components, which include the need to conduct focus groups with volunteers to enrich the data collected to date, and that are associated with a range of identified hypotheses. The study is, inter alia determining the current and optimum roles of the professionals practicing in the built environment, relative to design, procurement and construction, within the realm of health and safety (H&S).

The study has identified that the ECDRPW is a major Client in the EC, and has several of role players within its service delivery and practices that cover the building and civil sectors of the built environment across the province. Given that the Construction Regulations were amended in 2014, and have far reaching consequences for major role players such as the ECDRPW, we therefore request the participation of a range of built environment professionals (BEPs') (internally and externally) as well as Contractors that are registered with Treasury.

The sample stratum therefore would have two levels, and in each level, two groups.

The first level identified should be from Head Office (Bhisho), and the two groups (interviewed separately), would include those involved with Civil projects, and those involved with Building projects.

The second level would be at district level, and for convenience, the Cacadu, or Sarah Baartman District is recommended. The two groups would include those involved with Civil projects and those involved with Building projects, andno more than 14 per group, which provides each participant with an opportunity to add value to the data collection.

Each group (in each area) would need to be made up of the BEPs' as listed, and where possible registered with the appropriate professional registering body:

Building Group (Bhisho)	**Building**	**Civil**
Client	Senior Manager,	Senior Manager
Designers (all categories)	Architect, Quantity Surveyor, Engineer: Mechanical, Electrical, Civil, Structural, Project Manager, Construction Manager	Engineers: Technicians: Civil, Structural, Project Manager, Construction Manager
Contractors	Grade 5-9	Grade 5-9
Construction CHSA	External	External
Construction CHSM and CHSO	Preferably from the participating Contractors	Preferably from the participating Contractors
ECDRPW CHS	Internal position	Internal position

Building Group (Cacadu / Sarah Baartman)	**Building**	**Civil**
Client	Senior Manager / District Manager	Senior Manager
Designers (all categories), sample internally and externally, and should include a sample of building inspectors (for building)	Architect, Quantity Surveyor, Engineer: Mechanical, Electrical, Civil, Structural, Project Manager, Construction Manager	Engineers: Technicians: Civil, Structural, Project Manager, Construction Manager

Contractors	Grade 5-9	Grade 5-9
Construction CHSA	External	External
Construction CHSM and CHSO	Preferably from the participating Contractors	Preferably from the participating Contractors
ECDRPW CHS	Internal position	Internal position

Each session should **not take more than 2 hours** to complete, and we would be grateful if you would endeavour to agree to assist with the setting up and contacting the relevant parties to participate. As participation is voluntary, the student will provide refreshments and snacks for those participating. The student will further provide a venue if there is no appropriate venue available at any of the sites. The sessions be completed in a day per area, with a session in the morning and afternoon. All equipment will be provided by the student.

Dates to be considered include 19 May in Bhisho, or East London, and 27 May in Port Elizabeth.

The collated data will be utilised in the said PhD study, and assist with the formation of a model that could be utilised among those working in the public sector and assist with compliance to the better practice standards and overall H&S legislation, including the Construction Regulations (2014).

A research publication will be developed, and a copy will be made available to the ECDRPW when published. If you could please send your response per e-mail to: john.smallwood@nmmu.ac.za and cc to claire@occumed.co.za or per facsimile to (041) 504 2345,

Should you have any queries please do not hesitate to contact me at: 083 659 2492 or the student, Claire Deacon on 083 658 5390.

Please note that your anonymity is assured i.e. the individual responses will not become public knowledge.

Thanking you in anticipation of your positive response.

John Smallwood, PhD (Construction Management)

(Construction Programme Director, MSc (Built Environment) Programme

Professor, and Head, Department of Construction Management

Claire Deacon

PhD (Construction Management) Candidate

ANNEXURE 2: LETTER TO PROSPECTIVE PARTICIPANTS FOR ACTION RESEARCH FOCUS GROUPS

Good day to you.

RE: Focus Groups: addressing: 'The effect of Integrating Design, Procurement and Construction relative to Health and Safety

The Eastern Cape Department of Roads and Public Works has been requested to participate in focus groups to discuss 'The Effect of Integrating Design, Procurement and Construction relative to Health and Safety'. The focus groups form part of an NMMU PhD Construction Management study by Ms Claire Deacon, who is a Registered Professional Construction Health and Safety Agent (one of two currently practicing who are on the Departmental Data Base), who has carried out many projects for the Department.

