



# Association of Schools of Construction of Southern Africa

The Twelfth Built Environment Conference

6 - 7 August 2018, Durban, South Africa

# Conference Proceedings



International Council  
for Research and Innovation  
in Building and Construction

## **PREFACE**

The ASOCSA Built Environment conference series has become the undisputed leading built environment conference on the African continent. It is one of only two construction-related conferences in South Africa that has been fully accredited by the Department of Higher Education (DHET) for subsidy. Since its inception in 2006 the blind peer reviewed conference proceedings have been referred to by private and public sector policy and decision makers. The series produces a post-conference edition of the Journal of Construction, which is on the list of journals approved by the South African Department of Higher Education and Training (DHET) for subsidy. The series continues to be underwritten by major industry stakeholders that have included the Construction Industry Development Board (CIDB), Council for the Built Environment (CBE), Master Builders South Africa (MBSA), branches of the MBA, major construction companies and PPC Cement. It has been endorsed by the International Council for Research and Innovation in Building and Construction (CIB), one of the largest global built environment research organizations.

## **OBJECTIVES**

The Twelfth Built Environment Conference continued in the tradition of previous conferences in the series and provided in an ever-increasing challenging global economic environment with shrinking sponsorship budgets an international forum with a very clear industry development and sustainability focus that provides the opportunity for researchers and practitioners from developed, developing and underdeveloped nations to deliberate topical current issues that impact the Built Environment.

The broad objectives of the conference are:

- To provide a forum for multi-disciplinary interaction between academics and industry practitioners;
- To disseminate innovative and cutting edge practices that respond to the conference theme and outcomes, namely Reflections on Directions in Construction;
- To provide a world class leading internationally recognized, accredited conference for the built environment; and
- To contribute to the existing built environment body of knowledge (BEBOK) and practice.

The conference organizers brought together in a single forum a group of researchers and academics from the full range of built environment disciplines that include engineers, architects, quantity surveyors, construction and project managers. Delegates were drawn not only from South African institutions of higher education, government agencies, and other construction-related organizations but also from the African continent, Australia, Europe and the United Kingdom.

## **CONFERENCE THEME AND OUTCOMES**

### ***SUSTAINABLE CONSTRUCTION, TRANSFORMATION AND DEVELOPMENT, EMERGING OPPORTUNITIES AND CHALLENGES***

This conference sought responses to questions related to current conversations and debates on infrastructure delivery and sustainability such as, for example,

- Innovation in Construction Means, Methods and Materials
- Construction and Project Management
- Construction Education, Training and Skills Development
- Sustainable Human Settlements and challenges
- Sustainable Construction
- Industry barriers, challenges and threats
- Procurement and Contracting
- Infrastructure Design and Delivery Challenges
- SME Contractor Development
- Construction Health & Safety
- Contractor Development

and includes papers that address, inter alia,

- Current trends and developments
- Policies
- Legislation and regulations
- Practices
- Case studies

These internationally peer reviewed and edited proceedings were aimed at contributing significantly to the body of knowledge relative to the science and practice of construction not only in South Africa but everywhere that the products of construction are being produced.

**Dr Hendrik Prinsloo**  
**Johannesburg, South Africa**  
**August 6, 2018**

## **ACKNOWLEDGEMENTS**

The organizing committee of the Twelfth Built Environment conference, held in Durban, South Africa, wish to thank the Council of the Association of Schools of Construction of Southern Africa and membership universities and individuals for supporting this conference through their valued contributions. Without that support this conference and the further development and growth of the Association of Schools of Construction of Southern Africa (ASOCSA) with respect to its mission in the region would not have been possible. Further, this support demonstrates the commitment to the further development of the body of knowledge relative to the science and practice of construction. This commitment is deeply valued and acknowledged.

Our thanks are extended to Professor Theo Haupt (Mangosuthu University) and Dr Hendrik Prinsloo (University of Pretoria) who worked unstintingly on every aspect of the conference. Together with the Scientific and Technical Committee and additional reviewers to whom special thanks are extended they worked hard and long to prepare refereed and edited papers and published proceedings of the highest standard that satisfy the criteria for subsidy by the South African Department of Higher Education and Training (DHET).

The contribution and excellent support of our webmaster, Wendal Koopman, in setting up and supporting our conference website is appreciated.

Finally, the sterling contribution and efforts of Ferial Lombardo to the success of this conference is acknowledged in her capacity as conference organizer working with the conference committee and evident in the superlative logistic coordination and attention to detail in every aspect of the conference organization.

## **ORGANISERS – SOUTH AFRICA**

Dr Hendrik Prinsloo, University of Pretoria, South Africa, President  
Prof Theodore Haupt, Mangosuthu University, Academic Chair  
Mrs. Ferial Lombardo Haupt, Conference Organiser

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## PEER REVIEW PROCESS

In order to maintain and ensure the highest quality in the conference proceedings and comply with the requirements for subsidy of the South African Department of Higher Education and Training (DHET), a rigorous two-stage system of peer review by no less than two acknowledged experts in the field has been followed. In terms of this process, each abstract received was twice blind reviewed in terms of:

- Relevance to overall conference theme and objectives;
- Relevance to selected sub-theme;
- Originality of material;
- Academic rigour;
- Contribution to knowledge; and
- Research methodology.

Authors whose abstracts were accepted after a blind peer review process was completed, were provided with anonymous reviewers' comments and requested to submit their full papers noting and addressing these comments. Evidence was required relative to the action taken by authors regarding the comments received. These resubmitted papers were twice blind reviewed again in terms of:

- Relevance to overall conference theme and objectives;
- Relevance to selected sub-theme;
- Originality of material;
- Academic rigour;
- Contribution to knowledge;
- Research methodology and robustness of analysis of findings;
- Empirical research findings; and
- Critical current literature review.

Authors whose papers were accepted after this second review were provided with additional anonymous reviewers' comments and requested to submit their revised full papers. These final papers were only included into both the conference presentation schedule and the conference proceedings after evidence was provided that all comments were appropriately responded to, having been multiple peer-reviewed for publication. At no stage was any member of the Scientific and Technical Committee or the editor of the proceedings involved in the review process relative to their own authored or co-authored papers. The role of the editor was to ensure that the final papers incorporated the reviewers' comments and arrange the papers into the final sequence based on the conference presentation schedule as captured on the conference proceedings and Table of Contents. Of the 80 abstracts originally received, only 43 papers were finally accepted for presentation at the conference and inclusion in these proceedings, representing an acceptance rate of 53.7%. To be eligible for inclusion these papers were required to receive one of three recommendations from at least two reviewers, namely

- Accepted for publication or
- Provisional acceptance provided minor changes / corrections are made or
- To re-submit for publication provided author/s reconsider/s the areas of concern

## LIST OF REVIEWERS

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#### **TAX BENEFIT**

ASOCSA is a registered Public Benefit Organization as defined in Section 30 of the Income Tax Act and a registered Section 21 Company as defined in the Companies Act. Therefore, all donations made to ASOCSA will be fully deductible for income tax purposes and a section 18A certificate, for proof of deductibility will be issued to the donor upon receipt of the donation. The deductible donation is limited to 10% of the donors' taxable income before providing for Section 18A and Section 18 deductions.



## History

ASOCSA is not the first attempt to form a body that addresses, inter alia, matters of construction education and training. In the days of the Building Industries Federation South Africa and the National Development Fund there were regular annual meetings of the Heads of Departments that offered construction-related programs. Recognizing the two-tiered higher education sector in South Africa, there were separate meetings for universities and the former technikons. In the more recent past, the Chartered Institute of Building - Africa initially convened annual educators' forums that did not quite fulfill the same function as the previous forums. However, during 2005 the very first meeting of University Heads of Departments drawn from all higher education institutions in South Africa met for the very first time since the re-landscaping of the sector in the same venue to discuss matters affecting construction, and particularly construction education in the country. This meeting was repeated in 2006 where the need was expressed for the establishment of a formal forum / association of universities to engage in discussion / debate / collaboration / promotion of matters of mutual interest.

## Broad Aims

ASOCSA aims to be the professional association for the development and advancement of construction education in Southern Africa, where the sharing of ideas and knowledge inspires, guides and promotes excellence in curriculums, teaching, research and service. To achieve this aim ASOCSA is partnering with the construction industry to find ways to effectively represent the interests of both construction academic and industry practitioners. ASOCSA will offer a variety of programs and services designed to help its members serve their customers more effectively and succeed in an increasingly challenging environment of construction information management and technology. To this end ASOCSA provides a forum for the debate and discussion of issues of mutual interest to all industry stakeholders. For example, one of the tasks of ASOCSA will be supporting the development of curriculums that address the needs of the construction sector in the Southern African region. ASOCSA convenes an annual conference that is one of only two construction-related conferences accredited by the Department of Higher Education and Training (DHET) where construction academics and practitioners can interact relative to practical experience and the findings of relevant research. This conference series is endorsed and underwritten by the International Council for Research and Innovation in Building and Construction (CIB) as well as several major industry stakeholders.

The Journal of Construction which is accredited by the Department of Higher Education presently published electronically four times per year is the official journal of ASOCSA and in the past more than 5,000 complimentary copies were distributed to all industry stakeholders in the Southern African region. The production and distribution of practice notes and technical papers is a further endeavor to grow the partnership between academia and industry.

With respect to the Southern African region, ASOCSA is committed to the following:

### Vision

To drive innovative construction related higher education

### Mission Statement

To promote, facilitate, develop and monitor the relevance and quality of construction related curricula, research and graduates in conjunction with higher education institutions, industry and government.

### Strategic objectives

The objectives of the Association are:

- to promote and facilitate the development of curricula for construction related programmes
- to assist with the accreditation of construction related programmes
- to hold an annual conference that acts as a forum for multi-disciplinary interaction between academics and practitioners
- to publish an accredited research-based journal and contribute to the built environment body of knowledge (BEBOK)
- to disseminate information dealing with construction education and related matters
- to develop and maintain closer links with industry and government
- to represent the collective views of its members
- to liaise with other organisations and persons to promote the interests of its members
- to promote and support relevant postgraduate research
- to provide bursaries to postgraduate students in accordance with set criteria

ASOCSA continues to seek opportunities to promote both academic and industry employment opportunities. Finally, ASOCSA intends to play a significant role in the accreditation of construction-related academic programs.

#### **Heads Forum meetings**

ASOCSA believes that meetings of the Heads Forum comprising of Heads of School and Departments of Construction is a vital component of its functions and holds Heads meetings during each conference. It is still the aim of ASOCSA to bi-annual Heads meetings.

#### **International Affiliation**

ASOCSA has commenced discussions about closer collaboration with similar institutions such as the Associated Schools of Construction (ASC) in the United States, the Royal Institute of Chartered Surveyors (RICS), the Chartered Institute of Building (CIOB), Australian Institute of Building (AIB) and Council of the Heads of the Built Environment (CHOBE) in the United Kingdom. ASOCSA has entered into a Memorandum of Understanding with the International Council for Research and Innovation In Building and Construction (CIB).

In summary, benefits of membership of ASOCSA which are self-evident include participation in meetings of the Heads Forum throughout the region, access to the Journal of Construction, reduced rates at all ASOCSA, MBA and CIB events, involvement at regional level with industry-academia forums, interaction and networking opportunities relative to, for example, collaborative research, curriculum development, external moderation of courses, and external examination

#### **ASSOCIATION OF SCHOOLS OF CONSTRUCTION OF SOUTHERN AFRICA**

##### **Office bearers**

President	Dr Hendrik Prinsloo	University of Pretoria
Vice-president	Victor Smith	Masterbuilders KwaZulu-Natal
Immediate Past President	Ferdinand Fester	Durban University of Technology

##### **Council Members**

Prof. Kahilu Shakantu	University of the Free State
Ephraim Zulu	Copperbelt University – Zambia
Ferdinand Fester	Durban University of Technology
Prof. Theo Haupt	University of Kwa-Zulu Natal
Victor Smith	Masterbuilders KwaZulu-Natal
Breda Strasheim	Stellenbosch University

##### **Journal of Construction Editorial Committee**

Editor:	Dr. Nishani Harinarain – University of KwaZulu-Natal
Associate Editor:	Dr. Justus Agumba – Durban University of Technology
Assistant Editor:	Prof Ayman Othman - The British University in Egypt

##### **Chair of Heads Forum**

Prof Kahilu-Shakantu	University of the Free State
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For more information on ASOCSA and its activities visit [www.asocsa.org](http://www.asocsa.org)



27 July 2018

Dear Author

**PEER REVIEW PROCESS: 12<sup>TH</sup> BUILT ENVIRONMENT CONFERENCE: DURBAN, SOUTH AFRICA 2018**

I confirm that the following peer review process was strictly followed relative to this conference.

In order to maintain and ensure the highest quality in the conference proceedings and comply with the requirements for subsidy of the South African Department of Higher Education and Training (DHET), a rigorous two-stage system of peer review by no less than two acknowledged experts in the field has been followed. In terms of this process, each abstract received was twice blind reviewed in terms of:

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Dr. O.O. Ugwu, University of Nigeria, Nigeria  
Dr. Geraldine Kikwasi, Ardhi University, Tanzania

Regards

A handwritten signature in cursive script, appearing to read "H. Prinsloo".

Dr Hendrik Prinsloo(ASOCSA President)

A handwritten signature in cursive script, appearing to read "F. Lombardo".

Ferial Lombardo (ASOCSA Conference Organizer)

## Presidential Report 2018

ASOCSA, in conjunction with higher education institutions, industry and government have made major strides to ensure the youth of our country has access to quality construction related education to prepare the future leaders of one of South Africa's most important industries.

A casing point is last year's Conference. The success of this Conference can not only be attributed to the 62 research papers presented (more than any of the previous conferences) and the large number of participants, but more importantly the strides that were made to set in motion a common industry goal to #MakeConstructionGreatAgain.

During the past year ASOCSA's Journal of Construction once again delivered high impact research papers with a strong industry focus.

I want to express my sincere gratuity to all involved, who has made the Journal of Construction one of the most distinguished and popular academic publications in the construction industry during the past decade. May the next decade also be filled with accomplishments and may the Journal continue to serve the industry as platform for quality industry focussed research.

One of our objectives for the year was also to growth ASOCSA not only locally but also internally. Closer links were established with the Associated Schools of Construction in the United States and we are hoping to partner to host and international conference in South Africa in the near future. Talks also started to collaborate on students competitions in the future.

A MOU was also signed with the Association of Researchers in Construction Management – ARCOM. ARCOM is based in the UK and aims to bring together all those interested in construction management research. The MOU will afford ASOCSA members the opportunity collaborate on international research projects and will provide members access to a vast amount of research resources.

One of the challenges that many of our academic members face is to source qualified staff with the required background and levels of expertise to pursue academic careers. We are launching an exciting initiative to support HOD's with this difficult task.

All ASOCSA members can now advertise their vacant positions on the ASOCSA website. This service will be provided free of charge until the end of the year and will provide a platform to increase the number of qualified candidates to apply to be part of your institution.

During the year members of the executive convinced a number of institutions to join our ASOCSA as new members or to reinstate their membership.

The discussions with professional bodies to streamline the accreditation of universities will be initiated in the near future.

It is indeed sad that my open door and the path that I have chosen requires me to give up the opportunity to serve as president of such a significant organization after only a year but I have no doubt with so many capable and dedicated people ASOCSA will continue to grow and make the world a better place.

I am handing over the leadership baton to my vice president Victor Smith of the MBA Kwazulu Natal. He is an extremely capable person with all the required skill to lead ASOCSA to build on our past successes and to even further improve our value proposition for all our valuable members.

I want to thank my colleagues for the tremendous opportunity I had to be part of such a capable team.

Thank you for allowing me the opportunity to talk to you, I wish you all of the best for the conference and the future.

Dr Hendrik Prinsloo

ASOCSA President

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# **The impact of Government-driven initiatives for the success of Small Medium Enterprises (SMEs) in KwaZulu–Natal, South Africa**

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## **ABSTRACT AND KEYWORDS**

### **Purpose of this paper**

The study aims to investigate the role played by construction SMEs in improving the economy of the country. Moreover, the study seeks to establish whether government initiatives targeted at construction SMEs have an impact on the effective performance of construction SMEs and whether they have achieved their intended outcomes in KwaZulu-Natal, South Africa.

### **Design/methodology/approach**

A quantitative research approach was used using a cross sectional questionnaire survey to collect the data. The targeted respondents were construction SMEs and Government officials. The total of 101 questionnaires were returned and analysed using the Statistical Package for the Social Sciences (SPSS) 25. This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number HSS/0860/017M)

### **Findings**

The results from SPSS showed that finance is significantly correlated with health and safety and human resources since construction SMEs require finance to monitor and implement health and safety and human resource is required to finance expenditure. The research findings further showed that, even though Government provides initiatives they do not have an impact on the performance of construction SMEs because they are not fully utilised.

### **Research limitations/implications**

The study was conducted in South Africa but due to financial constraints the study only focused on Small Medium Enterprises in Kwa-Zulu Natal that were currently active with CIDB in grades between 2 and 5.

### **Practical implications**

Suggestions are made for future research that include; whether construction SMEs are doing enough to be sustainable and why construction SMEs are failing regardless of the initiatives introduced by Government

### **Response to the conference theme**

The paper seeks to understand the role played by construction SMEs for economic development and the impact Government initiatives have in the sustainability of construction SMEs.

**Keywords: Government initiatives, Construction SMEs, Growth, Sustainability**

## **1 INTRODUCTION**

According to FinMark Trust (2015), Fatoki (2014), Cant and Wiid (2013); Kongolo (2010) and Olawale & Garwe, (2010) SME's are expected to play a pivotal role in creating employment, poverty improvement, economic growth and a balanced society in developing countries. The development of small medium enterprises (SME's) will result in improvements in the economies of nations (Peprah, Mensah and Akosah, 2016; Kongolo, 2010). In 1996, the South African Parliament promulgated the National Small Business Act (102 of 1996) that was to promote and protect the interests of SME's (Parliament Liaison Office, 2014; Underhill Corporate Solutions, 2011). Moreover, the South African government introduced a new Ministry of Small Business Development, which was established in 2014 specifically targeted at assisting the small business sector (SEDA, 2016 and Parliamentary Liaison Office, 2014).

Governments have tended to develop special initiatives to support SME's in developing countries (GEM, 2014; Fatoki and Garwe, 2010 and

White Paper, 1995). Even though, the South African government had introduced these various initiatives, the Parliament Liaison Office (2014) argues that current government programmes are complex and not easy to navigate. Arguably, the creation of the Department of Small Business will further complicate the development strategy by making it difficult for SME's to know where to turn for support. In South Africa, these initiatives are specifically targeted at promoting the attractiveness, growth and sustainability of the SME sector and to act as the strategic framework to create employment, poverty alleviation and economic growth (GEM, 2014; Fatoki and Garwe, 2010 and White Paper, 1995).

According to Vilakazi (2016); GEM (2012) and Underhill Corporate Solutions (2011) most of the SME's are not aware of government initiatives. Chimucheka and Mandipaka reported differently stating that most of the SME's are aware of these initiatives, but the support given is inadequate. However, despite the availability and introduction of these policies, programmes and strategies that are meant to develop SME's, not all SME's have realized their full potential by growing economically and creating jobs and are still challenged with numerous challenges that obstruct them from realizing their intended outcomes.

## **2 LITERATURE REVIEW**

### **2.1 Challenges facing construction SME's**

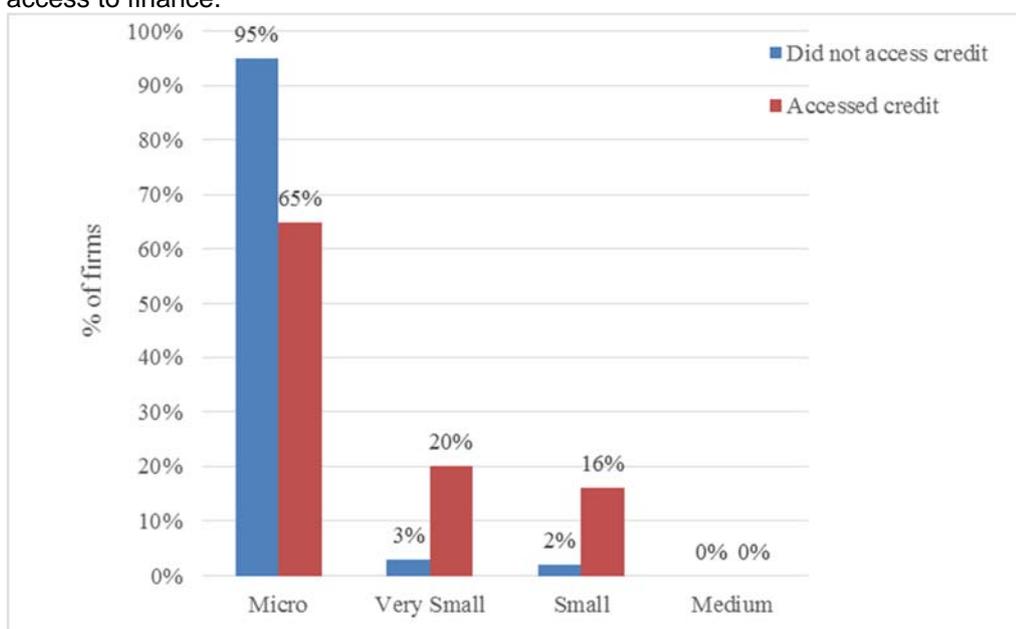
Olawale and Garwe (2010); Agwu and Emeti (2014); Thwala and Phaladi (2009); Katua (2014); Kongolo (2010); Ogbo and Mwachukwu (2012); Chittithaworn, Islam, Keawchana, and Dayang (2010); CIDB (2011), confirmed that SME's are faced with several challenges that affect their growth, contribution to the economic development and sustainability. Despite the government focus in supporting the SME's and their contribution on creating employment and promoting growth (Agwu and Emeti, 2014; Cant, 2014 and Maloka, 2013). SME's are constrained by numerous challenges that hinder their development and contribution in to the economic development such as lack of access to finance, poor management skills, insufficient resources, failure to understand the sector, cannot price competitively, crime and corruption and late payments by clients (SEDA, 2015; Agwu and Emeti and 2014; Maloka, 2013).

#### **2.1.1 Access to finance**

SME's require finance for start-ups and sustainable growth (Olawale and Garwe, 2010). The poor accessibility of funds and communication affects the growth and development of SME's (Agwu and Emeti, 2014; Olawale and Garwe, 2010). Lack of financial support on SME's is the second most reported contributor of SME failure in South Africa (Olawale and Garwe, 2010). FinMark Trust (2015) finds that approximately 87% of South African

registered SME's have never received funding, and 93% of all SME's have never had access to funding. Furthermore, FinMark Trust through their analysis proves the lack of financial support on SME's categorised as micro, very small, small and medium, Figure 2.3 illustrates the accessibility of credit, the rate of firms that did not access credit are micro at 95%, very small with 3% and small with 2%, while medium shows 0% for both accessing and not accessing credit. In terms of those that have accessed credit.

New SME's can also access finance from their own wealth, friends, family and private firms (Olawale and Garwe, 2010). The majority of SME's are unable to access finance as they represent high risk, inadequate assets, suffer from low capitalisation, lack of adequate guarantee and credit information (SEFA, 2015; Agwu and Emeti, 2014 and Maloka, 2013). Moreover, lack of business information and management skills that leads to poor accessibility of credit and without finance SME's will fail (Fatoki, 2012). Olawale and Smit (2010), noted that SME owners need to take full responsibility for their own learning and personal development especially in financial management skills. According to Dalberg (2011) access to financial support do not only helps the start-ups, growth, success and sustainability of firms and risk reduction, but also promotes revolution and entrepreneurial activity. Furthermore, firms with greater access to finance are more able to grow and perform better when compared to SME's without access to finance.



**Figure2.1: Access to credit by SME's** (Source: FinMark Trust, 2015)

### **2.1.2 Lack of management skills**

Management is frequently defined as the alignment and management of numerous activities in a business to accomplish the goals and objectives of the business (Wiese, 2014). Lack of management skills and inadequate skilled labour are some of the challenges that affect SME's growth in developing countries (Motsetse, 2015; Agwu and Emeti, 2014 and Olawale and Garwe, 2010). Olawale and Garwe (2010) further emphasised that Managerial skills are very crucial to the survival and growth of new SMEs. CIDB (2016), Agwu and Emeti (2014), CIDB (2012), Ogbo and Nwachukwu, (2012), DTI (2008) reckons that a proper management skill is vital for SME's performance, sustainability and growth. Managing SME's successfully consumes an excessive time and effort, the owners of the new firms manage their business to reduce cost, this course business failure as they lack management skills (Motsetse, 2015). The management skills can be broken down as follows: time management, human resource management, cost management, quality management, health and safety management, management of site conditions and management of subcontractors including payment (CIDB, 2012 and Mensah and Benedict, 2010).

Emuze (2011) agrees that complying with this management aspect will lead to successful projects as they are linked to each other, for example quality failure may lead to time and cost complications.

#### **2.1.2.1 Time management**

Time management is regarded as an ability to determine the duration each activity and when each activity should be completed to create space in critical activities and not cause delays in delivery (Mensah and Benedict, 2010). SME's need to achieve a proper time management they need to execute the proper strategic planning on their activities (Agwu and Emeti, 2014).

#### **2.1.2.2 Human resource management**

According to Emuze (2011) based on the information they obtained from respondents survey the following non-value adding activities related to human resource contribute significantly to poor project performance in South African construction industry: lack of required competencies, inadequate supervision, human error / mistake, ignorance, strikes, low employee morale, idleness on site and Unnecessary work. Department of human settlement (2015) states that the human resource management in the public sector is governed by the following acts to perform significantly, The Public Service Act and Regulations, The Labour Relations Act, The

Skills Development Act, The Skills Development Levies Act, The Employment Equity Act.

### **2.1.2.3 Cash flow management**

The Canadian Construction Association (1996), describes cash flow as the money coming in the company and going out the company. According to Motsetse (2015), for a business successful a qualified accountant must be employed to manage the cash flow of the company and all other financial cost. Accordingly, Canadian Construction Association (1996) and Aren and Sibindi (2014), stated that a good cash flow management is crucial for a stable growth and sustainability of every business and failure to manage cash flow can result in affecting the company reputation and bankruptcy.

### **2.1.2.4 Quality management**

Quality is one of the most important parameters of project performance (Emuze, 2011). The government is encouraging firms to adhere to quality assurance and be accredited to ISO 9000 as well as other standards (Zindiye, Chiliya and Masocha, 2012). Meeting these standards will enable SME's to offer quality products to both international and local markets (Ibid). According to CIDB (2011c) there are several challenges that hinder the successful achievement of quality. Corruption is regarded as the major barrier in achieving construction quality in South Africa (Ibid).

The result of poor quality management is evidenced in the construction of low cost housing whereby they have been poorly constructed and resulting in structural defects, in which during the evaluation it will be costly to renovate or reconstruct (CIDB, 2011c)

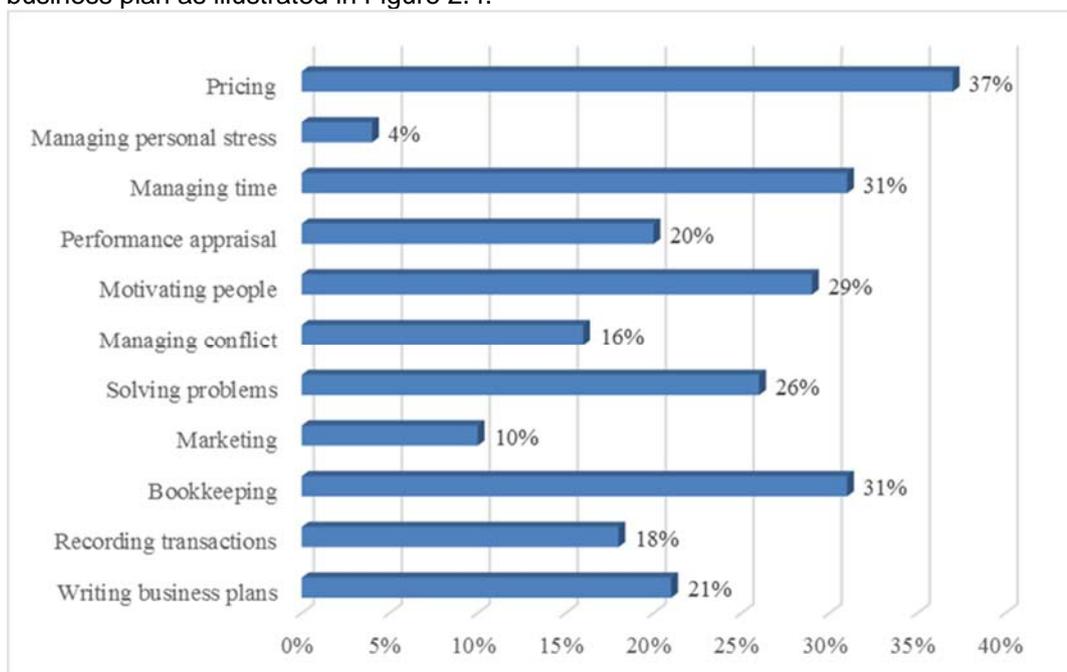
### **2.1.2.5 Health and safety and environmental management**

Department of human settlement (2015) states that when complying with requirements of the Occupational, Health and Safety (OHS) Act (Act No. 85 of 1993) it reduces the risk on employees from being harmed and illness at work and creates a safe working place. Furthermore, the compliance with OHS (Act No. 85 of 1993) is to continue a safe working environment for the employees, conducting monthly OHS inspections, identifying and reducing risks (Ibid).

### **2.1.2.6 Management of subcontractors**

According to Cant (2012) and Scheers (2010) based on the information they obtained from respondents survey on the challenges faced by SME's in managerial skills, 37% had problems establishing competitive prices, 31% had problems on recording business transactions, 31% were unable to write a performance appraisal, 29% experienced marketing problems, 26% had difficulty managing conflict in the workplace, 18% had problems

with time management, 16% experienced problems solving problems, 21% could not managed personal stress, 20% experienced problems with book keeping, 10% had problems motivating people; and 4% could not write a business plan as illustrated in Figure 2.4.



**Figure 2. 1: Managerial skill** (Source: Cant, 2012 and Scheers, 2010)

According to NDP (2030), CIDB Annual Report (2011/12) Infrastructure is vital for the development of faster economic growth and higher employment, and both public and private sectors can play important roles in building infrastructure. CIDB Annual Report (2011/12) is concerned about the shortage of skilled labour as the result contractors struggle to complete projects timeously and successfully, which then impacts on their profit as well as quality of the work done. Cant (2012) pointed out that managerial skills and business knowledge are a significant indication of SME's performance to tasks and activities related to business.

### 2.1.3 Insufficient resources

Resources is anything that a business owner need and use to pursue a business opportunity, for example resources can be money that is invested in the business, the people who contribute their efforts, knowledge and skills and the physical assets (Chimucheka, 2013). These resources can be divided into four categories, namely human resources, information

resources, physical resources and financial resources and are discussed below (Ibid).

### **2.1.3.1 Human resources**

A firm will not exist without productive human resource and it is the owner's responsibility to recruit and manage labour and other resources within the firm, moreover human resource includes all people and their efforts, skills, knowledge and insights that they contribute to the overall performance of the business venture. (Chimucheka, 2013 and Mahadea and Pillay, 2008). To develop their human resource efforts, entrepreneurs also need to arrange for training and education to employees, there is also a need to motivate employees to encourage high performance (Chimucheka, 2013 and Emuze, 2011).

### **2.1.3.2 Financial resources**

Finance is a primary requirement for SME's financial resources are very vital in any business and to any business owner or operator (Chimucheka, 2013). Lack of suitable financial resources places major constraints on SME development (Ibid). Entrepreneurs need to determine the nature of financial resource needs and investigate proper means to obtain the necessary financial resources (Ibid). Different sources of financial resources exist, but they can simply be classified into two broad categories, which are debt and equity (Ibid). Financial resources need to be carefully managed, because poorly managed cash flow has been acknowledged as one of the key causes of SME contractor's failure (Ibid).

### **2.1.3.3 Physical resources**

They include physical assets such as buildings and equipment. Physical resources also include raw materials that could be used to create the products and services of a business (Ibid).

### **2.1.3.4 Information resources**

Both internal and external information resources are very significant to contractors for they will allow them to develop well knowledgeable plans to fight competition as well as to advance performance of their ventures (Ibid).

## **2.1.4 Failure to understand the sector**

For SME's to be successful they need to understand the market dynamics, test and understand environmental changes, mainly the extent of current and future competition and this will preserve their firm's growth, sustainability and performance (Chimucheka, 2013 and CIDB, 2011b)

### **2.1.5 Uncompetitive pricing**

According to Motsetse (2015) the building rates are increasing annually, and the growth of the construction industry depends on the steadiness in material prices. However, regardless of the increasing of material prices, Chadhliwa (2015) stated that contractors are still using low rates when tendering in order to submit a winning tender. Chadhliwa (2015), further stated that that low rates affect the growth of SME contractors.

### **2.1.6 Crime and Corruption**

According to Olawale and Garwe (2010) and DTI (2008) crime and corruption are major factors that prevent business growth in South Africa. GEM (2011) argues that the growing rate of unemployment, service delivery protests and mounting concerns about corruption, crime and governance are the result of the country's economic, social and political challenges that are increasing daily.

This high rate of crime and its effect to business is growing, causing SME's to focus on ways to overcome crime, rather than focusing on growing their businesses and be ahead of their opponents (Olawale and Garwe, 2010). OECD (2015) further stated that high crime is forcing firms to increase their security, and it has been reported that the employment for private sector security has been increased by approximately 400 000 guards that is twice the size of the police force. Over the last decade, the number of business robberies has increased by a factor of 4.5 as well as the rate of corruption at the government level have grown (OECD, 2015).

The construction industry is regarded as one of the most corrupt industry in developed and developing countries, it was categorised as the sector in which bribery of public officials was the most common and it is still growing significantly worldwide (CIDB, 2011c). The construction industry is followed by real estate and property development according to Bribe Payers Index (BPI) (Ibid). The Contractors can do anything to gain higher cidb grades including submitting fake records in support of their registrations and pay off of cidb employees (Ibid).

### **2.1.7 Late payments by Clients**

The delay in receiving monthly and final payments from Clients creates major problems for emerging contractors and economy (Motsetse, 2015). The late payment by Clients, especially from government have led most of the emerging contractors to liquidation even thou they performed significantly, do the work according to the standards and of high quality (Ibid). Therefore, the emerging contractors ends up having cash flow problems, owing the bank and defaulting, especially those that do not have

means to sustain the drain of their cash flow (Ntuli and Allopi, 2013 and Motsetse, 2015).

According to Department of Public Works strategic planning (2015 – 2020) late payments to emerging contractors is regarded as one of the key challenges because it does not only affect the contractors but also service delivery is delayed as well as economic growth.

## **2.2 The effectiveness of government initiatives in construction sector**

According to CIDB (2015) the South African construction SME's play a pivotal role in the economic growth and employment creation. Since 2008, the South African construction sector has contributed approximately 9% in to the formal and informal employment as well as the GDP (Ibid). According to Ranjit, Mwanaumo and Nkado (2011) quoted by Wentzel, Wentzel, Smallwood and Emuze (2014), the South African construction industry is still in a process of improvement. This is based on fact that the construction SME's still needs assistance in terms of training and business advice, monitoring and counselling (Wentzel, Wentzel, Smallwood and Emuze, 2014).

There are several initiatives in South Africa specifically targeted at promoting the attractiveness, growth and sustainability of the construction SME's. However, South African emerging contractors are faced with various challenges. The SA government introduced these initiatives to offer different products intended at supporting the small business sector in terms of training, skill development, access to finance, reduce late payments by clients, access to job opportunities and assist with managing cash flows to sustain their enterprises.

Though the government initiatives impact emerging contractors differently as they are in different stages of grading (CIDB, 2011b). SBP Alert (2009), argues that the impacts and accomplishments of the government's programmes have not met their full potential. For the past fifteen years the government has invested in countless programmes aimed at supporting and developing the SME sector in different categories (ibid). Despite this, South Africa is still behind other evolving countries in promoting the growth and sustainability of small businesses (ibid). SBP Alert report reckons that for government initiatives to have an effective impact, the joined-up approach is required.

## **3 RESEARCH METHODOLOGY**

### **3.1 Sampling Procedure**

A quantitative research approach was used using a cross sectional questionnaire survey to collect the data and non-probability sampling technique. A total of 201 questionnaires were distributed to active civil

engineering (CE) and general building (GB) SME contractors with grades between 2 to 5 in KwaZulu-Natal selected from CIDB construction register database. The total number of 96 questionnaires were returned, representing 48% of the total that were distributed. Moreover 10 questionnaires were distributed to four government entities and five were returned, representing 50% of the total that was distributed. The data was analysed using the Statistical Package for the Social Sciences (SPSS) 25.

### **3.2 Interpretation of measurement scales**

The scales of this study were developed such that scale intervals are uniform. The four-item scale used was adapted from Fellows and Liu (1997) and minor changes were done to fit the context of this study. The instrument was measured on a 4-point Likert scale where 1 = No impact, 2 = Low impact, 3 = Moderate impact and 4 = Major impact. The group interval coefficient value was calculated as  $(4 - 1) / 4 = 0.75$  and Table 5.3 illustrates further the intervals that were taken as reference values in evaluating and interpreting the responses obtained from the 4-point scale.

### **3.3 Response rate**

The number of completed questionnaires obtained were 96 out of 201 sent out via emails representing an overall response rate of 48% from contractors while three were received from government entities. Given the time and financial constraints the response was acceptable, and no further attempts were made to increase the number of responses.

## **4 SURVEY RESULTS AND DATA ANALYSIS**

### **4.1 Demographic Information of Respondents**

Table 1 shows the profile reports on the information about the respondent and the enterprise profile. The information includes; respondent's position in the company, gender, race, education, discipline, CIDB grading, CIDB classification, number of years worked in the current company and number of full time employees employed in the current company including the employer.

It is evident that 51.0% of the sample own their own businesses; 54.2% were male; 93.7% were Black; 43.5% had obtained at least various Certificates; 25.9% were construction managers; 22.4% were civil engineers; 60.2% were in CIDB Grades 2 and 3 as either GB or CE; 95.8% had at least 10 years' experience and 67.0% employed between 1 and 5 employees.

Table 1: Respondents Information

Description	Frequency	Percent (%)
<b>Respondents position</b>		
Owner	49	51.0
Contracts Manager	9	9.4
Project Manager	19	19.8
Site Manager	14	14.6
<b>Gender</b>		
Male	52	54.2
Female	44	45.8
<b>Race</b>		
Black	89	93.7
Coloured	3	3.2
Indian/Asian	2	2.1
White	1	1.1
<b>Education</b>		
Master's degree	2	2.2
Honours/BTech/BSc	18	19.6
Certificate	40	43.5
Matric	24	26.1
No qualification	8	8.7
<b>Discipline</b>		
Construction Management	22	25.9

Civil Engineering	19	22.4
Finance	3	3.5
Quantity Surveying	4	4.7
Education	11	12.9
Project Management	16	18.8
Other	10	11.8
<b>CIDB Grading</b>		
Grade 2	37	39.8
Grade 3	19	20.4
Grade 4	21	22.6
Grade 5	16	17.2
<b>CIDB Classification</b>		
GB	41	43.6
CE	39	41.5
Both	14	14.9
<b>Number of years in the current company</b>		
1 – 5 years	40	42.6
6 – 10 years	50	53.2
10 – 20 years	4	4.3
<b>Number of full time employees</b>		
1 – 5 employees	59	67.0
6 – 10 employees	19	21.6
10 – 20 employees	10	11.4

## 4.2 Reliability and Validity of Measurement Instrument

The measurement instrument for the constructs researched is shown in Table 2. The instrument used principal component analysis and Equamax with Kaiser Normalization rotation and eigenvalues greater than 1. The Kaiser- Meyer-Oklin (KMO) measure of sampling adequacy was 0.689. The analysis produced various groups of factors with some of the items cross loading, therefore, when factor loadings were less than 0.5 or cross loading they were suppressed. The factor loadings per measurement item are fairly strong and displayed in Table 2.

After factor analysis, the resultant constructs were analysed for reliability testing (Cronbach alpha, corrected item to total and CR values), validity checks (AVE values) as shown in Table 2. The coefficient of alpha and composite reliability values was used to establish the level of internal consistency. The Cronbach alpha reliability co-efficient for all scaled constructs was  $> 0.7$  and corrected item to total correlation  $> 0.5$  which means all constructs meet the minimum criteria of acceptability as recommended by Byrne (2006) cited by Mhlophe and Chinomona (2015).

All the constructs had a CR value that was  $>$  than the recommended 0.7, with quality management related challenges  $< 0.7$ . All but one Average Variance Extracted (AVE) were  $>$  than the recommended 0.5 with one construct with 0.341.

Table 2: Measurement Instrument Analysis

Research Constructs	Research Items Used	Cronbach's Test		CR Value	AVE Value	Factor Loadings
		Corrected item – total	$\alpha$ Value			
FRC	FRC4	0.617	0.924	0.948	0.754	0.775
	FRC5	0.655				0.744
	FRC6	0.710				0.924
	FRC7	0.782				0.931
	FRC8	0.760				0.898
	FRC9	0.757				0.919
	HRM4	0.773				0.630
	HRM6	0.833				0.760

HRM	HRM7	0.801	0.920	0.863	0.515	0.733
	HRM9	0.787				0.763
	HRM10	0.609				0.606
	HRM11	0.591				0.793
HSAF	HSAF1	0.676	0.886	0.884	0.565	0.873
	HSAF2	0.550				0.799
	HSAF3	0.633				0.835
	HSAF4	0.714				0.782
	HSAF6	0.728				0.570
	HSAF7	0.737				0.597
QMRC	QMRC2	0.776	0.925	0.672	0.341	0.669
	QMRC3	0.869				0.556
	QMRC4	0.835				0.596
	QMRC8	0.903				0.503

The discriminant validity of all constructs was assessed with correlation analysis with the correlations shown in Table 3. The relationship between the financial, human resource management, health and safety and quality management were investigated using Spearman correlation coefficients.

**Table 3: Correlations between constructs**

Research Constructs	FRC	HRM	HSAF	QMRC
Financial related challenges (FRC)	1.000			
Human resource management related challenges (HRM)	0.384**	1.000		
Health and Safety related challenges (HSAF)	0.223*	0.563**	1.000	
Quality Management related challenges (QMRC)	0.078	0.414**	0.428**	1

The results further showed that all inter-construct correlations ranged from 0.078 to 0.563 which represents a positive correlation and they are all < 0.80 indicating a good discriminant validity because there are no constructs that are strongly correlated. Therefore, each construct represents a different concept. FRC is significantly correlated with HSAF and HRM since construction SMEs require finance to monitor and implement health and safety and human resource is required to monitor expenditure. Moreover, HRM is significantly correlated with HSAF and QMRC as it is evident that human resource management is required to monitor and drive health and safety and quality management.

## 5 RESEARCH NORMALITY TEST ANALYSIS

After assessing the instrument to show that it is reliable and valid, relationships among the constructs were tested. The normality test was performed to assess whether the bivariate relationship needed to be assessed with parametric or non-parametric tests. Table 4 represents the results of the Shapiro-Wilk normality test and indicates that scales for constructs were ( $p=0.005$ ) for FRC and ( $p=0.00$ ) for HRM, HSAF and QMRC implying that the data are significantly different from a normal distribution, since ( $p<0.05$ ) does not follow a normal distribution. Since all constructs are non-normally distributed, non-parametric tests were performed.

**Table 4: Tests of Normality**

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FRC	0.166	78	0.000	0.952	78	0.005
HRM	0.195	78	0.000	0.921	78	0.000
HSAF	0.195	78	0.000	0.921	78	0.000
QMRC	0.155	78	0.000	0.928	78	0.000

## 6 CONCLUSIONS

From the findings of the study, it can be concluded that construction SMEs play the pivotal role in terms of economic development and employment creation; and they can still provide more permanent work. It can further be concluded that government has introduced several initiatives that have a little impact in the development of the construction SMEs and they are not easily accessible and advertised, therefore they are not utilised efficiently

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# Assessing the Impact of Leadership and Managerial Skills in Developing a Sustainable Construction Business: SMMES Perspectives

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## ABSTRACT AND KEYWORDS

### Purpose:

The study aims to assess how leadership skills impact on the development and management of sustainable organisations among SMME contractors.

### Design:

The research design is a qualitative approach with an in-depth interviewing method on the impact of leadership skills among 34 surviving (beyond the first five years) SMME contractors in Port Elizabeth, South Africa.

### Research Limitation/Implications:

The findings of this study should be adopted with caution, as the study is based on a small sample in the context of the South African construction market.

### Findings:

The research findings show that the key leadership abilities that foster economic sustainability of SMME contractors in the construction industry are: the ability to form competent project teams; having an exceptional business skill, talented and competent staff; ability to resolve disputes within the project team, and with clients amicably. The study further revealed that personality and organisational attributes such as strategic thinking and strong personality; having dynamic and functional business

structure; transformational leadership quality; people driven and transparency positively contributed to SMME contractors' competitiveness in the industry.

**Practical Implications:**

The study provided insightful and required leadership skills for developing and managing a construction business.

**Conference Theme:**

SME Contractor Development

**Keywords:**

**Leadership skills, SMME contractors, Sustainability, South Africa**

## 1. INTRODUCTION

According to Burns (2016), for the economic sustainability of any organisation, the owner must be able to continuously adapt to the trend of changes, develop strong managerial competence and become innovative business leader. Werner (2012) states that successful business leaders are those who initiate change, strategies and pursue development and long-term vision, inspire and empower people, and connect with their followers. Business leadership and strategies involve the communication of clear vision, specific direction, build and lead strong team, and constantly innovate to gain and to sustain competitive advantage (Morse and Babcock, 2010). Johnson et al. (2011) believed that leadership is a strategic and intellectual prowess that influences an organisation, project team(s), and individuals within an organisation towards achieving their desired results. Therefore, the business owner's personal cognitive abilities, strategic motive, social skills, expertise knowledge and problem-solving capabilities are important factors that influence the business growth trajectory (Burns, 2016).

Thus, the concept of leadership and management depicts complementary business skills and competencies. This concept presents the nexus of success factors of many organisations, both the large and small firms as, Werner (2012) affirmed that leadership and management are intertwined. Burns (2016) claimed that business owners as leaders in their firms ought to be strategic thinkers and effective communicator with well-developed business's vision, strategy, and culture that would foster effective managing, monitoring and controlling organisational activities and performance. In other words, Werner (2012) posits that organisations (such as the SMMEs contractors) must have leadership and managerial skills as the only viable means to establish a sustainable business organisation. Therefore, the business (owner) leader should have capability to manage

whilst the organisation's managers must have capability to lead business activities and processes successfully (Werner, 2012).

### **1.1 Internal Factors that Influence Business Failure among SMMEs**

Burns (2016) claimed that personal characteristics (internal factors) that trigger business failure among SMMEs are delusional behaviour (excessive optimism over one's business competence), resistance to seek professional advice, limited formal education and financial business literacy, and excessive control behaviour, and over emotional reactions on business decision. According to Johnson *et al.* (2011) successful strategic leaders have impeccable capability of discerning situations such as change, challenges and opportunities; and innovatively take advantage of circumstances. The business owners are the leaders of their organisations, and should have capability of initiating and managing changes through creation of added value (into their new services and products) and a cultural system that support emerging changes within the market (Johnson, Whittington & Scholes, 2011). According to Burns (2016) lack of managerial capabilities such as the capability to create a robust business structure and delegate human resources appropriately has caused most of firms' failure among the SMMEs. Also, inadequate managerial competence such as poor financial control, poor business planning and marketing strategies; and personal and company insolvency were the contributing factors of business failure (Burns 2016; and Johnson *et al.*, 2011).

According to Morse and Babcock (2010) leadership is a critical part of an organisational management functions. Hellriegel, Jackson, Slocum, Staude, Amos, Klopper, Louw and Oosthuizen (2011) posit that that traditional concept of management involves the process of performing organisation's tasks and activities through planning, organising, leading, motivating, and controlling strategic resources and assets. Burns, (2016) states that the start-ups and SMMEs need a balance between their leadership and management skills as these competencies are indispensable towards developing and growing a sustainable business. Burns (2016) reiterate that an effective leadership is critical, whilst management skills is of paramount importance to ensure surviving on day-to-day business operations.

### **1.2 Research Question**

What is/are the impacts of leadership and managerial skills among the South African SMME Contractors in the growth of a successful construction organisation?

### **1.3 The Objective of Study**

The study aimed to assess the impact of leadership and managerial skills among the surviving SMME contractors towards developing viable construction business.