The focus groups will study the role of professionals and other persons practicing in construction in the Built Environment and their engagement in Health and Safety. A copy of the official letter of request from NMMU Department of Construction Management is attached.

The focus groups will further provide valuable feedback for the study, and the Departmental OHS staff. Findings will assist in determining how the Department will see its way forward through the changes which will be implemented in August this year which will affect the Construction Industry in many ways.

Port Elizabeth: 01 June 2015 Venue: TBA Times: 08h30 and 12h30	Bhisho: 02 June 2015 Venue: Small Board Room, Times: 10h30 and 14h00

We invite a range of those practicing and registered in the building and civil sections from the Department, OHS, Consulting and Construction fields and feel that the discussion would be of great interest to anyone interested or involved in Health and Safety. We are limited to a maximum of 14 delegates per session, so we are working on a first come first serve basis.

Please complete the appropriate section of the form and group, noting your area of expertise.

There will be no cost to the attendees and refreshments will be served.

Please send your reply to Peter Castle at peter.castle@dpw.ecape.gov.za. Cell 083 478 0446

We hope that you will be able to find the time to participate in this valuable study.

Best Regards

Peter

Each group (in each area) would need to be made up of the categories listed, and where possible registered with the appropriate professional registering body, please detail category if not on the list:

Building Group	**Building**	**Category of participation and area of expertise (record which)**
Client	Senior Manager /District Manager	
Internal Designers (all categories)	Architect Quantity Surveyor Engineer: Mechanical, Electrical, Civil, Structural, Technician Project Manager Construction Manager Other	
External Designers (All Categories)	Architect Quantity Surveyor Engineer: Mechanical, Electrical, Civil, Structural, Technician Project Manager, Construction Manager Other	
Contractors	Grade 5-9	
Construction CHSA	External	
Construction CHSM and CHSO	Preferably from the participating Contractors	
ECDRPW CHS	Internal position	

Civil Group		
Client	Senior Manager	
Internal Designers (all categories)	Engineers: Technicians: Civil, Structural, Project Manager, Construction Manager	
Contractors	Grade 5-9	

Construction CHSA	External	
Construction CHSM and CHSO	Preferably from the participating Contractors	
ECDRPW CHS	Internal position	

Name:	**Contact Number:**
Select Time and Venue: Port Elizabeth: 01 June 2015 Venue: TBA Times: 08h30 and 12h30	 Bhisho: 02 June 2015 Venue: Small Board Room, Times: 10h30 and 14h00

ANNEXURE 3: FOCUS GROUP LETTER OF CONSENT

LETTER OF CONSENT

THE EFFECT OF THE INTEGRATION OF DESIGN, PROCUREMENT, AND CONSTRUCTION RELATIVE TO HEALTH AND SAFETY

I, _____

hereby consent to participate in the focus group for the NMMU PhD study entitled 'The effect of the integration of design, procurement, and construction relative to health and safety'.

I authorise the PhD candidate CH Deacon, NMMU Student No. 201341247 to record all comments audio-visually as well as in the thesis. I understand that no reference to my name or company will be made, and all recordings will be held in the strictest confidence.

I may be contacted should there be any further clarity sought during the transcribing of the recordings.

Signature: _____

Date: _____

ANNEXURE 4: FOCUS GROUP QUESTIONS

FOCUS GROUP QUESTIONS:

The purpose of this research is to determine the effect of the integration of design, procurement, and construction relative to H&S. Given the recent changes in South African legislation and need for professional construction H&S registration, there is a clear need to develop a model that will assist with the inclusion of all stakeholders and role players during the construction life cycle.

Such a model could be used by all to realise the benefits of H&S as an integral part of the construction sector. The shift in behaviour could ultimately realise a reduction in the risks, saving the valuable lives of the workers who are building South Africa.

Questions:

1 Can we draw the current model of procurement used broadly outlining the processes used in the DRPW, linking the procurement model to the 6 stages generally used in the built environment?