## **2. LITERATURE BACKGROUND OF THE STUDY**

### **2.1 Concept of Leadership and Management for Small Businesses**

The concept of leadership and management capacity depict the complementary business skills and competencies that foster successful entrepreneurs. As Morse and Babcock (2014) claimed that leadership is the strategic process of influencing, managing and getting cooperation of others to accomplish a predestined result. Burns (2016) viewed the concept of management as a functional design and structural process such as planning, organising, commanding, coordinating and controlling the complexity of an organisation's activities in logical, efficient and effective manners; whilst leadership deals with the broader strategic principle and philosophy of a business (Burns, 2016). Thus, leadership is a vital force that drives, direct, communicate and motive the whole process of organisational activities (Burns, 2016). On the other hand, the management fosters the implementation of change, preservation and maintenance of authority, and structure to monitor holistic organization activities and resources (Werner, 2012). Therefore, for start-up and SMMEs the need for balance between leadership skills and management competencies is indispensable towards developing and growing a sustainable business; as Burns (2016) states that in an organisational activity, an effective leadership is critical, whilst management skills remains paramount to survive day-to-day business operations.

According to Johnson et al. (2011) strategic and effective business leaders are visionaries who develop empowering strategic goals, motivates, and inspire the sense of direction and purpose, with mutual trust among people and organisations towards achieving their primary objectives. Werner (2012) adds that successful business leaders initiate change, strategies and pursue development and long-term vision, inspire and empower people, and connect with their followers. The business owners have to exhibit both managerial and leadership skills as, it is an essential capability to develop and grow business (Burns, 2016).

### **2.2 Leadership Skills and its Importance on Construction SMME Contractors**

The construction industry role players and leadership have been criticised for not doing enough to improve the sector's working conditions, innovation,

and competitiveness. Skipper and Bell (2006) affirmed that there is a need for drastic improvement in leadership skills within the construction industry, as this approach would enhance the sector's productivity and economic development of given nation. According to Barros (2013), organisations (such as SMME contractors) need to have the leadership ability to influence the behaviour of their workforce through motivation, rewards, team building, delegation and empowerment. Thus, leadership skill would enhance the SMME contractors' ability to both motivate the internal workforce, as well as to generate insights to communicate with diverse project teams for holistic organisational success (Barros, 2013). In addition, Songer, Chinowsky and Butler (2006) reveal that the rapid changes in the business environment (including construction industry) have called for competent leaders and business owners to revive the industry, in order to be competitive. Therefore, SMME contractors need to acquire creative knowledge and leadership skills that would enable them to overcome the present market challenges, and to achieve competitiveness in the industry. Bogus (2006) perceives SMME contractors as potential construction leaders who must master the basic technical knowledge, education, and work experience in a construction business. These skills would empower them to develop their strategic leadership styles, and to effectively overcome and solve the numerous challenges in the construction business (Bogus, 2006).

### **2.3 Leadership Influence in Organisational Strategy**

An organisation's strategy is influenced by its strategic leaders. The strategic leaders are individual(s) or small groups of individuals whose personality, position and reputation allow them to dominate the strategy development and process of an organisation (Johnson *et al.*, 2011). Johnson *et al.* (2011) further explain that an organisational strategy may be seen as a deliberate intention of the leader or business owner (SMME contractor) to advance their business capability and competitiveness through strategies. According to Kates and Galbraith (2007), the business strategy is derived from the organisation's leadership perspective. Its understanding of external factors (competitors, suppliers, customers and emerging technologies) and organisation's internal strengths (strategic resources), are keys to its (strategy) success. However, one of the important factors to identify a successful organisation is to evaluate its leadership capabilities and how external and internal factors (such as human resources, processes and assets) of the organisations are managed. Internal factors (such as human resources) must be properly managed in any organisation, as such, Megginson, Byrd and Megginson. (2003) highlighted that human and other strategic resources would require a constant cooperation and interaction, in order to achieve success in any given organisation. Megginson *et al.* (2003) further suggest that leadership is one of the basic management functions of a business owner; because it

serves as a means to communicate, motivate, and discipline employees. Thus, the leadership and managerial skills are indispensable for a construction business. Werner (2011) further reported that organisational-change experts have claimed that about 70% to 90% of successful organisational transformation is attributed to leadership and 10% to 30% to the management structure.

#### **2.4 Leadership as a Key Factor for Organisational Competitiveness**

Ofori and Toor (2012) support the transformational leadership perspective is the most suitable for the construction industry's competitiveness, because of its competitive edge to generate higher quality work and to stimulate the creation of tackling and solving real problems within the industry. Butler and Chinowsky (2006) state that it is the responsibility of a competent leader in any organisation to know what type of leadership to employ, depending on the market position. Butler and Chinowsky (2006) further support the coupling of transformational leadership with emotional intelligence, in order to enhance the ability of an organisation to change, harness opportunities, and remain competitive. In this view, Ofori and Toor (2012); and Butler and Chinowsky (2006), assert that the construction industry has a greater need for leadership-driven approach that is capable of managing stress, pressure and challenges associated with the industry; as well as the complex nature of the industry. Indeed, leadership is essential for project development in the construction industry; as Ofori and Toor (2012) further state that the success or failure of projects in the construction organisation is highly dependent on their leadership, and as such the business leaders at all levels create a supportive work environment for the project participants. Ofori and Mui Mui (2012) admonished that business owners (such as SMME contractors) must perceive themselves as business leaders and champions. Also, they should involve themselves actively in an innovative process of construction methods and techniques.

However, Liphadzi, Aigbavboa and Thwala (2014) noted that the need to have a new breed of construction industry leader have been heightened, because the construction leaders such as SMME contractors are responsible for the project service delivery and performance. And there is need for them to be a strong motivator to their project team(s), in order to achieve organisational goals. The SMME contractors and managers who have strong influence on their innovative business processes within their organisations are considered to have substantial leadership competence. Liphadzi *et al.* (2014) added that an effective contractor and project leader should have skills such as the leadership, technical capability, interpersonal competence, management, experience, task oriented, and good employee relationship. These skills are the bedrock for successful business leaders and competitiveness in the construction industry. Werner (2011) concurs

in citing De Vries's work (2005) that effective leadership characteristics are clusters of competencies in three areas: (i) personal competencies (achievement motivation, technical know-how, self-confidence, energy and personal effectiveness); social competencies (influential power, political awareness and empathy); and cognitive competencies (conceptual thinking). Concisely, leadership and innovation skills that could lead an organisation into sustainability and competitiveness rely heavily on the creation of basic knowledge, through education, science and skills training (OECD, 2007).

### 3. RESEARCH METHOD

Research methods are the techniques and principles used in conducting a research, and the body of knowledge that utilises these methods are referred to as the methodology (Kinash, 2008). The selection of research methodology and methods in the discipline of management and social sciences is influenced by the researcher's assumptions about the nature of the social world and his experience on the subject matter (Creswell and Clark, 2007). The two cardinal types of methods of research are basically the qualitative and quantitative methods. Thus, the combination of these two methods in a single research is referred to as the "mixed research method".

Leedy and Ormrod (2010) viewed quantitative research method as an attempt to seek and collect factual data, and to study the relationships between them. The information is usually derived in the form of numbers that can be quantified and summarised. Okorie (2014) argues that in quantitative research, the researcher is a neutral observer of the phenomena in question, maintaining distance or objectivity from the research subject (SMME contractors). According to Marshall and Rossman, (2011); and Sutrisna (2009), qualitative research methods use a naturalist approach to uncover and understand phenomena in their framework of specific settings. Qualitative research is commonly employed in studying complex situations and social phenomena (such as SMME Contractors' leadership skills), particularly, research involving human perceptions, opinions and experiences. Guest, Namey and Mitchell (2013) added that the qualitative research method is inductive and flexible in nature. It provides the researcher with a unique avenue to probe into responses or observations. It also allows for a detailed explanation of leadership experiences, behaviours and beliefs that are fostering sustainable business development among the surviving SMME contractors in the construction industry.

The research method of study is qualitative in nature, and with an in-depth interview rooted in a phenomenological approach. According to Marshall and Rossman (2011), interviews consist of a range of specialised methods such as qualitative interviews often scripted as in-depth

interviews, focus group, ethnographic, phenomenological, life histories, narrative and digital storytelling. Lewis (2009) claims that the key characteristic of in-depth interviews is that it focuses on the participants, in order to elicit the participants' personal perspectives and experiences on the subject matter in a detailed manner. As such, this research sought the understanding of the multi-dimensional leadership nature of the surviving small and medium contractors' phenomenon, relating to business management practices, strategies, beliefs, skills and competences. Thus, this study was conducted with the selected Construction Industry Development Board (CIDB) Registered Contractors that are within grade 4 to 6 in the Port Elizabeth area of the South African construction industry. The individuals interviewed in this study were the Business owners, Managing directors, and Senior managers.

#### 4. DISCUSSION AND FINDINGS

##### 4.1 Contractors Profile: The Cidb Contractors' Grading

The population size of this study is seventy-four (74) as the total number of construction firms in grade 4-6 of the CIDB registrar of contractors and active. Thus, out of seventy-four (74), thirty-four (34) contractors were purposively selected and interviewed in order to evaluate the impact of leadership and managerial skill and attributes that are contributing towards developing, growing and sustaining their business activities beyond the first five years. The first five years, is the period that mostly referred to as the "red-sea crossing" for potential sustainable organization especially in the construction industry. Thus, Table 1 indicates that out of 34 construction organisations (SMME contractors) participated in the study, 13 (38%) were under cidb grade '4GB and 4CE'- coded as D1-D13; 13 (38%) contractors with cidb grade '5GB and 5CE'- coded E1-E1; and whilst 8(24%) contractor in cidb grade '6GB and 6CE' is coded as E1-E8.

**Table 1: Research Participants** (The cidb contractors' grading)

Respondents	Response	
	Number	%
Cidb Grade in Port Elizabeth		
4GB & 4CE	13	38.00
5GB & 5CE	13	38.00
6GB & 6CE	8	24.00
<b>Total</b>	<b>34</b>	<b>100.00</b>

**Source:** Author's construct

## 4.2 The Interviewees' Years of Experience in Construction Industry

Table 2 reveals the working experience of the interviewees in the construction industry. Thus, their experience ranges from seven (7) to thirty-five (35) years.

**Table 2: Participants Years' Experience in Construction Industry**

Respondents Years of Experience in Construction Business	Response	
	Number	%
5- 15 Years	15	44.00
16-25 Years	11	32.00
26-35 Years	4	12.00
36-45 Years	4	12.00
<b>Total</b>	<b>34</b>	<b>100.00</b>

Table 2 indicated that forty-four (44%) of the participants a working experience of between five (5) and fifteen (15) years; 32% had worked since 16 to 25 years; and 12% had worked for 26 to 35 and 36 to 45 years respectively.

The various grades amongst the interviewees were adequately and well represented (see Table1). The data collected through an in-depth interview were insightful, significant and meaningful, as most participants had vast levels of experience in the South African construction industry (see Table 2). Thus, the number (34) of the participants (SMME contractors) for this research study was adequate for the intended purpose. The insightful knowledge and data generated from the study were coded, and thematically discussed, interpreted and presented accordingly.

## 4.3 Interview Questions

**Question 1:** In your opinion and business experience, how would you describe the leadership attributes of your organisation?

**Question 2:** Could you please highlight the key leadership capabilities and managerial skills that gave your organisation a competitive edge towards sustaining your growth beyond the first five years of operation?

## 4.4 Finding and Analyses- Theme

### **Theme1: The SMME Contractors "Concept of Leadership" and Leadership Characteristics**

Ten (10) participants (5Es, 2Ds and 3Fs) out of 32 explained that: Their organisational leadership is not defined as autocratic in nature, but very

sound, open, participative, encouraging and engages the employees in the major business decisions with respect to project planning, execution, monitoring and administration. Also, as energetic, ethical, morally right, skilled, qualified, people driven, dynamic, transparent, innovative and transformational, with a clear strategic vision that has assisted them to be sustainable business organisations. E2 added that: *“Our superiors use an open leadership style; and this has engendered our growth as an organisation. The staff, from top to bottom are allowed and are free to express themselves and their ideas relating to improving their personal growth and organisational performance”*.

*“Our leadership style emphasises our collective and individual development. Our leadership model is basically a people and performance-orientated one”* (D2).

*“We have a business philosophy in the company that says “work hard and play hard”. Our project team is a dynamic and competent army of employees”* (F6).

*“Our strong point of leadership is the ability to create an environment of oneness, and coherent team spirit amongst the employees; and an uncompromising principle of fair and ethical conduct that is also community- oriented”* (E12). These findings are in line with the thoughts of Werner (2012); Johnson et al., (2011); and Burns (2016), that business owners should be able to lead and manage a strong project through collaboration of their employees.

However, participants (F4, E5 and E6) believed that their organisations' successes hugely depended on them as the business owners and leaders. They described themselves as transformational and dynamic leaders. *“I lead from the front and I am a good example. I frequently up-skill myself and I facilitate our employees' skills training in leadership of their own respective sections within the organisation”* (E5).

*“However, we critically assess and check the character, behaviour and background of all (potential) employees and ensure that the person(s) is/ are of a good reputation and technically qualified, before recruiting them into our system. We advocate and ensure that our employees are neatly dressed and properly protected on site”* (D9). These results corroborate with the view of Ofori and Toor (2012) which affirm that transformational leadership is the most suitable for the construction industry's competitiveness towards generating higher quality work and excellent project delivery within the construction industry.

Furthermore, four (4) respondents (F3, E9, D6 and D7) believed that their organisational leadership was strong, flexible and functional; and plans, organises and manages projects and employees successfully.

E9 noted that: *“Our organisational leadership is not as vibrant as it could have been, because we could not afford to employ top-notch construction professionals. We are very conservative in making business decisions; I do allow employees to express their talent and display their competencies, but*

*I like being in control of the major business decisions. And this has engendered our business growth.”*

D8 stated that: *“The leadership of our organisation is competitive; and it has been under my watch as the CEO for about 20 years now. The organisation is a self-sustaining business and we are satisfied with our progress and performance so far”*. These findings are partially compatible with the views of Butler and Chinowsky (2006) and Ofori and Toor (2012) that it is the responsibility of a competent leader in any organisation to know what type of leadership to employ, depending on the market position. However, this raises concern on the sustainability of this sort of leadership style, this group of SMME contractors are employed in leading and managing their businesses.

## **Theme 2: The SMMEs Key Leadership Capabilities that serve as a Competitive Edge**

Nine (9) participants (3Ds, 3Es and 3Fs) believed that their business' ability to effectively and successfully plan and finish numerous projects on time and within budget, is a huge competitive advantage for their organisation. Also, three (3) participants (D1, D2 and D5) explained that their key leadership abilities- through the collective efforts of all the individual employees (admin and site workers) and from the business owner are major contributions toward the growth of their firms.

One of the participants- D11 stressed that: *our organisation's strategic ability to engage, inspire and retain key competent employees for the long period and as team players remain significant in supporting their business growth. They all regarded their key employees as ingredients for making their project teams more competitive.*

D3 explained that: *“The key leadership capability of this organisation that made us competitive is our strategic ability to create a market position; the ability to project and foresee the timeline of our financial profile; and to foresee the future challenges and opportunities that could either enable our organisation to improve or lead us into a setback and/ or liquidation”*.

In addition, respondent (D9) claimed that: *“Our business leadership incorporates exceptional skills, talent and competence for dispute resolution within the project team or with clients. With this quality of leadership, we built a strong and competitive project team, as we have the skills to resolve differences amicably and to form alliances. We also constantly train and upgrade our employees' skills in areas that require improvement; and these have been beneficial to us”* (D9). These findings resonate with views of Liphadzi et al. (2014) that an effective contractor and project leader should have skills such as the leadership, technical capability, interpersonal competence, management, experience, task oriented, and good employee relationship are the key factors that foster sustainability and competitiveness in the construction industry. Also, Werner (2011) acknowledged that effective leadership within an

organisation have characteristics and clusters of competencies such as: personal competencies (achievement motivation, technical know-how, self-confidence, energy and personal effectiveness); social competencies (influential power, political awareness and empathy); and cognitive competencies (conceptual thinking). Also, the OECD (2007) advocates that leadership and innovation skills, which could lead an organisation into sustainability and competitiveness are embedded continuous improvement of basic knowledge, through education, science and skills training

## **5. CONCLUSION AND RECOMMENDATIONS**

This research was conducted with the aim to assess the impact of leadership and managerial skills among the surveying SMME contractors in the developing and growing an economic sustainable construction firm. The study findings indicate that the surviving SMME contractors (in cidb grade 4-6 contractors) perceive the concept and characteristics of their organisational leadership skills and management characteristics that foster sustainability of their firms are: being strategic, financially buoyant, flexible, dynamic and functional, transformational, energetic, ethical and morally right, skilled and qualified, people driven, transparent, innovative, and non-autocratic., the study also reveals that survival and sustainability of a construction organisation is strongly anchored in engaging their employees in the major business decision from leadership perspectives. Some of the contractors' employees are involved in the strategic business decisions such as: in project planning, execution, monitoring, administration and overall organisational performance; and as such this strategic leadership contributes to positive outcomes of economic sustainability and competitiveness in their respective construction businesses.

This study indicates that the key leadership capabilities that foster significant performance among the SMME construction firms are: formation of competent project team; having strategic business aptitude to engage, inspire and retain the organisations' key competent employees; having exceptional skills, talent and competence for dispute resolution within the project team or with clients; constant training and upgrading of employees' skills in the various areas requiring improvement; experience and sound understanding of the construction market; specialisation as competitive advantage; and collective alliance and synergy with clients, sponsors and employees. These leadership capabilities enhanced the contractors' competitive edge and supported their business growth and performance in the market. The study was conducted in Port Elizabeth construction market, as such caution must be exercised in the adaptation of the findings. Thus, the findings cannot be holistically generalised. However, the areas of future research should be focus on tracking down the SMME contractors that been out of business in order to critically understand the actual factors that led to their business failure.

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**Exploring the Perceptions of  
Construction SMEs on Appropriate  
Supporting Policies For Growth and  
Development by the Qatari  
Government For Effective Participation  
in Infrastructure Procurement and  
Delivery for the 2022 World Cup**

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**ABSTRACT AND KEYWORDS**

**Purpose of this paper**

The purpose of this paper is to gauge the perceptions of SMEs of the measures they believe would enhance their development and growth by the Qatari government to ensure full and effective participation in the procurement of infrastructure and services for 2022 World Cup, which also serves the strategy of capacity building in the construction sector and diversification of the Qatari economy.

### **Design/methodology/approach**

A quantitative research methodology was applied to allow a cross-sectional data to be collected using a questionnaire survey. The literature on SMEs in Qatar indicates heterogeneity and this resulted in the categorisation of SMEs into three types. These include micro construction SMEs, small construction SMEs, and medium Construction SMEs. A total of 146 fully completed on-line questionnaire were obtained and analysed using the Statistical Package for the Social Sciences (SPSSx). The Kruskal-Wallis test was used to rank the factors believed by SMEs to hindering their effective participation in construction activities in Qatar

### **Findings**

The results from SPSS results clearly showed that there is a huge variance in the perception of factors believed by SMEs to be hindering their effective participation in construction activities in the country. SMEs are particular about their underdeveloped entrepreneurial skills, lack of access to both financial and human capital, the distance between SMEs and construction educational institutions, unfair market competition for labour, materials, and equipment. From these findings, the study concluded that it is important that intended beneficiaries of government policies are consulted for inputs into policy formulation for effective outcomes.

### **Research limitations/implications (if applicable)**

The study only focused on Small Medium Enterprises in Qatar, however, given similar socio-economic and political characteristics, the findings have wider applicability across the Gulf Corporation Council (GCC) countries, including Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, Bahrain, and Oman.

### **Practical implications (if applicable)**

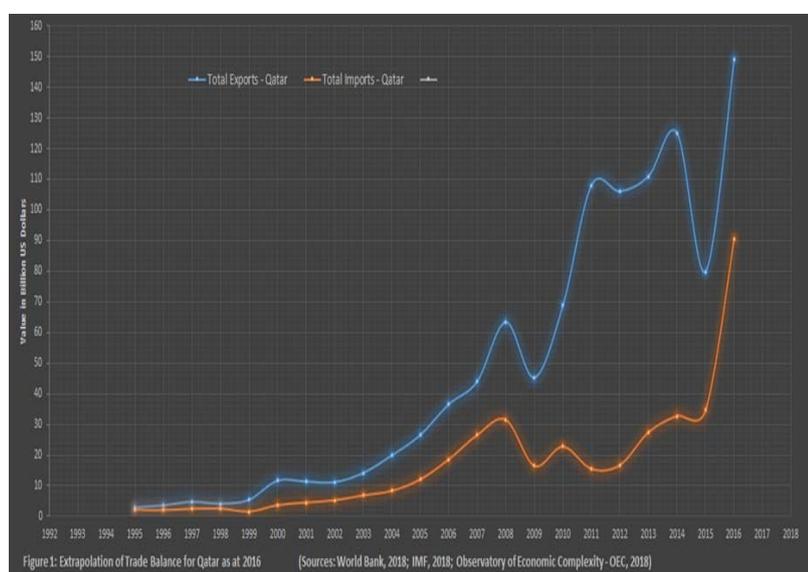
The study calls for an interface or platform where construction SMEs can interact with the Qatari government on how SMEs can be better supported for enhanced capacity building and development.

**What is original/value of paper?** The paper acknowledges the global pattern of the predominance of construction SMEs and their roles in construction industry development. This explains the various initiatives advanced by governments for SMEs development, and by critically appraising the effectiveness of such initiatives by the Qatari government, this study advances previous knowledge with its findings and recommendations.

**Keywords:** Qatar, SMEs, Participation, Infrastructure, Procurement, 2022 World Cup

## 1. INTRODUCTION

Qatar is hosting the 2022 **Fédération Internationale de Football Association** (FIFA) games, requiring huge infrastructure and service in support. Previous experience has shown that these infrastructure and services are huge and indivisible, requiring considerable managerial and technical expertise as well huge financial outlay to deliver (Ebohon, et. Al, 2002). Being one of the few countries with a huge balance of payment surpluses, Qatar is one of the few countries with the economic strength to host the World Cup. As Figure 1 shows, Qatar has consistently maintained a balance of payment surplus since 1995 (IMF, 2018a), and has the purchasing power parity to effect the huge indivisible capital requirements in terms of infrastructure and services to stage the quadrennial event.

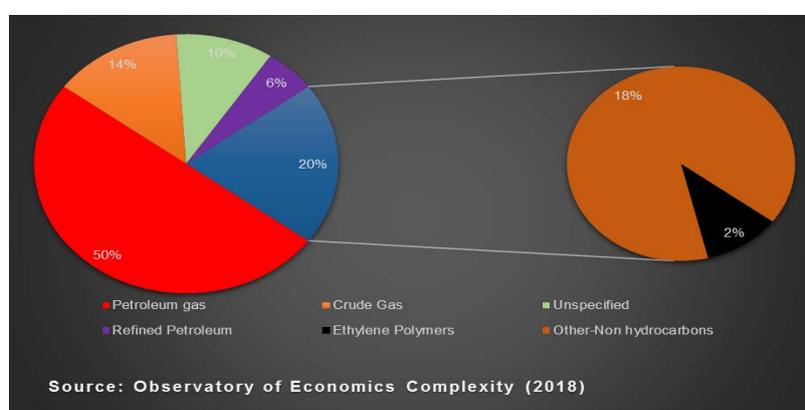


**Figure 1:** Extrapolation of Trade Balance for Qatar in 2016

However, the dramatic fall in oil prices, from a peak of \$115 per barrel in June 2014 to under \$35 at the end of February 2016, has forced many oil and gas-dependent countries to consider major economic restructuring. As Figure 2 shows, gas is Qatar's main export and source of foreign exchange, making the country largely a monocultural economy, these being a set of countries that rely predominantly on one or two commodities for export earnings. Qatar's problem is further compounded by its reliance on foreign workers for technical and managerial expertise to propel the economy. This has huge significance for the balance of payments given dwindling foreign export earnings occasioned by falling oil and gas prices

in view of the impact of guest workers' remittances on foreign exchange and

Qatar saw its successful bid as a golden opportunity to begin the process of economic restructuring; beginning with the construction sector, it sets about ensuring that locally based small and medium-size construction enterprises (SMEs) participate effectively in the huge infrastructure procurement and development to effect the 2022 Football World Cup game. Similarly, it was also envisaged that the growth and development of local construction SMEs will obviate the need for foreign technical and managerial expertise for maintenance of existing infrastructure and services, as well as replication in areas of disamenities. This initiative is captured in two strategic policy documents – Qatar National Vision (QNV)



2030 and the National Development Strategy both of which are purposeful in creating an enabling regulatory environment generally, and specifically for enhancing industrial capacity building, particularly with regards to SMEs' growth and development (Jaoui and Rashi, 2015; The Business Year 2015). Of particular interest is in creating an enabling environment for Qatari SMEs to grow and prosper.

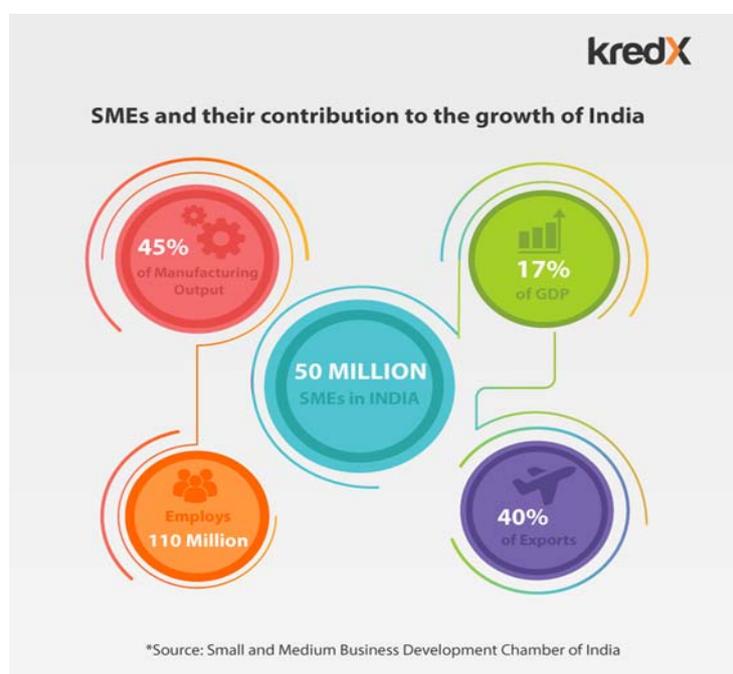
**Figure 2:** Structure of Qatar's export

## 2. SMES AND ECONOMIC DEVELOPMENT

Its is a fact that large firms and conglomerates all started life as SMEs, and the most formidable competitions faced by large firms and global conglomerates are also from SMEs. Moving from corporate to the individual, SMEs affords numerous opportunities for skills and career developments, particularly entrepreneurship. In other words, SMEs incubate innovation, entrepreneurship, facilitate corporate discipline; all of which are critical to economic growth and development, especially

economic diversification (OECD, 2017, Fernandez and Ali (2013). According to the World Bank Group, Small and Medium Enterprises (SMEs) play a major role in most economies, particularly in developing countries (Ayyagari, et al. 2011).

World Bank Group, Small and Medium Enterprises (SMEs) play a major role in most economies, particularly in developing countries (Ayyagari, et al. 2011). Formal SMEs contribute up to 60% of total employment and up to 40% of national income (GDP) in emerging economies. These numbers are significantly higher when informal SMEs are included. As Figure 3 clearly indicates for India, SMEs contributes significantly to its economic growth, contributing 17% of GDP, and accounting for 45% of manufacturing output, 40% of total export, and employing 110 million employees



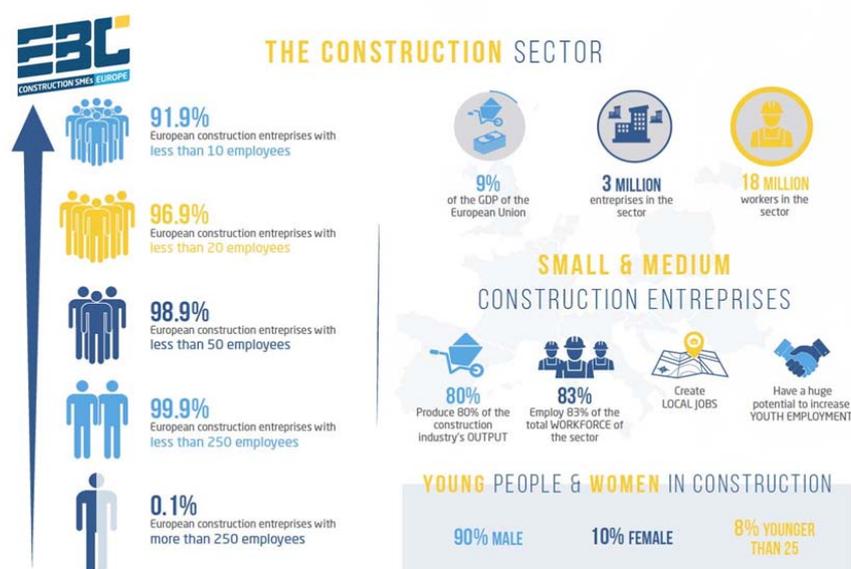
**Figure 3:** SMEs and Economic Growth in India

Indeed, a 2003 comprehensive study of the significance of SMEs in Europe confirmed its importance to European economic growth and prosperity when it concluded that SMEs are a catalyst and engine of economic growth and development (EU, 2003, Ayyagari et al. 2003). This has huge implications for economic diversification efforts given the evidence that supports the growth and performance of SMEs as necessary

prerequisites to effective economic diversification (EU, 2003, Ayyagari, 2011, and OECD 2018, IMF 2018b)). This is the reality that Qatar have grasped firmly in view of the concerted efforts by governments, particularly in the developing countries, to develop and grow their SMEs' sector. In Great Britain for example, specific policies in place to develop and grow SMEs manifest in financing, technology and innovation, electronic commerce, management and internationalisation measures. Similarly, in Korea, tax concessions and loans at favourable interest rates are introduced to grow and support SMEs. In the United States, small and medium-size enterprises are heavily supported, and the range of support include providing direct research and development grants; loans to scale and grow the enterprise; innovation vouchers to assist SME manufacturers with new product development and innovation efforts; and funding joint pre-competitive research programs (Ezell, and Atkinson, 2011). The use of innovation vouchers is most commonly used across many countries, including Austria, Canada, and Germany, to grow SMEs.

### 3. QATAR CHOICE OF CONSTRUCTION SMES

The choice of the construction sector, apart from the opportunism of the 2022 World Cup Games, comes as no surprises. Across the global economy, the construction industry is driven by SMEs (EU 2003; Institute of Value Management, 2015)), and as Figure 4 indicates, 98.9% of European construction enterprises employ less than 50 employees, 80% of total construction output is accounted for by construction SMEs, and also responsible for 83% of the total construction workforce.



**Figure 4:** European Construction and SMEs

**Source:** <https://www.euractiv.com/section/social-europe-jobs/infographic/the-construction-sector-in-europe-and-its-smes-facts-and-figures/>

The Construction Industry is diversified, and with extensive backward and forward linkages with the rest of the economy involving numerous clients like property builders, property developers, material suppliers and contractors, attracting inward investors to the economy. The construction sector is an important sector that contributes greatly to the economic growth of a nation (Adam, 1997; Swett, 2015), hence the ideal sector to lead economic diversification efforts.

Given the policy decision of the Qatar government to pioneer economic diversification by seizing on the timing of the 2022 World Cup and the opportunities it presents, this study sets out to investigate the appropriate measures construction SMEs would like to see implemented that will enable them to grow and become effective partners in the building and delivery of infrastructure and services for the 2022 World Cup and beyond.

#### 4. CURRENT STATE OF QATARI CONSTRUCTION INDUSTRY

Qatar's construction industry remains one of the most vibrant and fast-expanding in the Middle East, and a key driver of non-oil growth in the state. Major infrastructure projects including the Doha Metro, Long Distance Rail, Hamad Port, the next phase of expansion at Hamad International Airport (HIA), and a network of new roads and drainage systems are expected to keep the industry on track are ongoing, while new builds in the health, education, real estate and hospitality segments will further complement existing growth in the sector. Qatar's construction industry is a critical non-oil growth driver, accounting for around 10% of GDP at the end of 2015, and the single largest employer, employing 37% of Qatar's 1.7 million workers (MDPS, 2015).

The total estimate of the value of construction projects undertaken for Qatar in 2015 stood at US\$200 billion and the sector is estimated to grow at an annual rate of 11.4% up till 2022 when the World Cup games come to end. Additional to the currently ongoing 2022 World Cup infrastructure and service provision, other the high-profile projects which are undertaken include:

- Qatar Rail and Metro Project. This is thought to be the world's largest civil engineering project that started in 2013. This involves the design and construction of the tunnels and stations of the initial phase of the Doha Metro. These contracts relate to the first 130 kilometres of the railway, of which 99 kilometres will be underground.
- Hamad International Airport (HIA) previously known as New Doha International Airport (NDIA) had a passenger terminal, capable of handling up to 50 million passengers per year; a 750,000 tonnes-per-year cargo terminal; free trade zone; and a business park.

- New Doha Port Development Project (New Port). A major new sea port to the south of Doha, with annual capacity to accommodate six million 20-foot equivalent units as well as a naval component.
- Doha Bay Crossing.
- Lusail Real Estate Development. A mixed-use development of 38 square kilometres including housing, offices, shops and four exclusive islands.
- Energy City. An integrated energy hub to enhance the Gulf region's ability to capture critical revenue streams from hydrocarbons and act as a nucleus for the Middle East's oil and gas industry.
- Msheireb Downtown Doha. A large urban regeneration complex by Msheireb Properties in central Doha, designed to reflect the architectural heritage of Qatar.
- Doha Festival City. Entertainment and leisure complex with retail outlets, hotels; convention centre.
- Healthcare facilities, including five primary healthcare centres across Doha, plus four hospitals at Hamad Medical City.

Most of these projects are of huge and indivisible capital type investments which are the technical and management capacity and expertise of local construction firms, particularly the small and medium-term construction enterprises. The measure adopted by the Qatari government to grow and develop construction SMEs can be found in Law No (13) of 2000 for the Regulation of Foreign Capital Investment in Economic Activity generally (subject to a few specific exceptions), which requires non-Qatari contractors and consultants to form partnerships with Qatari partners to be able to bid for work generally. Joint ventures, which can be either incorporated to become a single company (LLC), or based on a contractual joint venture agreement are most favoured. For the huge infrastructure procurement occasioned by Qatar 2022 World Cup, international contractors must comply with Law (13) of 2000

Many would regard the indigenisation policy, well intended as it may be, to be a necessary but insufficient policy instrument to enhance the growth and development of construction SMEs in Qatar (Oxford Analytica, 2013, Uppal, 2014). Evidence abound showing that at the end of most joint ventures, local firms still struggle to remain in business. Indeed, looking at the work of Jarkas and Haupt (2015) where the challenges faced by SMEs revolve, amongst other factors, around problems of capacity to compete for skilled and experienced workers with large firms. The absence of 'level playing field' that enables local construction SMEs to grow and compete remains a major factor inhibiting growth and development of construction SMEs in Qatar. This brings to the fore, the significance of this study, which is to investigate measures local SMEs consider effective to their growth and development in Qatar.

## 5. RESEARCH METHODOLOGY

The approach taken to explore the perceptions of construction SMEs regarding the appropriate measures to be introduced by the Qatari Government to enhance their growth and development, according to Kothari (2004) is systematic. In the process of seeking knowledge, which is the purpose of this study to derive appropriate measures that will support the growth and development of construction SMEs in Qatar, a methodological approach is necessary (Chadwick et. Al. 2004, Creswell, 2003). The research methodology for this study is informed by the epistemological and ontological positioning of the researchers. Epistemology concerns knowledge and how it is derived and understood, while ontology, on the other hand, is about the conception and understanding of reality (Saunders et al 2015). The researchers adopt the positivist and interpretivist methodological approach to the study in the belief that it will yield objective and rich knowledge to lead to new knowledge on the measures to facilitate the growth and development of Qatari construction SMEs.

In order to ensure the sample studied adequately represents the target population, in this case, all construction SMEs in Qatar, the OECD (2016) and QDB (2016) definition and categorisation of SMEs were considered. SMEs are defined as non-subsiary, independent firms likely to employ less number of employees than large organizations. The two important criteria here are the number of employees and income or asset levels of firms. According to Table 5.1, construction SMEs have been classified into three categories, including Micro with 1-10 employees, small that employs 11 to 50 employees, and the medium SMEs employ 51 to 250 employees (Oxford Business Group, 2010; Clyde and Company 2013).

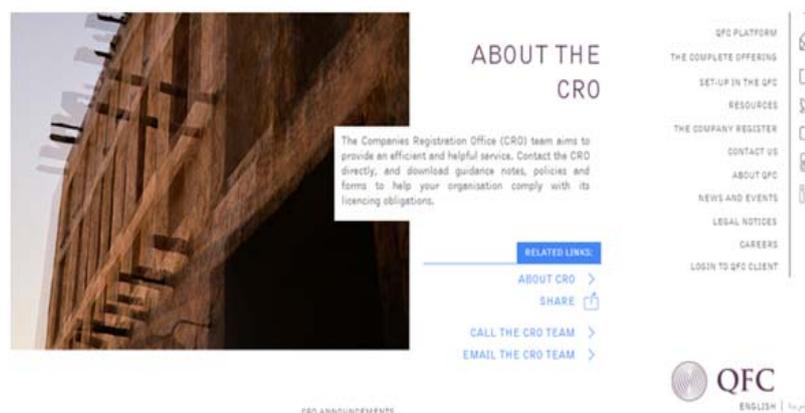
**Table 5.1** SMEs classification in Qatar.

<b>Sector</b>	<b>Criteria</b>	<b>Micro</b>	<b>Small</b>	<b>Medium</b>
Agriculture	No. of Employees* Annual Turnover	1 to 5 Less than 1	6 to 30 1 to less than 20	31 to 250 20 to 100
Manufacturing	No. of Employees** Annual Turnover	1 to 5 Less than 3	6 to 50 3 to less than 20	51 to 250 20 to 100
Creative Industry	No. of Employees* Annual Turnover**	1 to 5 Less than 1	6 to 30 3 to less than 20	31 to 100 20 to 100
<b>Construction</b>	<b>No. of Employees* Annual Turnover**</b>	<b>1 to 10 Less than 3</b>	<b>11 to 50 3 to less than 20</b>	<b>51 to 250 20 to 100</b>
Trade	No. of Employees* Annual Turnover**	1 to 5 Less than 3	6 to 50 3 to less than 20	31 to 100 20 to 100

Other Services	No. of Employees* Annual Turnover**	1 to 5 Less than 3	6 to 50 3 to less than 20	51 to 250 20 to 100
*Employees measured by staff headcount; ** Annual turnover measured in Qatar Riyals				Source: State of Small and Medium Enterprises in Qatar, Qatar Development Bank (2016)

## 5.1 Data collection

The first task was to identify a homogenous set of SMEs respondents to ensure a broader well representative sample of construction SMEs in the sector. In Qatar, the Company Registration Office – CRO (2016) houses a search engine where all the companies register their contact details from which contact details in form of email and website addresses were generated. This allowed visits to respective websites and to then send emails to construction professionals. As shown in Figure 3, the CRO is a public body accessible to anyone in Qatar (Moubaydee, et al 2013, Central Tender Committee (2016)). Other contact details were obtained by looking at respective website addresses based on company grade listing.



**Figure 5:** Company Registration Office – CRO for Qatar SMEs Registration Portal  
Source: Qatar Financial Centre Authority

## 5.2 The structure of the Questionnaire

A questionnaire was designed to elicit the necessary data for the study. The first section of the questionnaire was designed to inform on the characteristics of potential respondents. This was to assist in categorising

responses according to key themes derived from literature to form the required data for the study. For instance, the study needed to tease out whether construction experience explains for variations in respondents' perception about the appropriate measures necessary to grow construction SMEs in Qatar. It is expected that credible conclusions can only be generated if study parameters for the sample frame are clearly defined. Therefore, the study generated comparative data around the following:

- Age
- Gender
- Professional background
- Construction industry experience
- The scale of organisation: large, medium, small firms
- Specialism: whether they work for general or specialist contractors
- Contractor's Classification: low/ medium or high?

Clearly evident in Table 5.1 is the even representation of construction practitioners across Qatari construction SMEs where 30% of construction professionals that responded were from Micro SMEs; 39% and 32% for small and medium SMEs respectively. The importance being that with an equal number of professionals in all bands of SMEs, there is a good chance of capturing a broad range of construction SMEs in Qatar.

**Table 5.1** Characteristics of Respondents  
Professional background and contractor's specialism

Age	The scale of SME organisation (N = 146)			Total
	Micro	Small	Medium	
18 to 24yrs	1	4	7	12
25 to 29yrs	3	9	4	16
30 to 34yrs	8	8	3	19
35 to 39yrs	6	2	1	9
40 to 44yrs	4	5	6	15
45 to 49yrs	6	8	7	21
50 to 54yrs	2	7	6	15
55 to 59yrs	9	10	7	26
60yrs+	4	4	5	13
<b>Total</b>	<b>43</b>	<b>57</b>	<b>46</b>	<b>146</b>
<i>Percentage</i>				
Age	Micro	Small	Medium	Total
18 to 24yrs	0.68	2.74	4.79	8.22
25 to 29yrs	2.05	6.16	2.74	10.96
30 to 34yrs	5.48	5.48	2.05	13.01
35 to 39yrs	4.11	1.37	0.68	6.16
40 to 44yrs	2.74	3.42	4.11	10.27
45 to 49yrs	4.11	5.48	4.79	14.38

50 to 54yrs	1.37	4.79	4.11	10.27
55 to 59yrs	6.16	6.85	4.79	17.81
60yrs+	2.74	2.74	3.42	8.90
<b>Total</b>	<b>29.45</b>	<b>39.04</b>	<b>31.51</b>	<b>100.00</b>

Table 5.2 also shows a fair distribution of respondents' age relative construction experience. A quick definition seems to be prevalent with individuals with less experience likely to be the younger professional and expectedly, individuals with 20 years and above of construction experience are also likely to be 40 years or older. It is feasible to deduce from this that the earliest entry age is on average 20 years.

<b>Table 5.2: Age of respondents by construction industry experience</b>								
<b>Age</b>	<b>Industry experience (N = 146)</b>							<b>Total</b>
	<b>0 to 4 yrs</b>	<b>5 to 9 yrs</b>	<b>10 to 14 yrs</b>	<b>15 to 19yrs</b>	<b>20 to 24yrs</b>	<b>25 to 29yrs</b>	<b>30yrs+</b>	
18 to 24yrs	10	2	0	0	0	0	0	12
25 to 29yrs	9	7	0	0	0	0	0	16
30 to 34yrs	4	13	2	0	0	0	0	19
35 to 39yrs	0	3	6	0	0	0	0	9
40 to 44yrs	0	2	5	4	0	4	0	15
45 to 49yrs	0	0	10	7	2	2	0	21
50 to 54yrs	0	0	1	5	4	4	1	15
55 to 59yrs	0	0	0	0	8	5	13	26
60yrs+	0	0	0	0	1	5	7	13
<b>Total</b>	<b>23</b>	<b>27</b>	<b>24</b>	<b>16</b>	<b>15</b>	<b>20</b>	<b>21</b>	<b>146</b>
<b>Percentage</b>								
<b>Age</b>	<b>0 to 4 yrs</b>	<b>5 to 9 yrs</b>	<b>10 to 14 yrs</b>	<b>15 to 19yrs</b>	<b>20 to 24yrs</b>	<b>25 to 29yrs</b>	<b>30yrs+</b>	<b>Total</b>
18 to 24yrs	6.85	1.37	0.00	0.00	0.00	0.00	0.00	8.22
25 to 29yrs	6.16	4.79	0.00	0.00	0.00	0.00	0.00	10.96
30 to 34yrs	2.74	8.90	1.37	0.00	0.00	0.00	0.00	13.01
35 to 39yrs	0.00	2.05	4.11	0.00	0.00	0.00	0.00	6.16
40 to 44yrs	0.00	1.37	3.42	2.74	0.00	2.74	0.00	10.27
45 to 49yrs	0.00	0.00	6.85	4.79	1.37	1.37	0.00	14.38
50 to 54yrs	0.00	0.00	0.68	3.42	2.74	2.74	0.68	10.27
55 to 59yrs	0.00	0.00	0.00	0.00	5.48	3.42	8.90	17.81
60yrs+	0.00	0.00	0.00	0.00	0.68	3.42	4.79	8.90
<b>Total</b>	<b>15.75</b>	<b>18.49</b>	<b>16.44</b>	<b>10.96</b>	<b>10.27</b>	<b>13.70</b>	<b>14.38</b>	<b>100</b>

At the time of capturing the respondents, about 53% of the sample had worked for longer than 15 years in the construction industry in Qatar, allowing us to deduce that the study is informed by construction professionals with substantial experience of Qatar's construction industry and therefore likely to reflect accurate and sustained experiences of construction SMEs in the country. This factor is critically important to the study, particularly where it is knowledge and experience practitioners

regarding adjudged appropriate measures to grow and develop this subsector of the industry. This goes without saying that beyond this, is also the fact that with experience of completing various projects comes detailed insights about the workings of the industry, particularly the interactions within construction sector itself, and also with the wider economy.

With this in mind, the study is a homogenous sample of SMEs with an interdisciplinarity of construction knowledge as represented by the main professions who make up a typical construction project. These characteristics and profiles will enable respondents give a good account of the challenges SMEs face and therefore the measures that can be put in place to ensure the longer term sustainability of this subsector critical Qatar's Construction industry development and the wider ambition of economic diversification.

The second part of the questionnaire was open ended, and respondents, as SMEs, were asked to list the challenges they face operating in Qatar that they feel hinder their growth and development. The challenges identified were combined in to the following themes in Table 5.3.

**Table 5.3:** Themes and Variable labels

<b>Themes</b>	<b>Variable Labels</b>
Limited scope for technology transfer and absorption between construction SMEs and large construction firms	<b><i>PerSMEs1</i></b>
Inability to compete with large construction multinationals with specialism and established goodwill	<b><i>PerSMEs2</i></b>
Difficulties competing with large multinational firms on quality and other none-price competitive activities	<b><i>PerSMEs3</i></b>
Low capacity to invest in human capital development regarding up-skilling workers in new construction technology and management knowledge	<b><i>PerSMEs4</i></b>
Increased barriers to entry through the indivisibility nature of projects	<b><i>PerSMEs5</i></b>
Lack of enforcement of existing labour rules and regulations about the six-year expatriate rule	<b><i>PerSMEs6</i></b>
Lack of national framework to encourage SMEs in up-skilling their workforce	<b><i>PerSMEs7</i></b>
Insufficient local vocational training institutions to produce	<b><i>PerSMEs8</i></b>

necessary construction skills	
Vertical integration structure of large multinational companies and the effects on volume of work for SMEs	<b>PerSMEs9</b>

\*Perceived challenges by Construction SMEs in Qatar

The frequency analysis of the challenges identified by construction SMEs shows the pervasive nature of these challenges, as shown in Table 5.4. Prominent amongst them is the inability to compete with established large specialist or household name multinational construction firms. Issues with vocational training institutions, evidencing lack of capacity was also identified by all construction SMEs. It comes as no surprise that the other three challenges that featured highly also deal with inadequate capacity, namely, competition on quality, inadequate capacity to absorb technology, and finally, inadequate capacity to overcome barriers to entry owing to capital indivisibility. The final research strategy for this study was to go back and ask respondents to rank their perceived challenges already identified on a Likert scale where 5 is strongly agree, 4 = agree, 3 = undecided, 2 = disagree and 1 = strongly disagree, as presented in Table 5.5.

**Table 5.4:** Frequency of Identified Challenges by Qatari Construction SMES

Themes	Attributes of Themes	Frequency (N = 146)	
		Count	%
<b>PerSMEs1</b>	Limited scope for technology transfer and absorption between construction SMEs and large construction firms	117	80
<b>PerSMEs2</b>	Inability to compete with large construction multinationals with specialism and established goodwill	146	100
<b>PerSMEs3</b>	Difficulties competing with large multinational firms on quality and other none-price competitive activities	137	94
<b>PerSMEs4</b>	Low capacity to invest in human capital development regarding up-skilling workers in new construction technology and management knowledge	102	70
<b>PerSMEs5</b>	Increased barriers to entry through the indivisibility nature of projects	117	80
<b>PerSMEs6</b>	Lack of enforcement of existing labour rules and regulations about the six-year expatriate rule	95	65
<b>PerSMEs7</b>	Lack of national framework to encourage SMEs in up-skilling their workforce	110	75
<b>PerSMEs8</b>	Insufficient local vocational training institutions to produce necessary construction skills	146	100
<b>PerSMEs9</b>	Vertical integration structure of large multinational companies and the effects on	99	68

	volume of work for SMEs		
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**Table 5.5:** Aggregate rank order of perceived challenges to SMEs growth and Development in Qatar.