2 H&S has been a legal requirement across all 6 stages (that covers the construction life cycle) and applicable in construction for many years, how competent do you feel given your background about meeting the requirements of incorporating H&S?

3 What would you suggest would be the most appropriate way of including H&S in the model for procurement that would fit the 6 stages and ensure legal compliance?
   a. Given the permit requirements, current procurement practice?
   b. Baseline design risk assessment, project specific H&S Specification and an approved H&S Plan must be submitted?
   c. Possible 30 days for DoL to approve permit and results of delays may have on claims?

4 How could the mechanisms identified be included (in the current model drawn) to ensure appropriate H&S involvement during the 6 stages?

5 Any other items for discussion?

6 Feedback regarding the process and the discussion?

ANNEXURE 5: FG GUIDELINES

FOCUS GROUP GUIDELINES

THE EFFECT OF THE INTEGRATION OF DESIGN, PROCUREMENT, AND CONSTRUCTION RELATIVE TO HEALTH AND SAFETY

Thank you for taking the time to be part of the focus group, as part of the above study, it is really appreciated, and the findings will be made available to the Department of Roads and Public Works, and the participants if not part of the Department.

Ground rules:

- Questions will be posed to be considered
- You do the talking
- There are no right or wrong answers, you do not have to agree with the other participants
- Everything stays confidential, there will be no reference other than to a number and discipline
- We will be recording using both a tape recorder and a camera, just to ensure we do not lose any information
- Please allow fellow participants to finish their contribution

Refreshments will be available.

Thank you

Claire Deacon
083 658 5390
claire@occumed.co.za

ANNEXURE 6: LETTER OF INVITATION TO PARTICIPATE IN MODEL VALIDATION

Nelson Mandela Metropolitan University
for tomorrow

03 January 2016

Dear Research Focus Group Attendant

Re: PhD Survey: The Effect of the integration of design, procurement and construction relating to health and safety: The '*Deacon Procurement, Design and H&S Model*'

Thank you again for the participation in the above study held in June 2015. The PhD study by NMMU PhD Candidate Claire Deacon, has attempted to determine the various built environment professionals approach to health and safety through the construction life cycle.

We would be most appreciative if you could provide feedback to the attached model: The Deacon Procurement, Design and H&S Model that has evolved from the study.

Please note that anonymity is assured, and the questionnaire should **not take more than 5 minutes** to complete. We would be grateful if members would endeavour to complete the questionnaire electronically, and return it by **4 January 2016**:

per e-mail to claire@occumed.co.za

Should you or members have any queries please do not hesitate to contact Claire Deacon per e-mail or at: 083 658 5390

Thanking you in anticipation of your support.

John Smallwood, PhD (Construction Management)
Professor, and Head, Department of Construction Management
Programme Director, MSc (Built Environment) Programme

ANNEXURE 7: THE VALIDATION QUESTIONNAIRE AND DRAFT MODEL

'The Deacon Procurement, Design and H&S Model'

Dear Focus Group Participant,

Thank you for your participation, please complete the short questionnaire as a form of model validation. Your anonymity is guaranteed – the responses are for research purposes only. The questionnaire should not take you more than 5 minutes. You may enter your data electronically, please complete and send to claire@occumed.co.za by 4 January 2016.

Please enter a capital 'X' in an appropriate block. Please ensure each question is answered.

	STATEMENT	Unsure	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	To what extent do you agree with the 6 Stages of work posed?						
2	To what extent do you agree with the key activities of the 'Client'?						
3	To what extent do you agree with the key activities of 'All Stakeholders'?						
4	To what extent do you agree with the key activities of the 'CHSA'?						
5	To what extent do you agree with the key activities of the 'CHSO'?						
6	How useful would the model be relative to being used in your department/organisation?						
7	To what extent do you believe the model applies to the construction sector?						
8	To what extent do you believe the model applies to procurement?						
9	To what extent do you believe the model applies to design?						
10	To what extent do you believe the 'triggers' could be applied as H&S gateways in the IDMS?						
11	To what extent do you believe that should all stakeholders, including CHS, work together that accidents, injuries and diseases could be reduced?						

Comments (Please add if needed**):**

Please complete the following information in the event we need to verify or clarify your comments.