Themes	Attributes of Themes	Mean score	Rank	Themes Attributes Analysis
<b>PerSMEs1</b>	Limited scope for technology transfer and absorption between construction SMEs and large construction firms	3.93	1	<b>Issues of the need for technological capacity to innovate and compete with large established and specialist construction firms</b>
<b>PerSMEs3</b>	Difficulties competing with large multinational firms on quality and other non-price competitive activities	3.86	2	
<b>PerSMEs2</b>	Inability to compete with large construction multinationals with specialism and established goodwill	3.72	3	
<b>PerSMEs7</b>	Lack of national framework to encourage SMEs in up-skilling their workforce	3.66	4	<b>Issues of the need for appropriate institutions and framework guiding investments in human capital as well as continuing professional development (CPDs) in new and innovative construction skills</b>
<b>PerSMEs4</b>	Low capacity to invest in human capital development regarding up-skilling workers in new construction technology and management knowledge	3.64	5	
<b>PerSMEs6</b>	Lack of enforcement of existing labour rules and regulations about the six-year expatriate rule	3.58	6	
<b>PerSMEs8</b>	Insufficient local vocational training institutions to produce necessary construction skills	3.54	7.5	
<b>PerSMEs9</b>	Vertical integration structure of large multinational companies and the effects on volume of work for SMEs	3.54	7.5	<b>Issues of access to construction market owing to the structure of the large established and specialist construction firms.</b>
<b>PerSMEs5</b>	Increased barriers to entry through the indivisibility nature of projects	3.46	9	

The data has been collated and rank ordered in decreasing order of importance, using the 'theme attribute analysis' similar to principal component factor analysis (Kangwa and Olubodun, 2003). It can be observed that those challenges ranked highest by respondents have the attributes of the need for technological capacity to innovate and compete with large established and specialist construction firms in Qatar. The second rank ordered challenges have the attributes of the need for appropriate institutions and framework to guide investments in human capital as well as continuing professional development (CPDs) in new and innovative construction skills.

The third rank ordered challenges have the attributes of the need for measures and intervention to leverage market access for construction SMEs in Qatar. These three overarching attributes are critically evaluated to inform policy prescriptions that the Qatari government may consider implementing to enhance, not only the growth and development of construction SMEs, but also their resilience.

However, it is important to investigate the likelihood of variance in perception of challenges facing construction SMEs in Qatar. This acknowledges the fact that construction SMEs in Qatar are constituted into micro, small, and medium categories, and reflects the earlier disposition that they are likely to perceive and respond to the challenges affecting the growth in construction SMEs differently. The importance of capturing this effects is in policy prescription; it allows the tailoring of policies to the specific needs of the different categories of construction SMEs.

### **5.3 variance Analysis of the Perceived Challenges to SMEs Growth and Development in Qatar**

The 146 survey respondents comprised of the micro contractors, small contractors, and medium contractors. It is hypothesised that the experiences of contractors in undertaking construction projects will be shaped by the procurement team, including the clients, designers, principle designers and main contracting organisations who sublet works which most SMEs depend on for their survival.

Micro contractors are small in scale and can only take fairly small-scale works, whereas the small and medium contractors, by representation, are theoretically able to undertake any sub-contract works with the limiting factor being finance to purchase equipment and expertise for higher value projects (Quartey, et al 2017; Oxford Business Group, 2016). These experiences by construction SMEs are influenced by their knowledge and understanding of the structure, conduct and performance of the Qatari construction sector.

Mindful of this, the study sets out to establish the extent to which the experiences differ among the three SMEs classifications – micro, small, and medium, and whether there are persistent notable rank-variations depending on the size of SME. To this effect, the Kruskal Wallis procedure allows the study to compare the mean ranks for all the *K* groups across the three levels of Perceived construction SMEs Challenges (PerSMEs) in Qatar. The process of identifying and pooling the means for each group is shown in Figure 5.1

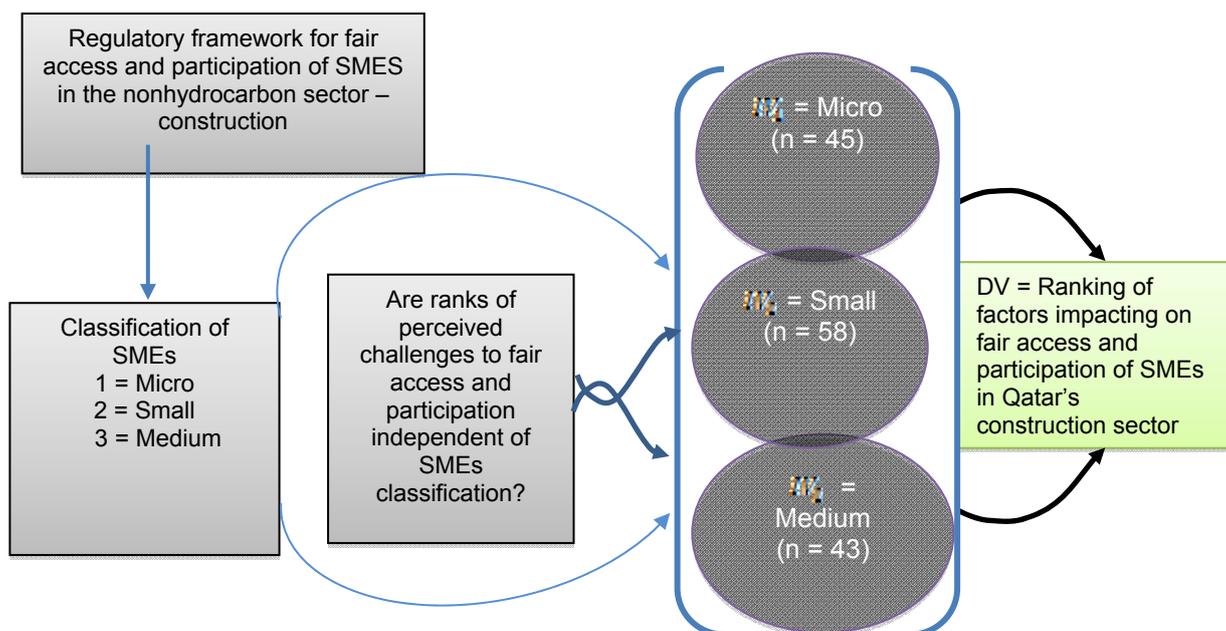


Figure 5.1: Procedure for Kruskal Wallis Analysis of Variance

Thus, a hypothesis is constructed, with the null-hypothesis that there is no difference in the ranking of the challenges to growth and development experienced by the three categories of construction SMEs in Qatar. The Alternative hypothesis on the other hand is that at least two categories of construction SMEs have different experience of the challenges to growth and development experienced by the three categories of construction SMEs in Qatar.

**Null Hypothesis:**

$H_0$ : The  $k$  population have identical ranking of PerSMEs

**Alternative Hypothesis:**

$H_1$ : At least two of the population differ in the ranking of PerSMEs.

The **decision rule** is to reject the null hypothesis in favour of the alternative hypothesis if the challenges to growth and development by the three categories of construction SMEs in Qatar are the same, in other words, if the mean value rankings are the same for at least two of the three categories of construction SMEs in Qatar – that is if the computed value KW is  $> \chi^2_{\alpha, df}$  and significant ( $\alpha$ ) 0.05 or at the 5% level of significance.

Thus, the Kruskal Wallis test is derived from the formula

$$KW = \frac{12}{n(n+1)} \sum_{j=1}^k \frac{R_j^2}{n_j} - 3(n+1) \quad (1.1)$$

The next step is let  $T_i$  = the total of the ranks from the  $i$ th sample in which the  $KW$  statistic follows the chi-square distribution with  $k - 1$ df. There are  $k = 3$  classifications of SMEs, the degree of freedom (df) is  $df = 3 - 1 = 2$ . The  $KW$  is derived from independent samples (Micro, small and medium organisations). The derived mean values relating to the nine PerSMEs factors (as presented in Table 5.5) were score on a Likert scale where 5 = strongly agree; 4 = agree; 3 = undecided; 2 = disagree; and 1 = strongly disagree.

The next step is to represent the mean score per SMEs classification (the  $K$  population samples) as shown in Table 8, in which the respective mean score relative to the three SMEs organisations are identified and colour coded for ease of identification with regards to each of the respective samples  $n_1$ ,  $n_2$  and  $n_k$ .

**Table 5.5: Perceived challenges to growth and development of SMEs in Qatar by classification**

Factors	Mean	SMEs Classification
PerSMEs1	4.15	Medium Contractor
PerSMEs2	3.85	
PerSMEs3	3.72	
PerSMEs4	4.00	
PerSMEs5	3.43	
PerSMEs6	3.65	
PerSMEs7	3.50	
PerSMEs8	3.72	
PerSMEs9	3.72	
PerSMEs1	4.05	Small Contractor
PerSMEs2	3.95	
PerSMEs3	4.00	
PerSMEs4	3.79	
PerSMEs5	3.82	
PerSMEs6	3.79	
PerSMEs7	3.72	
PerSMEs8	3.72	
PerSMEs9	3.56	
PerSMEs1	3.53	Micro Contractor
PerSMEs2	3.00	
PerSMEs3	3.81	
PerSMEs4	3.33	
PerSMEs5	3.00	
PerSMEs6	3.21	
PerSMEs7	3.74	
PerSMEs8	3.12	
PerSMEs9	3.33	

The next stage, is to pool the sample in decreasing order, and assigning each a rank value, as shown in Table 5.6.

**Table 5.6:** Pooled ranking of Perception of the challenges to growth and development of SMEs in Qatar by classification

Factors		Mean	<i>Pooled rank</i>
1	PerSMEs1	4.15	1
2	PerSMEs1	4.05	2
3	PerSMEs4	4.00	3.5
4	PerSMEs3	4.00	3.5
5	PerSMEs2	3.95	5
6	PerSMEs2	3.85	6
7	PerSMEs5	3.82	7
8	PerSMEs3	3.81	8
9	PerSMEs1	3.79	9.5
10	PerSMEs1	3.79	9.5
11	PerSMEs7	3.74	11
12	PerSMEs3	3.72	14
13	PerSMEs2	3.72	14
14	PerSMEs2	3.72	14
15	PerSMEs5	3.72	14
16	PerSMEs3	3.72	14
17	PerSMEs1	3.65	17
18	PerSMEs9	3.56	18
19	PerSMEs1	3.53	19
20	PerSMEs7	3.50	20
21	PerSMEs5	3.43	21
22	PerSMEs4	3.33	22.5
23	PerSMEs9	3.33	22.5
24	PerSMEs6	3.21	24
25	PerSMEs8	3.12	25
26	PerSMEs2	3.00	26.5
27	PerSMEs5	3.00	26.5

In Table 5.6, it is observable that the means of some of the pooled challenges (PerSMEs) happen to tie, and as is the conventional approach Kvanli et al (1992) and Kangwa and Olubodun (2004), the average of the rank to the tied position is assigned. For instance, there are separate 7 sets of ties which have been assigned the average rank of the position of tied factors. Examples are factors rank 3<sup>rd</sup> and 4<sup>th</sup> in Table 5.6 that have tied mean scores. The sum of their position is halved  $(3 + 4)/2 = 3.5$ . This procedure is repeated down the table with positions 12<sup>th</sup>, 13<sup>th</sup>, 14<sup>th</sup>, 15<sup>th</sup>, and 16<sup>th</sup> all tied. The value to each factor is  $(12+13+14+15+16)/5 = 14$  and therefore all the factors have been allocated the mean rank of 14.

Once this is done the respective rank positions for each corresponding factor from Table 5.6 is reallocated to each factor in Table 5.7.

**Table 5.7: Pooled ranks of perceived challenges to construction SMEs in Qatar by classification (N = 146)**

Factors	Sample mean (N = 146)	Medium Contractor (n = 43)	Rank of Medium contractor	Small Contractor (n = 58)	Rank of Small Contractor	Micro Contractor (n = 45)	Rank of Micro Contractor
PerSMEs1	3.93	4.15	1	4.05	2	3.53	19
PerSMEs3	3.86	3.72	14	4.00	3.5	3.81	8
PerSMEs2	3.72	3.85	6	3.95	5	3.00	26.5
PerSMEs7	3.66	3.5	20	3.72	14	3.74	11
PerSMEs4	3.64	4.00	3.5	3.74	9.5	3.33	22.5
PerSMEs6	3.58	3.65	17	3.79	9.5	3.21	24
PerSMEs8	3.54	3.72	14	3.72	14	3.12	25
PerSMEs9	3.54	3.72	14	3.56	18	3.33	22.5
PerSMEs5	3.46	3.43	21	3.82	7	3.00	26.5
			110.5		82.5		185
			$T_1$		$T_2$		$T_3$

Substituting the sum of the ranks for  $T_s$  from the Table 7, the KW statistic is derived as follows:

$$\frac{12}{27(27+1)} \left[ \frac{110.5^2}{9} + \frac{82.5^2}{9} + \frac{185^2}{9} \right] - 3(27+1)$$

$$\frac{12}{756} \left[ \frac{12210.25}{9} + \frac{6806.25}{9} + \frac{34225}{9} \right] - 84$$

$$\frac{12}{756} [1356.69 + 756.25 + 3802.78] - 84$$

$$\frac{12}{756} [5915.72] - 84$$

$$93.90 - 84$$

**KW = 9.90**

(1.2)

Reverting to the decision rule to reject  $H_0$  if KW (9.90) is greater than chi-square value at 5% level of significance and two degrees of freedom (where  $\chi^2_{0.05, 2df} = 5.991$  as derived from the standard chi-square distribution table).

Since  $KW > \chi^2$  (ie  $9.90 > 5.991$  Refer to Appendix A), we reject the null hypothesis in favour of the alternative hypothesis that at least two of the populations differ in the ranking of PerSMEs. In other words, two of the three SMEs classification perceive the challenges facing construction SMEs growth and development in Qatar differently.

#### **5.4 Policy implications**

The three overarching attributes detailed in Table 5.5 have huge policy implications. They show the onerous environment construction SMEs operate in Qatar, requiring urgent action by the government, particularly in view of the importance of SMEs to the wider economy, and more so, to the economic diversification commitment of the government.

The first attribute to be considered for analysis and policy responses concerns ***issues of the need for technological capacity to innovate and compete with large established and specialist construction firms*** amalgamates three perceived critical challenges to growth and development of SMEs in Qatar. This reflects the fact that construction SMEs in Qatar lack the technological and managerial expertise to be able to effectively compete with larger firms that are often multinationals

There are several policy initiatives the Qatari government may want to implement regarding these challenges faced by construction SMEs. Firstly, the government should invest and assist with developing the skills and capability of construction workers. There are several ways this could be implemented, for example, the Qatari Government facilitate access and training on new and innovate construction technology and management skills. The cost of training can be burdensome to SMEs, particularly the micro and small SMEs who tend to operate from the very low capital base. The government could subsidise the cost to the SMEs of retraining staff through the use of vouchers and other forms of direct grants. Similarly, the government can also offer support to construction SMEs to acquire or access relevant and construction technologies through tax initiatives such as Technology Acquisition Tax Credits and capital allowances to encourage investments in technology and attendant training.

Also, the Qatari Government should establish a National Business Support Helpline for SMEs where construction SMEs can be signposted to available opportunities. This will particularly benefit micro construction SMEs with very capital base unable to access and act on local, national and national information critical to growth and development owing to the low capital base. Another of such initiative targeting micro SMEs is a mentoring scheme, which the government should invest heavily to mentor

construction SMEs on various aspects of the construction business, particularly how to leverage growth and development using current technology. This should also be extended to business planning, innovation and efficiency, raising finance, and growing and managing the supply chain.

The second overarching attribute concerns **issues of the need for appropriate institutions and framework guiding investments in human capital as well as continuing professional development (CPDs) in new and innovative construction skills**. The Qatari government should establish a Construction Industry Development Board (CIDB) to provide a national framework to facilitate the growth and development of construction capacity in Qatar. Its remit, as with CIDB in other countries, should involve establishing guidelines for best practice, quality assessment system and thresholds, and health and safety standards to which all construction firms must subscribe. A mechanism must be put in place to ensure that educational institutions support the construction sector by working together to produce the skills and competencies required. The Qatari government should invoke the 'infant industry' argument to protect and grow the construction sector. This requires all construction companies to employ only skills and competencies not available in Qatar. This means enforcing the 6-year expatriate rule, expecting that this will encourage multinational firms to invest in developing local construction skills and competencies.

The third overarching attribute relates to **issues of the market access owing to the structure of the large and established specialist construction firms**. Participations of construction SMEs must be at the heart of the Qatari Government's procurement strategy for public procurement. Apart from facilitating the growth and development of SMEs, it also underpins the basis for effective competition, which is critical in driving down construction prices and raising construction value. To facilitate market access for SMEs, huge indivisible lump sum contracts should be broken down into smaller lots, and limits placed on the number of lots a single firm can bid. This is where concerns expressed about the vertical market structure of large construction firms come into play, and taken seriously by the Qatari government by legislating that construction subsidiaries must declare their parent companies. To further ensure market access, construction SMEs should be encouraged to jointly bid for government contracts. Similarly, barriers such as pre-qualifications should be made less onerous and should be dropped for below threshold procurements. In addition, efforts should be made to ensure where minimum turnover is required as pre-qualification, it should not be such that SMEs are disadvantaged. One of the challenges facing construction SMEs is the low capital base from which they operate, and prompt payments are critical to their survival; the Qatari Government must establish some maximum period that contract payments must be made to enhance liquidity and market survival by construction SMEs.

This not to say that the Qatari Government had not intervened to assist construction SMEs, as can be seen in the just recently convened 3-day private sector conference – the Moushtarayat 2018 organised by key

government and state agencies targeted at SMEs (Oxford Business Group, 2016 & 2018). However, in the light of the experience of construction SMEs, these measures grossly underestimate the challenges that hinder their growth and development, hence their effective participation in the construction market of Qatar.

## 6. CONCLUSION

This study sets out to investigate and understand the challenges facing local construction SMEs in Qatar with the hope of proposing an appropriate policy response. The findings show that local construction firms in Qatar do face huge challenges in terms of their capacity to grow and develop to effectively compete with the larger multinational construction firms. Measures such as the joint venture initiative between local and potential investors do nothing to enhance the fortunes of local construction SMEs who neither have the capacity to adopt, adapt, and absorb new and innovative construction technology and management practices. The Qatar government has a fundamental role to play in facilitating a level playing field for construction SMEs to thrive. This may require direct and indirect interventions in terms of grants, subsidies, and legal framework respectively to deliver the comprehensive solutions necessary.

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## **An investigation into health and safety factors in the South African construction industry**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The purpose of this study is to evaluate accident factors on construction site with a view to providing information that could enhance the health and safety controls in construction project delivery.

#### **Design/methodology/approach**

The study adopted a quantitative descriptive approach. The targeted population were safety consultants, quantity surveyors, engineers and project managers from the government organizations as well as medium and large private construction firms. Twenty-seven (27) valid questionnaires which represented a response rate of 67.5% from a total of forty (40) copies administered provided the quantitative data for the study. Primary data obtained were analysed using descriptive statistics.

#### **Findings**

This study identified twenty-seven safety variables which were evaluated under five groups; human, equipment, material, workplace and environmental factors. The relative significance of the factors indicated in this study is expected to provide useful insights for their effective management towards minimising accidents on construction sites.

#### **Research limitations**

The relative small sample size would limit a wider generalization of the findings.

**Originality/ value of paper**

The study contributes to health and safety working environments in construction site towards improving the overall project success.

**Keywords:** accident, construction, health, safety, South Africa

**1. INTRODUCTION**

The construction industry is reported as having a disproportionately high rate of recorded accidents (Naele, 2013). To this extent, different countries have put up laws for maintaining health and safety in their construction industries. For instance, the South African Occupational Health and Safety Amendment Act No 181 of 1993 compels that every employer shall provide and maintain, as far as is reasonably practicable, a working environment which is safe and without risk to the health of his employees. The Act was introduced and later amended with the aim of providing for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith.

Health and safety is an important part of project management because it requires planning, scheduling, estimating and cost control. According to Ritz (1994) and Maryania et al. (2015), construction is ranked among the highest accident-risk prone industries in the world. Despite the inherent dangers, most construction firms seem not to make adequate provisions to minimize accidents. Although measures and strategies designed to prevent, control, reduce or eliminate occupational hazards, accidents and risks have been developed and applied continuously over the years to keep pace with technological and economic changes (Alli, 2008), occupational accidents and diseases are still very frequent and their cost and psychological implications may be highly significant (Babatunde and Opawole, 2009).

According to Westhuizen and Fitzgerald (2005), a project is considered to be successful when it is finished on time, to the required quality standards and within budget. However, safe and healthy working environments have been linked to increase productivity and profits (Hesapro partners, 2013). Moreover, safety in the construction industry would fail if the behavioural, environmental, organisational and individual factors of a project are not incorporated into safety practices appropriately (Chong and Low, 2014). These evidences suggest that the ways firms plan, organise and execute the planned safety could contribute to project success. Unfortunately, the Ministry of Gender, Labour and Social

Development of Uganda (2004) asserted that there is no institution that gives full formal training in any subjects of occupational safety and health. According to Chong and Low (2014), to prevent accidents, it is essential to know the causes of accidents in a working environment. This knowledge would help to plan, manage and control accidents and ensure that projects are completed successfully. The element of safety factors are to be considered at every stage during project execution and for this reason safety should be designed and monitored (Oberlender, 2000). However, there appears to be a general lack of awareness regarding the effects of poor health and safety and this could explain in part the high rate of accidents experienced on project sites. Therefore the objective of this study is to investigate health and safety factors in the South African construction industry with a view to creating awareness as well as making recommendation on health and safety that can be pursued in enhancing project delivery.

## **2. LITERATURE REVIEW**

### **2.1 Nature of construction health and safety**

According to Ritz (1994), construction is a very risky industry with a high number of accidents. In general, accidents on site occur due to a number of factors (Sawacha, et al., 1999). Although contractors are traditionally responsible for safety, designers considering safety standards and best practices can prevent certain accidents from occurring (Malekitabar, et al., 2015). The dynamics surrounding accidents include the causes or triggers, the consequences and the mitigation parameters. Health and Safety Executive (2004) describes an incident in construction as an event that may or may not result in injury or ill health and/or an undesired circumstance or set of conditions that have the potential to cause injury or ill health. This differs from a near miss which is an incident that did not result in an injury but certainly could have, under slightly different circumstances (Geller (2001; National Safety Council, 2013). Another aspect of accidents and safety is safety hazards which combine with the nature of construction as major cause of accident (Chong and Low, 2014).

Hazard has been described as any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work (Canadian Centre for Occupational Health and safety, 2016). Chong and Low (2014) identified the types of hazards as; chemical, physical and biological, or in another way as; ergonomic, work organisation and safety hazards (Safety Line, 2015). According to Germain et al. (1998), incidents and accidents are inadequately controlled events, not only unintended events. This implies that events that are not planned for or that are ill-controlled could potentially end up in accidents. According to Oregon OSHA (2015), hazards need to be anticipated, detected and managed to

avoid occurrence. Geller (2001) had indicated that poor record keeping especially of previous accidents ultimately triggers more accidents, however, frequent reporting of near-miss incidences has proved to reduce the severity of injuries but not necessarily their numbers. In some other cases, changing work environments, mobility of workers and frequent changes in the location of construction sites have led to accidents (Auld, et al., 2001).

In Chong and Low (2014), the causes of accidents were attributed to working at high level of and the complexity of the construction project, resulting into falls. This implies that the general dynamics of how work is done on site in terms of worker movement, the changes in the working environment in terms of weather and work progress and design of the works could play a role in limiting or causing accidents. Construction accidents have also been attributed to collision of objects and equipment with other items or with people (Andolfo and Sadeghpour, 2015). Besides, accidents in construction has been attributed to poor communication and coordination between management and employees due to the fact that workers often come from different countries or have different first languages (As, 2001; Chong and Low, 2014), failure to ensure safe systems of work, poor maintenance, use of defective materials, and poor supervision and training (Haslam et al. (2005). Moreover, methods of material handling and transportation on site (Alinaitwe, et al., 2007), lack of good safety behaviour (Geller (2001), negativity and bad behaviour (Chong and Low, 2014), lack of knowledge, skill and ill training (Germain et al., 1998) were also significant causes of construction accident identified in previous studies. According to Germain et al. (1998), the causes of accidents can help with identification of the safety factors that cause them.

## **2.2 Implication of construction accidents**

According to Alinaitwe et al. (2007), construction is considered to be one of the least safe industries because of high accident rates, hence the consequences of accidents had come under focus in recent researches. Mossink and Greef (2002) asserted that the economic consequences of accidents and injuries can sometimes be identified as financial expenditures, damages or loss of resources, but effects such as psychology consequence of health damage are difficult to express in monetary terms (Babatunde and Opawole, 2009). For Hrymak and Pérezgonzález (2007), the consequence of accidents is not just a burden to businesses but also to the injured workers, their families and society in general. According to Mossink and Greef (2002), the consequences to the employer include loss of workdays, damages, medical costs, administration recruitment and loss of welfare. Rikhardsson and Impgaard (2004) pointed out that the psychological effect of accidents in terms of health, grief and suffering and quality of life as a result of workplace accidents would greatly

affect morale, mood, motivation and many other psychological traits associated with productivity and general quality of life.

### 2.3 Safety factors in construction

There are plethora of studies on factors that contribute to accidents, but studies with specific emphasis on the South African construction industry are limited. According to Geller (2001), human factor is the biggest contributing factor to almost every injury. Human contribution to construction industry has been explained by level of training, supervision and behaviour (Sawacha et al., 1999; Geller, 2001; Oswald et al. (2015). As such, Cox et al. (2005) reflected that training, as well as welfare and development are dimensions for worker commitment in construction industry. According to Oswald et al. (2015), lack of skill to perform a particular task is a hazard in itself. However, supervision has been significant in influencing the human factor to ensure safety and reduce accidents (Nelkin and Brown, 1984). Oswald et al. (2015) opined that the responsibility for worker safety would fall on the supervisor who bears knowledge that the workers are untrained to perform certain works. Another aspect of the human factor that had affected accident frequency is human behaviour (Sawacha, et al., 1999; Geller, 2001). In this regard, Geller (2001) advocated for a behaviour-based approach to safety which targets human behaviour and relies on interpersonal observation and feedback for intervention.

Machine has been identified as another factor of health and safety in construction. Haslam et al. (2005) concluded that problems arising from the human factor were present in 70% of the accidents, workplace issues in 49%, shortcomings with equipment factor (including PPE) in 56%, problems with suitability and condition of materials (27%), and deficiencies with risk management in 84% of accidents. Factors of accidents attributed to machine include lack of close supervision and monitoring (Andolfo and Sadeghpour (2015), collision with each other, and with other items like people and property (Germain, et al., 1998), faulty equipment (Vasconcelos and Junior, 2015; Haslam et al., 2005), and lack of training and skill in using machinery (Sawacha, et al., 1999).

The accident factors of construction materials include hazardous chemical composition (Nelkin and Brown, 1984; Bagley, 2013), handling (Navon and Berkovich, 2005), and housekeeping (Alinaitwe, et al., 2007). According to Sawacha et al. (1999), the awareness of hazardous materials is as important as the handling of such materials. Besides, the identity and the location of materials could be highly related to accident precursors and near-misses on construction sites (Wu, et al., 2013). In Andolfo and Sadeghpour (2015), site organisation or lay out was reported to play an important role in accident prevention and prediction model. Shimmin et al. (1980) had showed that a safe working conditions must begin at the design stage and must not be jeopardized by poor site co-ordination. According to

Alinaitwe et al. (2007), the differences in sites and changing of their working environments, mobility and manoeuvring of workers around them and frequent changes in construction site location had influenced the frequency of accidents.

### 3. RESEARCH METHODOLOGY

The study adopted a quantitative approach. The target population were safety consultants, quantity surveyors, engineers and project managers from the government organizations as well as medium and large private construction firms. Forty (40) of these were randomly selected throughout South Africa. The questionnaire for the study was subdivided into two sections. Section A identified the profile of the respondent, and B sought the safety factors that influence accidents on site. A pilot survey involving 10 respondents was earlier conducted with the aim of eliminating shortcomings as well as testing the user-friendliness of the questionnaire prior to production of the final copy. Majority of the questionnaires were distributed through e-mail since most respondents when contacted explained that they would rather fill in a soft copy rather than a hard copy. To improve the response rate, the respondents were communicated through e-mails and where possible followed up with phone calls. Questionnaires were also distributed according to categories to ensure a fair mix of responses and reduce the effect of none-response. The respondents were informed of their rights to voluntarily consent or decline to participate, and to withdraw participation at any time without penalty. The participants were given a brief about the purpose of the study, the procedures that would be used to collect the data, and assured that there was no cost to be incurred by them and that their involvement and responses shall be kept confidential. Anonymity and confidentiality were maintained throughout the study. For respondents available within the Free State province, hard copies were self-administered and some completed copies were scanned and e-mailed by the respondents. Primary data collected were analysed using descriptive statistics. The assessment was based on Kazaz *et al.* (2008) evaluation scale of data interpretation for likert scale ranking as shown in Table 3.1. The evaluation scale was divided into two columns. Column 1 and 2 measure the level of significance and the values of the data analysed respectively. A scale value of data  $\leq 1.80$  is ignorable, those 1.80 to 2.60 were considered as somewhat important, and a scale value of  $\geq 2.60$  but  $\leq 3.40$  were regarded as significant. Scale value of mean item score ( $\bar{T}$ ), where  $3.40 \leq \bar{T} \leq 4.20$  was considered very significant while a scale value of  $4.20 \leq \bar{T} \leq 5.00$  was interpreted very significant.

**Table 3.1:** The evaluation scale for data

Level of Significance	Scale value
Not Significant (NS)	$\geq 1.80$
Somewhat Significant (SS)	$1.80 \leq 2.60$
Significant (S)	$2.60 \leq 3.40$
Very Significant (VS)	$3.40 \leq 4.20$
Extremely Significant (ES)	$4.20 \leq 5.00$

(Adapted from Kazaz *et al.*, 2008).

## 4. RESULTS AND ANALYSIS

### 4.1 Respondents' profiles

The analysis was based on 27 valid questionnaires (67.5% response rate) retrieved from a total of forty (40) copies administered. The respondents were distributed as; directors (44.0%), project/construction managers (7.0%), architects (7.0%), quantity surveyors (19.0%), mechanical engineers (4.0%), builders (4.0%), health and safety officer (11.0%), and others specified as CAD draughts man (4.0%). About 48.0% of the respondents had at least a professional registration compared to 52.0% percent who did not. The results of the educational qualifications of the respondents showed that 41.0% held a first degree, 15.0% had a tertiary institution diploma, 41.0% obtained more than one degree, while none of the respondents had less than secondary school certificate qualifications. The profile of the respondents indicated that data obtained were quite suitable and can be used to make a reliable conclusion.

**Table 4.1:** Profile of respondent

Profile	Frequency	%
<b>Educational qualification</b>		
Secondary school certificate	1	4
Tertiary institution diploma	4	15
Tertiary institution first degree	11	41
Tertiary institution more than one degree	11	41
<b>Official cadre/Type</b>		
Director/share holder	12	44
Project/Construction manager	2	7
Architect	2	7
Quantity surveyor	5	19
Mechanical engineer	1	4
Building/ construction contractor	1	4
HSE officer	3	11
Others	1	4
<b>Years of working experience</b>		
1-5 years	5	19
6-10 years	3	11

11-20 years	6	22
21-45 years	12	44
45 years and above	1	4
<b>Total</b>	<b>27</b>	<b>100%</b>

#### 4.2 Assessment of safety factor groups influencing accidents on site

Five main factor groups identified in literature comprising human, equipment, material, work place or site and environment factors were evaluated to show their levels of contribution to construction accidents. The significance of the sub-variables in each case was evaluated based on Kazaz *et al.* (2008). Five human safety factors were identified as shown in Table 5.1. One of these was found to be very significant ( $3.4 \leq \bar{x} \leq 4.2$ ) and the other four were found to be extremely significant ( $\bar{x} \geq 4.20$ ). Lack of staff training in HSE practices ranked first with mean item score (MIS) of 4.63, while lack of expert supervision in the works trade ranked least with an index of 4.41. These results showed that human safety factors were those that are influenced by training and supervision. The implication, however, is that if the human factors are identified, planned, and controlled by supervisors, accidents would be substantially minimised. These findings agree with earlier studies (Geller, 2001; Haslam *et al.* (2005; Oswald *et al.* (2015). Oswald, *et al.* (2015) had opined that the responsibility for workers' safety fall on the supervisors who should ensure that they are adequately trained before they handle tasks.

Table 5.1: Human safety factors

Factors	Rank	EL	Min	Max	Mean	SD
Training, supervision and human behaviour						
Lack of staff training in HSE practices	1	ES	3	5	4.63	.0.565
Lack of HSE supervision	2	ES	2	5	4.52	0.802
Poor safety behaviour	3	ES	2	5	4.41	0.931
Lack of staff skills in work execution	4	ES	2	5	4.33	0.832
Lack of expert supervision in the works trade	5	VS	2	5	4.15	0.907
Average		ES			4.41	

SD = Standard deviation, Min = Minimum, Max = Maximum, EL = Effect level

The significance of equipment safety factors is evaluated in Table 5.2. All the factors were found to be extremely significant ( $\bar{x} \geq 4.20$ ). Viewed as a group, equipment safety factor was found to be the most significant in causing accident with an index of 4.44 (extremely significant/ES) (Table 5.7). Seven variables investigated in this group indicated a lack of and

improper use of personal protective equipment (PPE) to be the most important (MIS = 4.58), while use of untrained personnel to operate equipment (MIS = 4.56) ranked second most significant. Unsafe behaviour while working with and around equipment (extremely significant/ES, 4.52) ranked third most important. Lack of HSE supervision during operation of machinery (4.30) and lack of equipment records, monitoring of equipment usage, activity and storage (4.26) ranked sixth seventh respectively to be the least equipment variables.

**Table 5.2:** Equipment safety factors

<b>Factors</b>	<b>Rank</b>	<b>EL</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>
Lack of and improper use of personal protective equipment (PPE)	1	ES	2	5	4.58	0.801
Use of untrained personnel to operate equipment	2	ES	1	5	4.56	1.086
Unsafe behaviour while working with and around equipment	3	ES	1	5	4.52	0.893
Lack of inspection and testing of machinery prior to works execution	4	ES	3	5	4.44	1.097
Lack of maintenance and servicing for equipment	5	ES	2	5	4.41	0.844
Lack of HSE supervision during operation of machinery	6	ES	2	5	4.30	0.775
Lack of equipment records, monitoring of equipment usage, activity and storage	7	ES	2	5	4.26	0.984
<b>Average</b>		ES			4.44	

SD = Standard deviation, Min = Minimum, Max = Maximum, EL = Effect level

In Table 5.3, six material safety variables were evaluated. Poor techniques and planning while moving equipment over long distances was most significant at MIS of 4.37, making it to rank first. Lack of personal protective equipment (PPE) while applying materials (4.37) ranked second followed by lack of PPE while moving, off loading and loading of materials (4.33), which ranked third most important. Poor disposal of waste material (very significant at 4.19) ranked sixth most important in influencing safety behaviour at the work place and hence reducing the rate of accidents. The material safety factors were those identified that that can be treated through increased precaution in handling storage and usage in the work area to minimise accidents (Navon and Berkovich, 2005).

**Table 5.3:** Material safety factors

Factor	Rank	EL	Min	Max	Mean	SD
Handling, storage and usage						
Poor techniques and planning while moving equipment over long distances	1	ES	2	5	4.37	0.967
Lack of personal protective equipment (PPE) while applying materials	2	ES	3	5	4.37	0.688
Lack of personal protective equipment (PPE) while moving, off loading and loading of materials	3	ES	3	5	4.33	0.784
Ignoring of materials data sheets (MSDs) or instructions given by the manufacturer instructions from the manufacturer would minimise accidents	4	ES	1	5	4.26	0.944
Improper storage and storage techniques	5	ES	2	5	4.22	0.892
Poor disposal of waste material	6	VS	1	5	4.19	1.210
Average		ES			4.29	

SD = Standard deviation, Min = Minimum, Max = Maximum, EL = Effect level

The significance of workplace or site safety factors (Table 5.5) showed the most significant variable as poor housekeeping on site (MIS = 4.59). Viewed as a group, work place or site safety sub-factors were found to be the third most important group with an index of 4.33. Poor site layout ranked second and it is extremely significant at 4.41(Kazaz *et al.* (2008). On the other hand, high complexity of sites in terms of high mechanisation, very many floors and basements etc., was ranked as fourth and least most important (3.89). Findings agree with Alinaitwe *et al.* (2007) on the significance of construction work place. The low ranking of complexity of the construction project (though still very significant) indicated a slight

disagreement with Chong and Low (2014) on the significance of the complexity of the construction project resulting into accidents.

**Table 5.4:** Workplace or site safety factors

<b>Factor</b>	<b>Rank</b>	<b>EL</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>
Poor housekeeping on site	1	ES	3	5	4.59	.0.694
Poor site layout	2	ES	2	5	4.41	0.888
Lack of safety signage on site	3	ES	3	5	4.41	0.747
High Complexity of sites in terms of high mechanisation, very many floors and basements etc.	4	VS	1	5	3.89	1.281
Average		ES			4.33	

SD = Standard deviation, Min = Minimum, Max = Maximum, EL = Effect level

Five environmental variables were investigated in this group, and adverse weather including heavy rainfall, hurricanes, storms, wind (3.89) was found to be the most influential, while harm by wild animals (snakes, lions, cheetahs, hyenas etc.) (3.70) ranked second most important. Disease outbreaks (cholera, Ebola, flu etc.) (3.63) ranked third; social factors such as nearby parties, parades, and games (3.63) ranked fourth; and political factors such as riots, wars and demonstrations (3.30) ranked fifth and least important in influencing safety related to external environmental factors. The evidence of the five environment factors results evaluated showed that external factors can also contribute to accidents and can be controlled by adequate preparation and setting of all necessary emergency responses.

**Table 5.5:** Environmental factors

<b>Factor</b>	<b>Rank</b>	<b>EL</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>
Adverse weather i.e. heavy rainfall, hurricanes, storms, wind etc.	1	VS	1	5	3.89	1.188
Wild animals (snakes, lions, cheetahs, hyenas etc.)	2	VS	1	5	3.70	1.235
Disease outbreaks (cholera, Ebola, flu etc.)	3	VS	1	5	3.63	1.182

Social factors such as nearby parties, parades, games etc.	4	VS	1	5	3.63	1.245
Political factors such as riots, wars and demonstrations	5		1	5	3.30	1.325
Average		VS			3.63	

SD = Standard deviation, Min = Minimum, Max = Maximum, EL = Effect level

### 4.3 Group assessment of the construction safety factors

The results of the significance of the group safety factors are presented in Table 5.6. The safety factors identified were human, equipment, material, site or workplace and environment. The scale involving rating on interval scale of 1 through 5, where 1 and 5 represent the least the highest rating respectively was used to rank the factors and the results were interpreted based on Kazaz *et al.* (2008) (Table 4.1). Equipment factor ranked the most significant in influencing safety on site while environment factors are identified as the least significant main factor as shown in Table 5.6. These results show that an efficient management of equipment could contribute a significant reduction to health and safety working environments in construction site towards improving the overall project success.

Table 5.6: Main safety factors groups ranking

Factor	Mean	Rank in total
Equipment	4.44	1
Human	4.41	2
Work place and site	4.33	3
Material	4.29	4
Environment	3.63	5

## 5. CONCLUSION

This study investigated accident factors on construction site towards safety working environments and enhancing the overall project success. Twenty seven safety variables were evaluated under five factors; human, equipment, material, workplace and environmental factor. The results showed different levels of significance of the variables within the five main group factors. However, equipment related variables exhibited higher level of significance, thus implying the imperativeness of efficient equipment management in achieving a safer site and enhancing project success. On the other hand, environmental factor appears to be of little influence in term of site safety as their impact could be foreseeable and controlled.

Notwithstanding, a more robust assessment of their influence may be considered in future research.

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## **The Effects of Weight Lifting Belts on Manual Labourers in the Construction Industry: South Africa, Gauteng**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

Lower back pain and injuries occur every year that results in labour intensive employees being absent from work, which has a major effect on productivity levels within any construction project.

#### **Design/methodology/approach**

Field experiments were conducted and a sample of eight participants with different task activities was monitored over a 2 week period. Participants were interviewed before and after they used the weight lifting belts. The researchers observed the workers during the study to ensure that the work executed with the weight lifting belt was consistent with the previous week and each participant also had to complete a questionnaire after the work was completed.

#### **Findings**

There was no evidence to support the fact that the weight lifting belt will improve productivity on construction sites. The activities that did receive positive feedback included electric breakers and telescopic handler operators.

**Research limitations/implications**

This study was conducted on a construction site located in Pretoria East.

**What is original/value of paper**

The weight lifting belt could be tested with other technologies that could make it more comfortable and safer to wear. Further research should be conducted to determine if it should become part of standard PPE regulations for certain trades.

**Keywords:**

Weight lifting belts, Lower back pain, Labour, Operators, Production, and Construction.

**1. INTRODUCTION**

One clear problem that does exist is the ever-increasing existence and medical problem of labour intensive employees reporting back pains and injuries. According to the World Health Organization's International Labour Office, "musculoskeletal diseases" relating to lower back pain and discomfort, is listed as one of the most common medical conditions in labour intensive industries such as the construction industry, where manual labour forms the essence of the delivered service (Spinasant, 2015). Over 268 million non-fatal workplace accidents and injuries occur every year in which employees miss at least three workdays per employee per year, which has a major effect on productivity levels within any business. (Spinasant, 2015)

Musculoskeletal injuries are among the most common problems in occupational medicine. The National Institute for Occupational Safety and Health reported that about 35% of all compensation claims are related to back injuries (Margaret J. Rys, 1995). The NIOSH also reported that still today, approximately one third of the workforce is required to exercise manual labour daily (Margaret J. Rys, 1995). Dynamic pushing and pulling activities are a common requirement in many occupations and of the above-mentioned medical problems, 67% of back accidents were due to lifting and 20% due to pushing and pulling (Margaret J. Rys, 1995).

Wearing a weight lifting belt during physical activities has been shown to increase core development and lower-back muscles by promoting the correct form when lifting or moving heavy objects (Jim Stoppani, 2016). Through continuous use of the weight lifting belt, together with proper and appropriate form when lifting or moving heavy objects, the supporting muscles will develop and become stronger over time, thus taking the strain off your lower back (Jim Stoppani, 2016). By wearing a weight lifting belt, less strain will be put on the lower back and spine, which are the usual sources of severe pain and discomfort caused by any type of movement

that puts undue stress on the lower back (Peter F. Ullrich, 2012). This could lead, not only, to increased health benefits of general labourers on a construction site, but also increased performance of the work rate and efficiency in both the short-term and long-term (Jim Stoppani, 2016).

There is a group of researchers who do not support the beneficial claim of a weight lifting belt. The main problem found by these researchers is the manner of its use (Margaret J. Rys, 1995). The weight lifting belt interferes with the normal operation and mechanisms of the human body (Margaret J. Rys, 1995). Long-term use of the weight lifting belt may cause the body to become incapable to cope with physical activities in absence of a weight lifting belt (ROHMANN, 2015). Further research shows that the extensive use may cause lower back muscles to weaken as the weight lifting belt bears some of the strain that will normally be exerted on the muscles. Yet, the same strain may cause severe injury, pain and discomfort if the weight lifting belt is not worn (ROHMANN, 2015).

Lower back pain is the cause of high economic burdens right across the world per the 2010 Global Burden of Disease Study (Warren Kaplan, 2013). A decrease in physical activity causes limitations in movement during work and may lead to work absence, thus placing significant economic burdens on individuals, families, businesses and governments (Warren Kaplan, 2013).

Several studies confirm that employees, especially in work groups related to manual labour, suffer from lower back pain, which in Europe alone leads to more than 100 million work days lost per year when considering the amount of people who are affected by lower back pain on work days (Warren Kaplan, 2013). A Swedish study suggests that lower back pain is one of the direct causes of the workdays lost, increasing from 7 million to 28 million in seven years. In the United States alone, 149 million work days are lost as a direct result in lower back pain, accounting for more than 100 billion dollars in costs each year (Warren Kaplan, 2013).

According to (Udo, et al., 1993), the effects of wearing a preventive belt was studied during a normal working day of sixty male crane operators who had experienced lower back pain during the course of their careers. The work involves long hours of sitting as well as whole body vibration experienced on a regular basis with minimal breaks. Half of the workers were given weight lifting belts and the other half was not given weight lifting belts. The test was conducted for a period of one year.

In the weight lifting belt group, more than half of the people showed an improvement in the kinetic pain score or in muscle tenderness as compared with a third for the workers who did not wear the weight lifting belt. There was also a significant improvement in complaints of general back pain of those participants who wore the weight lifting belts. In this case, the weight lifting belts can be worn on a more permanent basis because of the minimal physical movement and more controlled environment the operators find themselves in, compared to that of the baggage handlers. (Udo, et al., 1993).

According to the Michigan Municipal Workers' Compensation Fund, consensus has not yet been reached on the effectiveness of weight lifting belts in any working industry of modern economies. Therefore, each company or organization should decide for itself whether to implement the use of weight lifting belts as part of their required working equipment or not. If a company decides to use the weight lifting belt, then the weight lifting belt should be supplied together with a comprehensive training program that will teach users how to use the weight lifting belt and how to conduct manual lifting correctly and safely. (Fund, 2017) (Margaret J. Rys, 1995).

A redesign of how the employees execute these activities, as to ensure a safer working environment, is not always possible or feasible. As an addition to task redesign, weight lifting belts can be promoted by management and provided to employees. This helps to alleviate and reduce the physical demands that these employees exert daily on their bodies. Although there is of yet no conclusive evidence that weight lifting belts will protect against lower-back pain or lower-back disability, further research into this topic may persuade industry leaders.

## **2. The role of the mind when using the weight lifting belt**

It is known that tests are often conducted with the fear that the test participants are prone to show improved conditions only because of the mere suggestion that the treatment will help. This effect is commonly referred to as the placebo response. It takes name from a remarkable phenomenon in which a fake treatment can sometimes improve a patient's condition simply because the person has the expectation that it will be helpful. The more a person believes they will benefit from the treatment, the more likely they are to report a benefit. (MedicineNet, 2016) (Harvard Health Publications, 2017)

These factors raise concern that the weight lifting belt might just withdraw the placebo response without the participants even realizing it. The placebo response often creates deception in research and is constantly seen as a bump in the road towards achieving a conclusive, honest study outcome that can be presented truthfully to the end user. It has since been used to determine how well new medicine works and how older methods are proven to be only a factor of the mind.

To ensure the study stays objective, the facts on why the weight lifting belt is issued to the participant will not be fully communicated to the participants and this study will shift more focus on the productivity of labourers rather than out right health improvements.

### **3. Factors that influence productivity and efficiency of construction labourers**

Construction managers are not only required to concentrate on building technologies and management of material resources, but also pay attention to the workforce itself, an entity whose behaviour cannot be easily predicted (Lill, 2008). To achieve improved worker efficiency on site, qualified construction managers as well as the experience of the site supervisors will be a huge advantage to the company cause. The balance between construction project requirements and the needs of workers in the construction industry can also determine the level of construction labour efficiency (Lill, 2008) (A Kazaz, 2008).

Safer work practices can also lower the risk of injuries and thus improve overall efficiency and productivity of a construction labourer. The most important reasons to maintain proper form during heavy lifting, is to prevent injury (NFPT, 2016). The proper lifting technique requires more energy, but the benefits include decreased pressure on the back muscles and discs, thus providing safe lifting (Neck Solutions, 2013). The right training and safety meetings on a construction site on a regular basis can be implemented to educate labourers on proper lifting techniques. This could reduce working related injuries and strains resulting in higher efficiency and less absentees from work. Research shows no clear evidence that any one technique is better than the other, but most conclusions lead to the answer that by refraining from bending your back when lifting an object will definitely prevent long-term damage to the lower back (Straker, 2003) (A Nelson, 2004). The Office of Environmental Health and Safety has a short training guide on the subject and how to implement the safe lifting technique without the help of any added equipment (Office of Environmental Health and Safety, 2003).

One may then ask, why do we go through the trouble of conducting an experiment on the efficiency and productivity that a weight lifting belt may have on a labourer? Well, according to a European study done by (PFM Kuijer, 2016) on working conditions, 35% of the employees reported manual lifting or carrying of loads on a regular basis. Despite the automation, workers are just as exposed to lifting and carrying as they were 10 years ago (PFM Kuijer, 2016). In the Netherlands, more than 20% of employees think that preventive measures are needed to reduce the physical workload (PFM Kuijer, 2016). They also found that lower back pain, is second only to the flu in most reasons for sick leave at an astounding 15% of the annual number of sick leave days (PFM Kuijer, 2016). In 2013, occupational physicians in the Netherlands reported 505 cases of back pain as occupational diseases (PFM Kuijer, 2016). This is 26% of the total number of reported occupational musculoskeletal disorders (PFM Kuijer, 2016). Similar results have been reported for Korea (Kim KH, 2010) and the United Kingdom (Hussey L, 2010).

According to (Punnett L, 2005), 37% of adult cases of lower back pain are attributed to occupation worldwide, with an estimated annual loss of 818 000 disability-adjusted life years worldwide. Although knowledge is gained about the possible work-related causes and prevention of lower back pain, we are making little progress in preventing this important complaint (Punnett L, 2005). (van Duijvenbode, et al., 2008) reviewed the effects of lumbar support for prevention of lower back pain and found inconclusive evidence whether the supports were effective supplements to other preventive interventions. This is conclusive support that there is a need for preventive measures and to determine whether the weight lifting belt will indeed be the solution.