Name:	e-mail address
Contact Number	

THE DEACON PROCUREMENT, DESIGN AND H&S MODEL

CONSTRUCTION HEALTH AND SAFETY INTERVENTIONS /CONSTRUCTION STAGES					
1	**2**	**3**	**4**	**5**	**6**
PROJECT INITIATION AND BRIEFING	**CONCEPT AND FEASIBILITY**	**DESIGN DEVELOPMENT**	**TENDER DOCUMENTATION AND PROCUREMENT**	**CONSTRUCTION DOCUMENTATION AND MANAGEMENT**	**PROJECT CLOSE OUT**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers; CWP					
KEY ACTIVITIES PER STAGE AND STAKEHOLDER					
Client: • Appoint the CHSA, and • Provide financial resources for the project. **Designers:** • Ensure financial resources for the project; • Identify communication channels, and • Use parameters set by the CHSA.	**All Stakeholders**: • Feasibility or value management; • Workshop the design aspects, and • Discuss O&M from the design perspective e.g. how washing or replacing of windows will be done through the life cycle.	**All Stakeholders:** • Detailed designs for the project by ensuring legal compliance to continue with construction, and • Selection of the procurement strategy and, including partner or contractor selection.	**All Stakeholders:** • Ensure inclusion of the CHSA as part of the technical SCM committees, and • Ensure contractors are adequately resourced and competent.	**All Stakeholders:** • Ensure appropriate legal compliance through the project; • Stop any work placing workers at risk; • Ensure means of change management is included, and • Monitor and maintain records relating to contractors and communication to ensure compliance.	**All Stakeholders**: • Ensure legal compliance through the project; • Ensure monitoring and close out records are submitted, relating to contractors and communication to ensure compliance, and • Maintain performance reports.

CONSTRUCTION HEALTH AND SAFETY INTERVENTIONS /CONSTRUCTION STAGES

1	2	3	4	5	6
PROJECT INITIATION AND BRIEFING	**CONCEPT AND FEASIBILITY**	**DESIGN DEVELOPMENT**	**TENDER DOCUMENTATION AND PROCUREMENT**	**CONSTRUCTION DOCUMENTATION AND MANAGEMENT**	**PROJECT CLOSE OUT**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers; CWP					

CHSA:
• Develop and maintain H&S policies and project strategic objectives;
• Develop a risk register:
  • Visit site to assess potential issues and risks;
  • Develop Baseline Risk Assessment (BRA), and
  • Develop project H&S parameters for designers.
	CHSA
	• Include requirement for H&S pre-qualification in the SCM process of tendering.
	• Further development of the BRA;
	• Advising on the investigations to be done (from a H&S perspective), and
	• Link BRA into designer project specific H&S specification (DSSHSS).
		CHSA:
		• Include H&S information in the project specifications and controls;
		• H&S pre-qualification in the SCM process of tendering (to reduce procurement time and potential contractor claims),
		• Reduce the time for developing the PSHS plan in contractual documentation to 7 days (unless extenuating circumstances)
		• Prepare BoQ against SSHSS for inclusion into the project specific H&S plan;
		• Finalise the SSHSS and BRA;
		• Assess the requirements and include criteria for the pre-
			CHSA:
			• Support the client to limit liability with SCM;
			• Assist with assessing competence and resources during tender adjudication and award, and
			• Ensure adequate information for CWP application.
				CHSA:
				• Ensure aspects of change management is included;
				• Stop any work placing workers at risk, and
				• Ensure monitoring of all contractors and communication to ensure compliance.
					CHSA:
					• Ensure monitoring and close out records are submitted. relating to contractors and communication to ensure compliance.
					• Reconcile hazards encountered with the BRA, SSHSS, and SSHSP;
					• submit operational and maintenance (O&M) information, consolidated H&S information for maintenance.