## **5. METHODOLOGY**

The aim of the research study was to investigate if a weight lifting belt can reduce lower back pain within certain trades. The objective was to identify different trades and conduct field experiments on a construction site. The construction site used to conduct the research study is located in Pretoria East on the corner of Botterklapper and Ilanga Road, which is situated right next to the well-known Lynnwood Road. For the research methodology, only one site was used to gather all the relevant data for the specific study. The reason for making use of only one construction site was because there was one research member that was working full time on this construction site and he could control the use of the weight lifting belt amongst the participants and he could control the work executed by the workers.

### **5.1 Sampling**

A total of eight participants were used to determine if a weight lifting belt is increasing efficiency and productivity on the construction site. The research team started with the tests on the 28<sup>th</sup> of August 2017, for two weeks, until the 10<sup>th</sup> of September 2017, where the members tested the participants working with the weight lifting belt. On the 11<sup>th</sup> of September, the participants did exactly the same work for another two weeks, but this time without wearing the weight lifting belt. The participants did this until the 24<sup>th</sup> of September.

The temperature on site for the period the participants were tested was constant throughout, at an average midday temperature of 28 degrees Celsius. Each participant was monitored on site, while wearing the weight lifting belt for two weeks. The weight lifting belt was rotated between the participants to ensure that there was enough time for each worker to

experience the change, if any, between wearing the weight lifting belt while working, and not wearing the weight lifting belt while working.

From the eight participants used, the following is a breakdown of the different work executed by the participants:

1. Two of the participants worked on scaffolding, that includes the erecting and moving of the scaffolding as well as breaking down and cleaning the scaffolding.
2. Two of the participants worked as operators on a telescopic handler. Materials such as bricks, mortar, tools were needed on the second floor of the building. The two operators took turns at operating the machine. While the one participant was operating the machine the other was giving directions at the front as to where to unload the bricks, mortar, tools. The operators made turns every three hours to operate the telescopic handler.
3. Two of the participants were doing patchwork throughout the construction site. One of the participants was tiling for the duration of time alone, while the other participant was only doing plastering work. The two participants were monitored closely to ensure they do the exact same work every day, and that they do not switch between tiling and plastering, as this would make the study inaccurate.
4. One participant was working alone with a vibratory rammer, compacting the ground for pavement and compacting around the site where loose ground was located. The last participant worked with an electric breaker, where it was required from him to break down a small concrete balcony on the second floor that was not built according to specification. The balcony failed to be built to specification again, and it was required that the participant break down the balcony for a second time. This participant was monitored on both occasions whereby he used the weight lifting belt for the first breakdown and then the second time he did not make use of the weight lifting belt.

At the end of every week, each participant was questioned with a relative questionnaire, so all the required data was gathered to ensure accurate results. For two of the participants interviewed (one of the scaffolding participants and one of the patchwork participants), we had to make use of a worker on site that could help translate the questions to the participant's language so we could get all the correct data from the participant. Each interview was around 15 minutes long and each worker was interviewed four times in total. All the interviews were verbal and the interviewer took all notes on paper. The questions used, were of such nature that the respondents had the opportunity to share all detail and how they felt working with or working without the weight lifting belt. All data was collected from the respondents and accurate results could be drawn up.

The team members on the construction site monitored the participants, and training was given to each participant on how to use the weight lifting belt to ensure that it was used for the time period required. The participants could do the same type of work with and without the

weight lifting belt. We committed these eight participants towards the exact same work each day for the whole period.

## 5.2 Data Analysis

Various research methods were implemented on the participants, following:

- 1) Field experiments were conducted every day in the environment where different participants were interacting in different situations. On the construction site different participants were tested with the weight lifting belt and feedback was given by the participants. By doing a field experiment it gave the research team a more accurate result on how effective the weight lifting belt really is on site while doing different work (McLeod, 2007).
- 2) Interviews were also done on the construction site with the participants to gather all required data on the weight lifting belt. Unstructured interviews were executed on all the participants so that they could give their personal opinions on the weight lifting belt and how they found the effectiveness of the weight lifting belt. Qualitative data was collected on site, and it was used to determine if the weight lifting belt will be beneficial towards productivity on the construction site.
- 3) Questionnaires were also used on site to get feedback from the participants in a written format. The authors made use of questions where the applicants only had to answer by indicating a yes or no by ticking the respective box. A wide variety of questions were given to the applicants to collect all data to ensure an accurate end result.

## 5. RESULTS AND FINDINGS

The main reason for this study aroused from the daily observations made from people involved on a construction site, who identified that there is a relation between heavy lifting and decreased productivity. The results showed that more than half the individuals experience back pain in one way or another during a normal day of work, which could be drawn to the fact that 88 % of the individuals questioned, did not know how to correctly lift heavy objects to prevent any strain on their lower back. 82 % of the participants do not know how to use, wear or adjust the weight lifting belt to maximize its performance. A worrying statistic is that none of them knew that there are possible disadvantages when wearing the weight lifting belt continuously.

The questionnaire gave an insight on the daily habits the individuals have during the working day. This included taking frequent breaks due to pain and discomfort. 50 % of the participants agreed that they could be more productive if they had a supportive wearable to prevent and reduce back strain or back pain, but they had a concern that the product would be too uncomfortable and thus limit their movement.

The participants were then given the weight lifting belt and they were observed by the research team to evaluate the performance while wearing the weight lifting belt. The participants also had to complete a questionnaire during their observation period to give feedback on their view and feeling towards the weight lifting belt. From the observations made, it was not noticeably clear whether the participants were more productive during a normal day, but they did take less frequent breaks and showed a more positive approach to their daily tasks.

The results from the questionnaire supported this theory, as 71 % of the participants indicated that they would recommend the weight lifting belt to their colleagues even though 63 % of the participants found the weight lifting belt to be uncomfortable. The participants had some scientism towards the fact that the weight lifting belt might make them more productive during a normal working day and that 75 % of the participants did not notice a difference in the amount of weight they could lift while wearing the weight lifting belt. These results are in line with the theory made in our research that the weight lifting belt might only have more noticeable effects on a long-term basis.

After the observation period, the research team allowed the participants to complete another section of questionnaire, to determine if the participants might have a different feeling about the weight lifting belt after a prolonged period. The questions focused more on what could not be tested, and the general feeling the participants had that used the weight lifting belt daily. The results showed that the teams involved in more labour-intensive areas have more objective views and showed more positive results throughout. The participants complain less of tiredness and they could notice a significant improvement after wearing the weight lifting belt. The participants also noted less discomfort from the weight lifting belt focusing more on the positive aspects other than the negative aspects.

There was, however, a clear agreement from all trades involved that the belt does reduce the amount of back pain they experience from a normal day of work. The participants also agreed, after the study, that they would recommend the weight lifting belt to their colleagues, but only if improvements are made to the weight lifting belt. Improvements to the material of the weight lifting belt will need to be made to create a more comfortable weight lifting belt for the extensive time periods that the individuals will wear the weight lifting belt.

The results further indicated a clear distinction that the participants using the electric breaker and the telescopic handler may benefit much more from this technology, as these participants had a more positive feedback on the usage of the weight lifting belt. On conclusion of our study the operators approached the authors to ask if they could continue using the weight lifting belts for their benefit, as they enjoyed using the weight lifting belt.

The results also show a positive mind set towards the weight lifting belt and therefore the study could grow and more research can be done to determine if the weight lifting belt does have long term advantages. There will however be some negative effects to look out for. The weight lifting belt

might cause discomfort to the labourer and affect his efficiency and productivity on site. The weight lifting belt might also not be effective to all labourers, and the cost implication of implementing the weight lifting belt might not be worth it to all the trades associated within the construction industry. Monitoring the labourers and their reaction towards the weight lifting belt, constantly, can mitigate these effects and ensure a safe, productive workforce at all times.

## 6. CONCLUSIONS

There was no conclusive evidence to support the fact that the weight lifting belt will improve productivity on construction sites. There was, however, positive feedback from certain labour trades and clear improvement in their approach to their respective fields of work.

The result clearly indicates that there are a few activities that benefit more from the use of a weight lifting belt than others. The activities specifically include an electric breaker and telescopic handler operators, which in turn can suggest benefiting all kinds of operators. There are few untested activities that were not tested conclusively which might also benefit from the weight lifting belt, including concrete workers and bricklayers.

Although we did not conduct conclusive tests with the weight lifting belt in conjunction with other technology, we can see from the results that the weight lifting belt can be improved in several ways to suit the construction industry.

The site conditions caused sweat under the weight lifting belts which led to irritation and discomfort. Slight improvements might encourage the labourers to wear the belt more regularly and for longer periods of time during working hours. The weight lifting belt could also be tested with other technologies including the integration with exoskeletons that are being developed and safety harnesses that could make the weight lifting belt more comfortable and safer to wear. This will essentially make the weight lifting belt a crucial part of all labourer's daily workwear.

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## **An analysis of the causes of construction accidents in South Africa: A case study approach**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper:**

This paper analyses the causes identified in accident investigation reports in order to determine if the causes identified are incorrect in order to determine the effectiveness of the subsequent preventative and remedial measures and the prevention of the recurrence of the same accidents. This paper only reports on part of the study.

#### **Design/methodology/approach:**

This study employs a qualitative research approach. A combination of exploratory and collective case study was done on construction accident causation where a sample of 30 accidents drawn from actual investigation records of a large construction company was examined to determine their recorded causes. These were compared against the various causation theories to determine if the correct root causes and remedial action was identified and whether the same accident is likely to recur or not.

#### **Findings:**

The findings indicate that accident investigation processes are ineffective as they primarily focus on the direct or trigger cause of an accident and not the underlying root cause. This leads to the incorrect remedial action taken ultimately resulting in the accident reoccurring. The findings cannot be generalized to the entire industry but gives insight into the possibility that other companies might be doing the same thing.

**Research Limitations:**

The accident investigation records to be analysed will consist of 30 cases of construction accidents that occurred in a particular construction company and not all accident causation theories were reviewed and analysed due to timeframe constraints.

**What is the value of paper?:**

This study aims to prove that construction accidents recur due to ineffective accident investigation processes which focus on direct causes instead of underlying root causes.

**Keywords:**

Accident causation, Health and Safety, Construction Accidents

## 1. INTRODUCTION

Many accidents involving loss of life and limb have occurred on construction sites across South Africa. Consequently, these accidents have created negative impressions of the industry and sector (CIDB, 2009). The examination of the causation of accidents is necessary considering the potential consequences of high casualty tolls, environmental damage, economic losses and ethical/moral considerations (Saleh and Pendley, 2012). It is well-known that construction represents a challenging regime in which to manage health and safety exacerbated by the enormous diversity in terms of the size and range of its activities (HSE, 2001). Poor health and safety (H&S) not only negatively affects workers lives which is always top priority, it also negatively affects project costs, quality, schedule and results in increased insurance premiums, medical costs and reduced productivity (Irizarry, Simonsen, and Abraham, 2005). Additionally, construction activities occur in hazardous working environments with direct exposure to many hazards that are not necessarily present in other industries or working environments. Benefits of improved H&S include increased efficiency, enhanced competitiveness, increased profitability, reduced delays, fewer disputes and reduced conflict (Arboleda and Abraham, 200

Health and safety improvements in the workplace are developed and shaped because of the knowledge gained and assumptions made from accidents that have occurred (Gibb, Lingard, Behm and Cooke, 2014). Understanding what causes accidents is important as it helps distinguish

between factors that require attention and remedial action and factors that are unimportant and can be ignored (Swuste, 2008). There are several theories that exist created by scholars in attempts to provide understanding of the causation of accidents on construction sites. Despite these theories, accidents have continued unabated. Typically, these theories have focused on the construction worker as being the primary cause of accidents – a basic tenet of the behavioural safety approach espoused by Krause and Hidley (1990) and others. According to Whittington et al. (1992), emphasis on individual failures resulted in a reliance on short-term solutions rather than uncovering more fundamental management or organisational problems. Generally, the proposed remedy targeted a specific event or operative, such that no effort was made to uncover the underlying cause of the accident. The HSE (2001) observed that changes at the direct level alone would not deliver the degree of change being sought, nor would the resultant improvement be sustained.

## **2. LITERATURE REVIEW**

In discussing accident prevention, it is important to clarify the terms "accident" and "incident." The term "accident" implies that the event was not expected, foreseen or intended sometimes resulting from negligence that results in injury, loss or damage (Asanka and Ranasinghe, 2015: SAMTRAC, 2017). An "incident" is defined as a minor happening, an event or an occurrence, whether predictable or not, that takes place because of something else (Marks, Teizer and Hinze, 2014).

The same types of accidents occur repetitively in the construction industry around the world. Many of the construction hazards are well known. Despite extensive research on many of these hazards they seem to continue to occur with the same incidence of death, injury and illness. Statistically, it is generally understood where deaths, injuries and illnesses are most likely to occur in the construction industry. However, the industry has been more than lethargic to learn from its mistakes and introduce interventions to prevent these outcomes (Lingard and Rowlinson, 2005).

### **2.1 Accident Causation Theories**

There are a vast number of theories about the causes of accidents on construction sites that are typically regarded as dangerous and hazardous working environments (Smallwood and Haupt, 2001). Some of the better known older theories include, for example, the following:

- Accident Proneness Theory
- Goals-Freedom-Alertness Theory
- Adjustment Stress Theory

- Chain of events (Domino theory)
- Distractions Theory

Examples of the more recent accident causation theories include, for example, the following:

- Reason's Framework for Accident Causation;
- Constraint-Response Theory;
- Multiple Causation Model;
- Human Error Theories; and
- Model of Causal Influences in Construction Accidents.

Accidents are preventable and should be regarded as failures of management (Hudson, 2014). None of the theories comprehensively addresses these issues. However, in line with the more modern accident theories, the aim of organisations should be to shift the emphasis from errors on the part of the individual to the management and organisational errors that cause poor health and safety performance.

Table 2.1: Summary of accident causation theories

Theory/Model	Focus of accident causation and target of corrective action	Ref
Accident Proneness Theory	On Worker	A
Goals-Freedom-Alertness Theory	On Worker	B
Adjustment Stress Theory	On Worker	C
Distractions Theory	On Worker	D
Chain of events - (Domino theory) – Heinrich's Theory	Social & Family Background	E1
	Personal Factors (greed, stupidity, recklessness could be in a person's nature or learned, etc.	E2
	Unsafe Acts (on the worker); Unsafe Conditions (mechanical or physical hazards)	E3
Chain of events - Bird's and Loftus' Updated Domino Theory	<b>Immediate Causes:</b> Unsafe Acts (on the worker); Conditions (mechanical or physical hazards); or Errors	F1
	<b>Basic (contributing) Causes:</b> Personal Factors (fatigue, lack of motivation, insufficient safety knowledge), or Job Factors (unrealistic work schedules, inadequate resources, etc.).	F2
	<b>Lack of Control by Management Root causes</b>	F3
Multiple Causation Model	<b>Management System (Root Causes):</b> Management Policies, Procedures, Supervision, Effectiveness, Training, etc.	G
Reason's	<b>Active Failures:</b> On Worker	H1

Theory/Model	Focus of accident causation and target of corrective action	Ref	
Framework for Accident Causation	<b>Latent Failures:</b> Head Office and Site Management Levels	H2	
Constraint-Response Theory	<b>Proximal Factors:</b> Site Management and on Injured Worker Levels	I1	
	<b>Distal Factors:</b> Management Level and Includes Project Conception Restraints; Project Design and Project Management Constraints;	I2	
Human Error Theories	<b>Behaviour Based Models:</b> On Worker	J1	
	<b>Human Factor Models:</b> On Worker; and Design of Tasks, Tools, and Workplaces	J2	
Hierarchy of Causal Influences in Construction Accidents Model	Immediate Accident Circumstances:	<b>Work Team:</b> Actions, Behaviour, Capabilities and Communication	K1
		<b>The Workplace:</b> Layout/Space, Lighting/Noise, Hot/Cold/Wet, Local Hazards	K2
		<b>Materials and Equipment:</b> Suitability, Usability, Condition	K3
	Shaping Factors:	<b>Work Team:</b> Attitudes, Motivations, Knowledge, Skills, Supervision, Health and Fatigue	K4
		<b>The Workplace:</b> Site Constraints, Work Scheduling and Housekeeping	K5
		<b>Materials and Equipment:</b> Design, Specification and Supply/Availability	K6
		<b>Originating Influences (Root Causes):</b> Permanent Works Design, Project Management, Construction Processes, Safety Culture, Risk Management, Client Requirements, Economic Climate and Education Provision	K7
System of Influences Approach Model	<b>Direct Level - Human and Technical Systems:</b> Competence, Motivation/Morale, Team Working, Situational Awareness/Risk Perception, Fatigue/Alertness, Health, Communications, Information/Advice, Compliance, Availability of Suitable Human Resources, Inspection and Maintenance, Equipment Operability, Workplace Environment, and External Conditions	L1	
	<b>Organisational Level - Organisational and Management Systems:</b> Recruitment and Selection, Training, Procedures, Planning, Incident Management and Feedback, Management/Supervision, Communications, Safety Culture, Equipment Purchasing, Inspection and Maintenance, Design, and Pay and Conditions	L2	
	<b>Policy Level - Corporate Policy Influences:</b> Contracting Strategy, Ownership and Control, Company Culture, Organisation Structure, Safety Management, Labour Relations, Profitability	L3	
	<b>Environmental Level - Social, Political and Market Context:</b> Political Influence, Regulatory Influence, Market Influence, Societal Influence	L4	

### 3. RESEARCH METHODOLOGY

An extensive literature review on accident causation theories and models and methods of investigation was conducted.

This study employs a qualitative research approach. A combination of exploratory and collective case study was done on construction accident causation where a sample of accidents drawn from actual investigation records of a large construction company was examined to determine their recorded causes. These were compared against the various causation theories to determine if the correct root causes and remedial action was identified and whether the same accident is likely to recur or not.

The research design is based on quota sampling as a sample of any 30 lost time accidents reports were required from the participating large construction company for selection and analysis for this study.

This paper is based on only part of the study, it excludes a survey of a small sample of contractors and health and safety officers which will be aimed at determining if the results of the case study is in fact in line with what these professionals actually experience on site.

### 4. FINDINGS

A sample of 30 accident investigation reports were analysed by categorising every cause identified in these reports according to the relevant accident causation theories as broken down in Table 2.1 to determine which theories were most prevalent or appeared most commonly. The frequency of each accident causation theory was analysed to determine if the identified causes of the accidents were focused on the actions and failures of workers or management and if the remedial actions taken were correct and were able to prevent the accident from reoccurring according to the theories they were classified under.

The causes of the 30 construction accidents as stated in the respective accident investigation reports were classified into three categories namely: *Direct Causes*, *Contributory Causes* and *Root Causes* to determine if the root causes were in fact identified. If the causes identified were the root causes and not direct or contributory causes, then the underlying issues would have been identified and the correct remedial action would have been taken which would prevent the reoccurrence of the accident. If direct or contributory causes were only identified for an accident, then it will be likely that the remedial action taken would have been ineffective and the accident will be likely to reoccur.

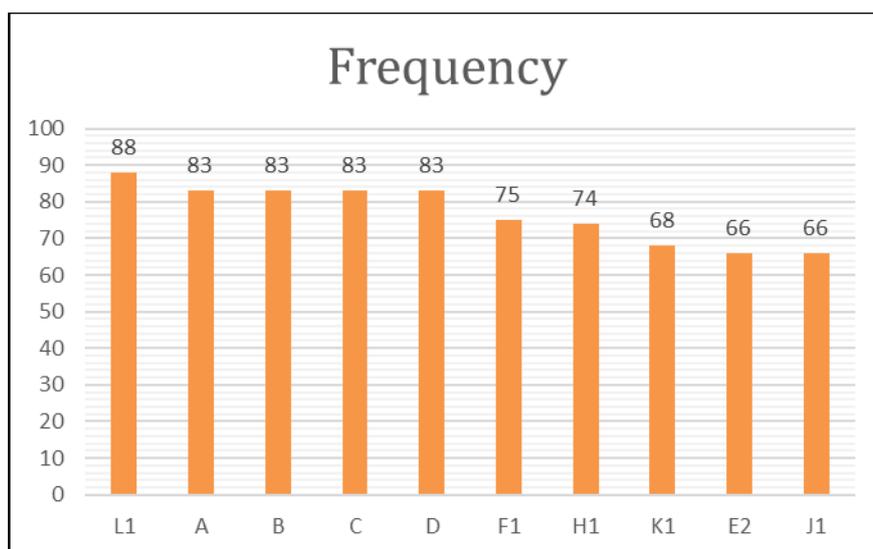


Figure 4.1: Accident causation theories that appeared most frequently

Figure 4.1 illustrates that the causes of the 30 construction accidents are mostly focused on the negligence of workers as the theories that focus accident causation on workers as listed below appear most frequently i.e., between a range of 88 and 66.

- L1 - System of Influences Approach model (Frequency:88)
- A - Accident Proneness Theory (Frequency:83)
- B - Goals-Freedom-Alertness Theory (Frequency:83)
- C - Adjustment Stress Theory (Frequency:83)
- D - Distractions Theory (Frequency:83)
- F1 - Updated Domino Theory (Frequency:75)
- H1 - Reason's Framework for accident causation (Frequency:74)
- K1 - Hierarchy of Causal influences in Construction Accident Model (Frequency:68)
- E2 - Domino theory (Frequency:66)
- J1 - Human Error Theory (Frequency:66)

This indicates that the causes of the 30 construction accidents typically fault workers as being the root cause of construction accidents.

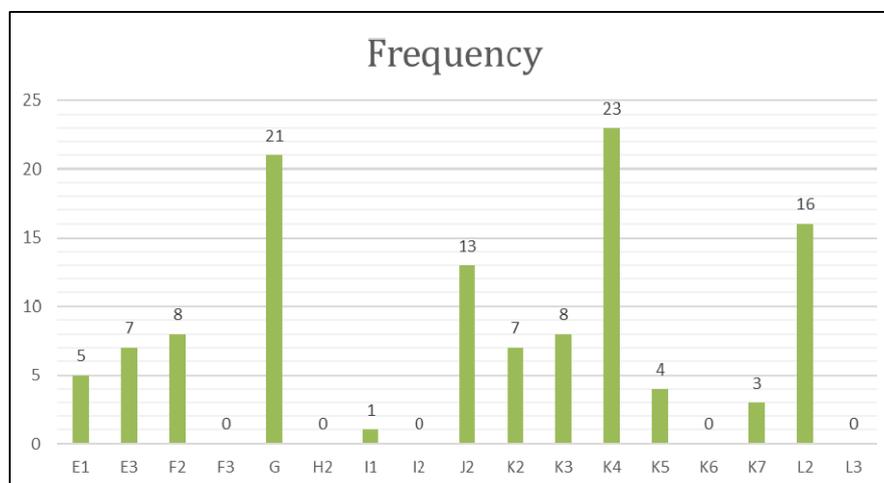


Figure 4.2: Accident causation theories that appeared least frequently

Figure 4.2 illustrates the accident causation theories that appeared least frequently. The theories listed below focus on the negligence or failures of management or the organisation and as illustrated by figure 4.2, appeared less frequently i.e., between the range of 0 and 23.

- F3 - Updated Domino Theory (Frequency:0)
- G - Multiple Causation Model (Frequency:21)
- H2 - Reason's Framework for accident causation (Frequency:0)
- I1 - Constraints – Response Theory (Frequency:1)
- I2 - Constraints – Response Theory (Frequency:0)
- K4 - Hierarchy of Causal influences in Construction Accident Model (Frequency:23)
- K7 - Hierarchy of Causal influences in Construction Accident Model (Frequency:3)
- L2 - System of Influences Approach model (Frequency:16)
- L3 - System of Influences Approach model (Frequency:0)

This indicates that the causes of the 30 construction accidents rarely if not ever relate to the negligence or failures of management or the organisation as being the root cause of construction accidents.

These findings indicate that accident investigation processes are flawed as they predominantly blame the causes of construction accidents on the negligence of workers. As much as worker negligence contributes to the cause of the accident there are further underlying causes such as the lack of training, supervision, health and safety awareness and culture within the organisation, management failing to rotate teams on strenuous tasks and much more that relate to the failure and negligence of management. If these underlying root causes are not addressed the accident will continue to reoccur.