		qualification and pre-tender H&S plan, and • Ensure all the H&S documentation is in included in the tender documentation.			
CONSTRUCTION HEALTH AND SAFETY INTERVENTIONS /CONSTRUCTION STAGES					
1	**2**	**3**	**4**	**5**	**6**
PROJECT INITIATION AND BRIEFING	**CONCEPT AND FEASIBILITY**	**DESIGN DEVELOPMENT**	**TENDER DOCUMENTATION AND PROCUREMENT**	**CONSTRUCTION DOCUMENTATION AND MANAGEMENT**	**PROJECT CLOSE OUT**
Each item should be considered as a trigger or 'gateway' in terms of the IDMS, in that the following stage does not proceed without the appropriate items relative to legal compliance and H&S being met. Stakeholders (all) includes the client, and designers; CWP					
			CHSO: • Prepare BoQ against SSHSS for inclusion into the SSHSP, and • Submit BoQ against SSHSS for inclusion into the project.	**CHSO:** • Ensure monitoring of all contractors and communication to ensure compliance, and • Stop any work placing workers at risk.	**CHSO:** • Ensure monitoring and close out records are submitted. relating to contractors and communication to ensure compliance.

ANNEXURE 8: DEPARTMENT OF LABOUR PRE- AND POST-TRAINING QUESTIONNAIRE

MULTI-STAKEHOLDER CONSTRUCTION HEALTH AND SAFETY (H&S) PERCEPTIONS (PRE- AND POST-TRAINING)

Please indicate by means of an X in the appropriate box the extent to which you disagree or agree with the following statements. H&S refers to construction H&S. Similarly, hazards and risk relate to construction H&S.

No.	Statement	Unsure	Strongly di	Disagree	Neutral	Agree	Strongly
1	All accidents are preventable	U	SD	D	N	A	SA
2	Accidents are planned events	U	SD	D	N	A	SA
3	Construction is inherently dangerous	U	SD	D	N	A	SA
4	Accidents are part of the job	U	SD	D	N	A	SA
5	'I am my brother's / sister's keeper'	U	SD	D	N	A	SA
6	Cost, quality, and time are more important than H&S	U	SD	D	N	A	SA
7	There are financial benefits to investing in H&S	U	SD	D	N	A	SA
8	Evaluation of project performance should include H&S	U	SD	D	N	A	SA
9	Workers knowingly take risks	U	SD	D	N	A	SA
10	Workers are adequately trained in H&S	U	SD	D	N	A	SA
11	Workers have adequate resources relative to H&S	U	SD	D	N	A	SA
12	Workers are included in decisions relative to H&S	U	SD	D	N	A	SA
13	Supervisors knowingly take risks	U	SD	D	N	A	SA
14	Supervisors are adequately trained in H&S	U	SD	D	N	A	SA
15	Supervisors are given adequate resources relative to H&S	U	SD	D	N	A	SA
16	Supervisors are involved in H&S	U	SD	D	N	A	SA
17	Management knowingly takes risks	U	SD	D	N	A	SA
18	Management is responsible for planning H&S	U	SD	D	N	A	SA
19	Management ensures adequate resources relative to H&S	U	SD	D	N	A	SA
20	Management is directly involved with H&S	U	SD	D	N	A	SA

21	H&S is solely the responsibility of the H&S Manager / Officer	U	SD	D	N	A	SA
22	H&S is an integral part of site management responsibilities	U	SD	D	N	A	SA
23	H&S is adequately priced for projects	U	SD	D	N	A	SA
24	Adequate H&S information is available for projects	U	SD	D	N	A	SA
25	H&S is related to constructability	U	SD	D	N	A	SA
24	Design can positively influence H&S	U	SD	D	N	A	SA
25	Design can negatively influence H&S	U	SD	D	N	A	SA
26	Design contributes to accidents	U	SD	D	N	A	SA
27	Designers can identify hazards at design stage	U	SD	D	N	A	SA
28	Designers can quantify risk at design stage	U	SD	D	N	A	SA
29	Designers can mitigate hazards at design stage	U	SD	D	N	A	SA
30	Designers can eliminate hazards at design stage	U	SD	D	N	A	SA
31	'Designing for H&S' should be a designer competency	U	SD	D	N	A	SA
32	Clients directly affect project H&S	U	SD	D	N	A	SA
33	Clients can positively influence H&S	U	SD	D	N	A	SA
34	Clients can negatively influence H&S	U	SD	D	N	A	SA
35	Clients can identify hazards during the conceptual phase	U	SD	D	N	A	SA
36	Clients can identify hazards during the feasibility phase	U	SD	D	N	A	SA
37	Quantity surveyors / cost engineers can influence H&S	U	SD	D	N	A	SA
38	The design team ensures adequate H&S information in tender documentation	U	SD	D	N	A	SA
39	Client H&S Agents should be procured during the feasibility phase	U	SD	D	N	A	SA
40	Client H&S Agents can influence H&S during design	U	SD	D	N	A	SA
41	Client H&S Agents influence H&S during construction	U	SD	D	N	A	SA
42	Client H&S Agents are given adequate information to perform their duties at each phase of the works	U	SD	D	N	A	SA
43	Client H&S Agents can play a positive role during construction	U	SD	D	N	A	SA
44	Client H&S Agents should be an integral part of the design team	U	SD	D	N	A	SA
45	'Designing for H&S' should be a client H&S Agent competency	U	SD	D	N	A	SA

ANNEXURE 9: MULTI-STAKEHOLDER PERCEPTIONS QUESTIONNAIRE (ECDRPW)

MULTI-STAKEHOLDER CONSTRUCTION HEALTH AND SAFETY (H&S) PERCEPTIONS

Please indicate by means of an X in the appropriate box the extent to which you disagree or agree with the following statements. H&S refers to construction H&S. Similarly, hazards and risk relate to construction H&S. Please ensure that you have responded to every question.

Please note that the questions below have been renumbered from the original questionnaire.

No.	Statement	Response (%)					
		Unsure	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	All accidents are preventable						
2	Accidents are planned events						
3	Construction is inherently dangerous						
4	Accidents are part of the job						
5	'I am my brother's / sister's keeper'						
6	Cost, quality, and time are more important than H&S						
7	There are financial benefits to investing in H&S						
8	Evaluation of project performance should include H&S						
9	Workers knowingly take risks						
10	Workers are adequately trained in H&S						
11	Workers have adequate resources relative to H&S						
12	Workers are included in decisions relative to H&S						
13	Supervisors knowingly take risks						
14	Supervisors are adequately trained in H&S						
15	Supervisors are given adequate resources relative to H&S						
16	Supervisors are involved in H&S						

17	Management knowingly takes risks						
18	Management is responsible for planning H&S						
19	Management ensures adequate resources relative to H&S						
20	Management is directly involved with H&S						
21	H&S is solely the responsibility of the H&S Manager / Officer						
22	H&S is an integral part of site management responsibilities						
23	H&S is adequately priced for projects						
24	Adequate H&S information is available for projects						
25	H&S is related to constructability						
26	Design can positively influence H&S						
27	Design can negatively influence H&S						
28	Design contributes to accidents						
29	Designers can identify hazards at design stage						
30	Designers can quantify risk at design stage						
31	Designers can mitigate hazards at design stage						
32	Designers can eliminate hazards at design stage						
33	'Designing for H&S' should be a designer competency						
34	Clients directly affect project H&S						
35	Clients can positively influence H&S						
36	Clients can negatively influence H&S						
37	Clients can identify hazards during the conceptual phase						
38	Clients can identify hazards during the feasibility phase						
39	Quantity surveyors / cost engineers can influence H&S						
40	The design team ensures adequate H&S information in tender documentation						
41	Client H&S Agents should be procured during the feasibility phase						
42	Client H&S Agents can influence H&S during design						
43	Client H&S Agents influence H&S during construction						
44	Client H&S Agents are given adequate information to perform their duties at each phase of the works						

45	Client H&S Agents can play a positive role during construction						
46	Client H&S Agents should be an integral part of the design team						
47	'Designing for H&S' should be a client H&S Agent competency						

Please record any comments you may have with respect to the aspects considered in the questionnaire.

Please indicate your project affiliation by recording your qualification and years of related experience in the blocks below:

Client	Project Manager / Principal Agent	Designer (Engineer / Architect)	Quantity Surveyor	Principal Contractor			Other
				Contracts Manager	Site Agent	H&S Officer	

ORGANISATION:		PHONE:	( )
ADDRESS:		FAX:	( )
		MOBILE:	( )
		E-MAIL:	
CONTACT PERSON:			

Please record your details below to facilitate contacting you, in the event that a query should arise. **Please note that the data provided in this questionnaire will be treated in the strictest confidence.**

Thank you for your contribution directed towards improving health and safety in South African construction.