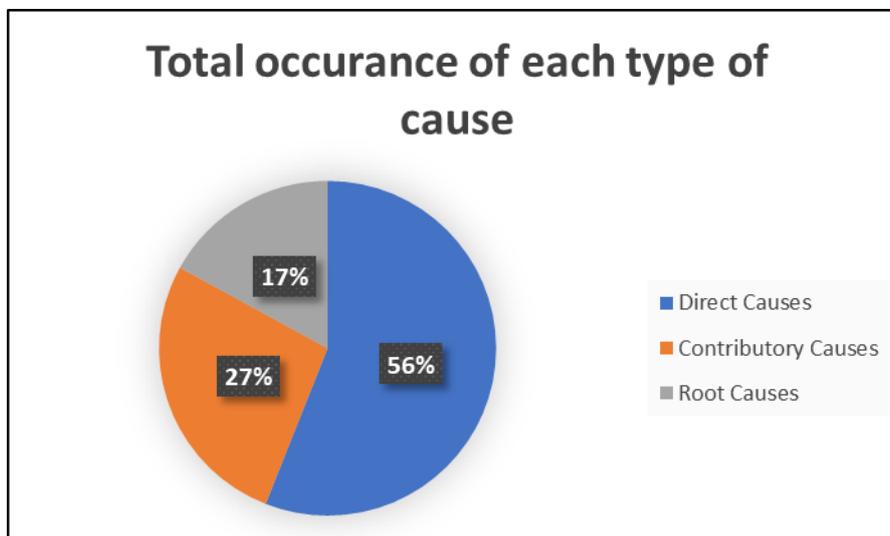


Figure 4.3: Total occurrence of each type of cause

The causes of the 30 construction accidents as stated in the respective accident investigation reports were classified into three categories namely: Direct Causes, Contributory Causes and Root Causes. As figure 4.3 illustrates, it was found that 56% of causes were direct causes, 27% were contributory causes and only 17% of accident investigation reports identified the root cause of the accident.

This therefore means that only 17% of accident investigation processes were done correctly and applied the correct and relevant remedial action to prevent the reoccurrence of the accident as the root causes were correctly identified which refer to organisational errors or negligence or problems with management which includes supervision.

The other 83% of accident investigation reports identified direct and contributory causes which the suggested remedial action was based on. Although this remedial action would have helped somewhat in the prevention of the reoccurrence of the accident, it does not address the underlying root cause of the accident which is therefore more likely to reoccur.

## 5. CONCLUSION

The findings indicate that the causes of construction accidents are predominantly related to the negligence and failures of workers and rarely identifies the negligence of management or the organisation as the

underlying root cause. It has been found that accident investigation processes are ineffective as they primarily focus on the direct or trigger cause of an accident and not the underlying root cause. This leads to the incorrect remedial action taken ultimately resulting in the accident reoccurring despite the emphasis placed on H&S within an organisation.

Given that the intent of any accident investigation should be to prevent the accidents recurrence, all root causes need to be investigated. Clearly the present system of accident investigation and recordkeeping focuses on the downstream event or the last domino in the chain. Arguably, this approach by only addressing the final trigger event will not prevent accidents from reoccurring.

Based on the findings, the behavioural health and safety interventions or the remedial action taken based on the direct or contributory causes, as part of a health, safety and environmental management system, would not necessarily prevent accidents. Rather they might reduce accidents but not prevent them.

The findings of this study cannot necessarily be generalized to the entire construction industry but it gives insight into the possibility that other construction companies might be doing the same thing, making the same misjudgements which results in ineffective accident investigation processes and the reoccurrence of accidents. It is therefore recommended that a more indepth study is done with a larger sample size of different construction companies in South Africa.

Considering that the ultimate goal for any construction stakeholder is to strive for zero accidents, any approach which does not prevent accidents is seriously flawed and needs to change.

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## **Process Health and Safety Management Elements: An initial review of literature**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose:**

There are management systems to prevent health and safety incident from taking place in the petrochemical industry but incidents still happen, people get injured, assets get damaged and environment is polluted. The aim of the study was to assess the existing process health and safety management systems and identify elements that require senior management's vigilant attention.

#### **Design/Methodology/Approach:**

This research used literature review and the methodology is qualitative. The research approach is inductive. Findings/Observations: The ten key process health and safety management elements from literature to be prioritized for an effective process health and safety management system are, namely Leadership Commitment, Training and Competency, Chemical Exposure Management, Health and Safety Risk Assessment, Process Hazard Analysis, Process Health and Safety Information, Operating Procedure, Control of Ignition Source, Control of Confined Space Entry and Permit to Work.

**Research Limitations:**

Only petrochemical industry was considered in this literature review. The next phase in this study will be to determine the extent of the application of the key elements outlined in the literature within the petrochemical industry in KZN province. Value of Paper: Paper presents ten key process health and safety management elements to the petrochemical industry.

**Key words: Process Health and Safety Management Elements.**

**1. INTRODUCTION**

Process health and safety management systems are a proactive management and engineering approach to control risk of failures and errors by reducing chance of human error and protecting employees, contractor employees, environments and assets from the risks associated with hazardous chemicals, but incidents still happen, people get injured, assets get damaged and environment is polluted. According to Cooper (1998) an organisation that has a good health and safety culture consists of a strong senior management commitment, leadership and involvement in health and safety, better communications between all organisational levels, greater hazard control, good induction and follow up on health and safety training and an ongoing health and safety schemes reinforcing the importance of health and safety, including near miss reporting. Material substances, processes or circumstances which pose threat to health and well-being of workers in any occupation are termed as occupational hazards. The occupational and hazard is major issue in oil and gas extraction industry (Kulkarni, 2017). Occupational and process health and safety accidents can be reduced through effective preventative measures by investing on health and safety equipment, training and educating the employees, process design and machinery. In order to develop a good health and safety culture, attitude of the workers needs to be reoriented by applying best practices, good housekeeping, change in work culture, and work practices (Beraha *et al.*, 2012). The most important indicator of a positive health and safety culture is the extent to which employees are actively involved in health and safety on a daily basis (Cooper, 1998).

The present study was conducted by reviewing petrochemical industry health and safety literature with the aim to assess the existing process health and safety management systems and identify the top ten elements that require senior management's further vigilant attention to reduce process health and safety incidents in the petrochemical industry.

**2. LITERATURE REVIEW**

The petrochemical industry as the name implies is based upon the production of chemicals from petroleum such as natural gas and crude oil. The occupational health and safety plays central role in industry as it protects all workers from health and safety related issues in their working environment. It is vital to protect workers from injuries on a social level, but there is also a positive economic impact in reducing health and safety hazards. Health and safety is without doubt, the most crucial investment and the question is not what it costs, but what it saves (Hughes and Ferret, 2007).

## 2.1 Leadership Elements

There are five leadership process health and safety elements namely leadership and commitment, training and competency, contractor management, asset integrity and effective communication. It is recognised that leadership is important in the creation of a culture that supports and promotes a strong health and safety performance of an organisation. According to Fuller and Vassie (2005) having senior managers who take a proactive interest in establishing a health and safety culture has been considered to be a key influence on organisational health and safety performance. It is imperative that leadership ensures that each employee is trained in an overview of the process and in the operating procedures, emphasis on the specific safety and health hazards, emergency operations including shutdown, and safe work practices applicable to the employee's job tasks. The other element that requires leadership's attention is contractor management, contractors working in petrochemical industry face a great risk during maintenance work. They are exposed to a number of inevitable hazards as most workers employed by contractors are unfamiliar with hazardous materials and more work performed under high pressure (Othman *et al.*, 2014).

It is the duty of the leadership team to ensure assets are maintained effectively and are safe to be operated at all times. According to Hardy (2013) mechanical equipment must be maintained to ensure that it will continue to operate correctly and safely. Process health and safety management standards require that an organisation establish and implement written procedures for maintaining equipment such pressure vessels, storage tanks, piping systems, pressure safety valves, emergency shutdown systems, and controls (monitoring devices, sensors, alarms and interlocks). An effective quality assurance program must be implemented to assure conformance to standards and codes, identify and record deficiencies and confirm that deficiencies have been corrected (Hardy, 2013). The last element is effective communication from all levels in an organisation. It is vital that information feedback is available to the right people at the right time and that means an effective communication system needs to be in place (Cooper, 1998).

## 2.2 Health and Safety Elements

Process health and safety elements include chemical exposure management, health and safety risk assessment, incident investigation, emergency response and audit compliance. The management of health and safety at work requires employers to make a suitable and sufficient assessment of the health and safety risks to employees and non-employees, arising from their work activities. It must be noted though that health and safety incidents still happen in the work place and it is important to investigate those incidents and appreciate root causes so that corrective actions can be assigned to employees that will close them. The intention is to prevent the similar incidents from happening again. According to Bond (2007) the sole objective of the investigation of an accident or incident under regulations shall be the prevention of accidents and incidents. Such incidents include those that could be called a near miss and incident or problem investigation should be factored back into the hazard analysis. According to Hardy (2013) organisations must plan for an emergency and be prepared to respond. As an absolute minimum, employers must develop an emergency action plan that includes evacuation and shelter in place instructions and training in the use of personal protective equipment. Audit compliance is a proactive attempt to identify gaps to comply and intervene when non-compliance is ascertained. Compliance audits provide a means for assuring that the procedures and practices in process health and safety management systems are being followed and are adequate (Hardy, 2013). The other potential topics to be considered under process health and safety when dealing with hazardous chemicals are noise exposure management, substance misuse and fatigue management.

## 2.3 Technical Elements

Four technical elements are important, namely, management of change, process hazard analysis, process health and safety information and human factor. To prevent or minimize process health and safety incidents in a petrochemical industry process hazard analysis is conducted by a team with expertise in engineering and process operations, including at least one employee who has experience and knowledge on the system. These process hazard analyses require process health and safety information to be clear and understood by all team members involved. According to Tzou *et al.* (2004) managing health and safety related information inadequately has been cited as a significant factor to industrial accidents. Accidents can take place even where process health and safety management systems exist and the probability of such occurrence increase if documentation is deficient.

Health and safety issues cannot be tackled effectively without interference of employers with a particular pattern of behaviours as

important criteria needed to change employee's behaviours (Zin, 2012). Employers and employees with good safety behaviour are particularly playing a significant role in achievement of safety compliance to occupational health and safety improvement in industry. According to Bond (2007) it is clear that in the vast majority of accidents or near misses employees were acting with the best intentions and did not expect a serious event to occur from their actions. It has to be accepted that to err is human but one can learn from these events and share with others the lesson learnt. Human error is not the sole cause of failure, but it is a symptom of a deeper trouble. Human error is the starting point of an investigation, not the end point. To do something about error, one must look at the system in which people work and focus must extend past "what occurred" to why do it occur (Bridger, 2015). Many accidents have resulted from small changes that did not appear to have an effect on health and safety prior to the incident (Hardy, 2013). These changes must be thoroughly evaluated to assure that health and safety in the process industry is maintained.

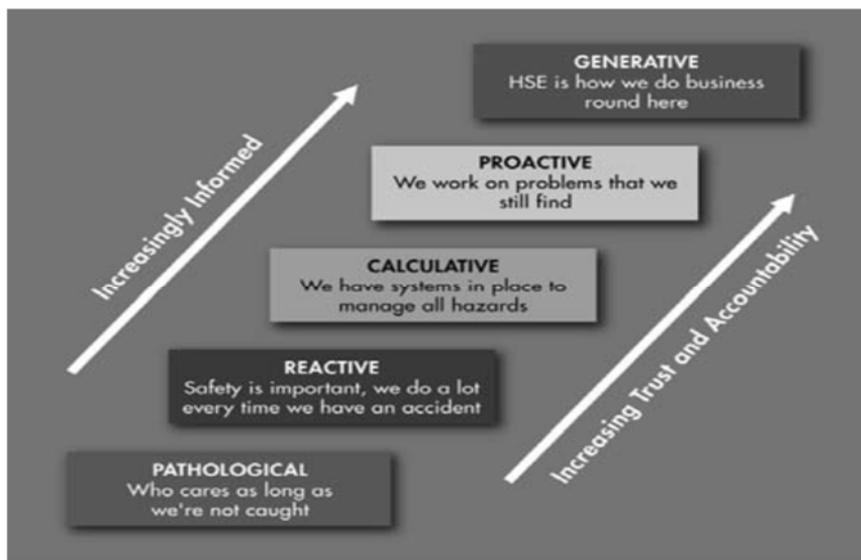
## 2.4 Operational Elements

Operational elements include pre-activity and shutdown reviews, operating procedure, control of ignition source, control of confined space entry and permit to work. Often accidents occur in the transition between operational phases, rather than when the process system is up and running in "steady state" mode. Start up and shutting down new and existing process systems can be hazardous because changes to design or operations may be made in real time to meet schedule temperatures and pressures, potentially introducing new hazards (Hardy, 2013). The other high risk operational activity in the petrochemical industry is the confined space entry. A confined space is an enclosed or partially enclosed area that is big enough for a worker to enter. It is not designed for someone to work in regularly, but workers may need to enter the confined space for tasks such as inspection, cleaning, maintenance, and repair. Confined spaces may contain hazardous atmospheres, including insufficient oxygen, toxic air, and an explosive atmosphere (Stojkovic', 2013).

In a petrochemical industry control of ignition sources is vital. Fire and explosion hazards prevention involves dealing with the elements of the fire triangle. They fall into three categories, namely absence of flammable atmospheres achieved by limited fuel quantities, control/avoidance of ignition sources and absence of flammable atmospheres by limiting the quantities of oxidant present (Puttick, 2008). A permit to work system is a formal written system used to control work that is potentially hazardous. According to Iliffe *et al.* (1998), many incidents in the petrochemical industry workplace are associated with maintenance works, which are typical controlled by permit to work. There are many other operational

elements that may be considered when dealing with hazardous chemicals, such as working at heights, energy isolation, suspended loads, excavation and entering a trench, disabling safety critical equipment and use of correct personal protective equipment when handling hazardous chemicals.

The hearts and minds paper published by Shell Global Solutions International symposium in 2016, suggests that there is a health and safety culture ladder with five levels, namely pathological (level 1), reactive (level 2), calculative (level 3), proactive (level 4) and generative (level 5). Pathological culture level 1 is where nobody cares to understand why accidents happen and how they can be prevented and at generative culture level 5, health and safety is seen as a profit centre and it is how business is done. Reactive culture level 2 says safety is important, and people do a lot when there has been an accident while the proactive culture is where employees work safely because they intrinsically motivated to do the right things naturally. Level 3 is calculative where an organisation says there are management systems in place to manage all hazards.



**Figure 2.1 Health and Safety Culture Ladder**

Adapted from Holstvoogd *et al.*, 2006.

The health and safety culture ladder in Figure 2.1 shows the various levels of cultural maturity, and the change process required to achieve a lasting change in personal and organisational culture (Holstvoogd *et al.*, 2006).

### **3. RESEARCH DESIGN AND METHODOLOGY**

According to Crotty (1998) methodology is the strategy or plan of action which lies behind the choice and use of particular methods. Methodology is concerned with why, what, from where, when and how data is collected and analysed. Methodology asks the question “how can the researcher go about finding out whatever they believe can be known (Guba and Lincoln, 1994)? Methods are the techniques and procedures used to collect and analyse data. The data collected will either be qualitative or quantitative. All paradigms can use both qualitative and quantitative data (Crotty, 1998). However, this paper has reviewed literature to determine the important elements to be considered in an effective process health and safety management system. The research methodology is qualitative and the research approach is inductive.

### **4. KEY OBSERVATIONS**

The key ten process health and safety management elements from literature to be prioritized for an effective process health and safety management system are, namely Leadership Commitment, Training and Competency, Chemical Exposure Management, Health and Safety Risk Assessment, Process Hazard Analysis, Process Health and Safety Information, Operating Procedure, Control of Ignition Source, Control of Confined Space Entry and Permit to Work. It is not clear from literature how the organisations are assessed for placement in the five levels in the health and safety culture ladder hence a standard check list assessment tool will be a great contribution to health and safety culture.

### **5. CONCLUSION**

Health and safety standards and regulations reasonably cannot cover all the possible cases for different types of works in a variety of hazards in a petrochemical industry. It is the duty of health and safety experts to share as much as they can on this subject of health and safety in the petrochemical industry that can expose employees and contractors to hazardous chemicals. The next phase in this study will be to determine the extent of the application of the key elements outlined in the literature within the petrochemical industry in KZN province.

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## **Women in construction: Sociocultural gender-linked influences on career choices**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose**

The purpose of this paper is to review the present status of women in the construction industry; in particular it discusses the social and cultural factors that hinder women's career choices in construction.

#### **Design**

A review of literature on women in the construction industry and the historical background and role of women is conducted. A literature assessment is also conducted to identify and understand the socio-cultural factors that influence the career decisions of women in the construction industry. Finally, conclusions and recommendations from the study are drawn.

#### **Research Limitations**

The study is limited to analysis and review of existing literature.

### **Findings**

Findings from the study reveal that despite the construction industry's contribution in terms of employment, the industry still has a low participation rate of women. It is found that women are confronted by a range of interrelated social and cultural factors that influence their decisions to take up professions in the construction industry. The study found that the major influences on the career decisions of women are parents, education and culture.

### **Value to conference theme**

The paper provides insights on how to meet the individual needs of 21st century women who are considering taking up a career in construction and also create a better path for women's recruitment and retention in the construction industry.

**Keywords:** Career choices, construction industry, male-dominated occupations, socio-cultural influences, South Africa, Women.

## **1. INTRODUCTION**

Despite several initiatives and legislations advocating for equality, the construction industry still remains excessively gender stratified and conservative in the recruitment and retention of women (Aulin and Jingmond, 2011; Sang and Powell, 2012). This has been particularly evident in the African construction industry where patriarchy is an obstacle to women's growth and development (Gurjao, 2006). Although there has been an increase in representation in other sectors, women are seriously underrepresented in all construction professions (Haupt and Fester, 2012).

Gender related studies have revealed that women's career decisions are affected by social and cultural role expectations (Powell, Bagilhole, and Dainty, 2009). Women have been perceived to be inferior to men and therefore, they are given minor positions in employment. Gender divisions in the workplace is established by vertical segregation and gender stereotyping (Commission on Gender Equality, 1999). More specifically in the construction industry with a low number of women, there is an indication of gender segregation and a shortage of skilled females in the workforce (Madikizela and Haupt, 2010). Mills and Ayre (2003) present evidence to the quiddity of socio-cultural gender linked factors by explaining that the field of construction is viewed orthodoxly as a profession with male –gendered social constructs with a focus on technical skills whereas women associate better with the social areas of construction.

According to Amaratunga and Haigh (2007) the construction industry is demonstrably male-dominated which makes it hard for women to survive in the sector. One of the reasons why female engineers are still not joining

the construction industry or are leaving the industry earlier than expected is "the image of the construction industry". The industry is under-utilising the full range of skills and talents in the population because of continuing unequal opportunities for some groups within the society (Ahuja and Kumari, 2015), and therefore, creating inefficiency and ineffectiveness by projecting a non-pluralistic image, results in shrinkage in the pool of potential role players and customers of the industry (Dainty, Bagihole, Ansari and Jackson, 2004).

Aneke, Derera and Bomani (2017) explains that the South African economy has the potential to achieve desired growth, but are hindered by the exclusion of women in key sectors that drive the economy, one of which is the construction industry. Much of the current literature describes a variety of constraints facing women in the construction sector ranging from harassment, cultural and racial discrimination to unfavourable policies and regulations (Agapiou, 2002; Fielden *et al.*, 2000).

Although the industry has sought to find solutions to the problem of under-representation of women, progress seems to be very slow and erratic. The paucity of empirical research in this area suggests that deeper exploration to this problem is required.

The general imbalance between men and women in the construction industry has been demonstrated and several critical issues in this regard have been identified. Firstly, the fact that women are underrepresented and marginalized in the construction industry; secondly, that the level of underrepresentation and nature of marginalization may vary in South Africa.

## **2. WOMEN AND THE CONSTRUCTION INDUSTRY**

The South African construction industry has been perceived as one of the key players in its contribution to the country's economy in terms of production of infrastructure and fixed capital assets (English and Hay, 2012). The construction industry plays a unique role in the country's labour market through the provision of employment. After hosting the World Cup in 2010, South Africa's construction industry has provided employment to 430,000 people in the third quarter of 2009, making it South Africa's most sought after industry. It is also one of the industries that provides a cutting edge of sustainable growth, development and innovation in the economy (Sangweni and Root, 2015). Furthermore, the construction sector has been described as one of the most sought industry in South Africa, creating 632,000 jobs in the first quarter of 2018 making it a pillar of growth for the country (Statistics South Africa, 2018).

Regardless of its significant contribution in terms of job opportunities in South Africa, women are still underrepresented, making men the major beneficiaries of these employment opportunities. The construction industry has a particularly low participation rate of women, including those employed in the industry and those in training (Sangweni

and Root, 2015). Of the total employed South African population in 2017, 44% were women and only 13% of these women were employed in the construction industry (Statistics South Africa, 2017). No changes have occurred over the years as it has been 44% since September, 2002. Furthermore, sectors of the economy such as mining and transportation had low concentrations of female employees (Ibid). Out of the total female work force which is estimated at about ten million and two hundred thousand, the construction industry has only one hundred and seventy four thousand (Ibid). This indicates that South Africa has a high proportion of the female work force in services industry.

The South African construction industry has been described as being the most untransformed sector in the country as it is still widely dominated by white male in management (Haupt, 2010). Historically, the construction industry is a highly male dominated sector in terms of employment at all levels (Haupt and Smallwood, 2004). According to Statistics South Africa (2017) women account for half of the labour force and are also generally unemployed across all racial categories. According to Van Klaveran, Tidjens, Hughie-Williams and Martin (2009) black women were under-represented with 31.3% unemployment rate which is eight times higher than that of black men.

Geerstemar (2005) explained that the percentage of women employed globally in the construction industry was less than 10% and the percentage is even lower for professionally registered women or women-owned construction firms. Recruitment by construction companies has been found to be homogenous as most of these firms select and recruit only men. Many studies have suggested that the percentage of women employed in the construction sector would have been lower, if not for the inclusion of clerical, secretarial, administrative and safety related positions which are predominantly occupied by women (Jahn, 2009; Sangweni and Root, 2015; Fielden, Davidson, Gale and Davey, 2000). According to Madikizela and Haupt (2008) women are recruited for clerical and secretarial services with a high percentage employed in part-time positions.

### **3. HISTORICAL BACKGROUND AND ROLE OF WOMEN**

A history of racial, gender conflict and oppression has been recorded in South Africa (Underwood, n.d.). All reviews on the origin of gender discrimination in South Africa has been initiated with the law. Gender-based discrimination in the work place became institutionalized in South Africa during the apartheid era. Certain categories of people such as females experience pronounced disadvantages as a result of these disparities. In the apartheid era black women and married women were hindered from being formally employed. Women were also not allowed to be employed or given managerial positions at the workplace (Ozumba and Ozumba, 2012). Therefore, it can be argued that the apartheid period in

South Africa created an enabling environment for gender-based discrimination in the work environment (Ibid).

According to the South African Department of Labour (2010) policies and legislations concerning gender mainstreaming only began to evolve after the inception of the democratic rule. The post apartheid era in Africa witnessed interventions for gender mainstreaming which were instituted to address inequalities that had occurred in the past (Underwood, n.d; GCIS, 2011). The effectiveness of these interventions for a gender positive environment could be measured as an increase in women empowerment, employment and promotion of women (Ozumba and Ozumba, 2012). These interventions include legal structures such as the Employment Equity Act and the National Policy Framework for Women Empowerment and Gender Equality. The Employment Equity Act No 55 of 1998 recognizes that apartheid and other discriminatory practices and laws resulted in disparities in employment and income within the labour market. However, the feminine footprint especially in the areas of employment and promotion of women are still lacking in some sectors of the economy such as construction (Ibid).

Traditionally, women have been perceived to be builders and makers of the home. With the influence of European societies, gender roles have become modified and women have continued to play an important role in the development of the economy (Kalabamu, 2001). Although, in the South African context women may share a common gender, their tribal and cultural backgrounds vary (English, 2007). The differences in their tribal backgrounds may influence the extent to which socio-cultural factors affect their career decisions more than others.

In any developed society, a woman's right to a career choice is a key factor that promotes economic and social contributions to that particular society (Parikh & Sukhatme, 2004). However, despite this awareness, the involvement and engagement of women in the construction industry is still stagnant (Sangweni and Root, 2015). Due to South Africa's cultural diversity, some women are brought up with the understanding that they cannot take up non-traditional careers such as construction and are advised to rather follow 'soft skills' careers such as nursing etc. (Ibid). Their primary roles are to take care of the family and nurture their children, while their spouses are the breadwinners and are only entitled to the work place. Putting women's roles in such stereotypical boxes is one of the hindrances that shorten the working life of women and makes it impossible to maintain an upwards trend in the number of women in construction (Dainty, Bagihole and Neale, 2001 ; Ginige, Amaratunga and Haigh, 2007).

#### **4. GENDER ROLES AND SOCIOCULTURAL INFLUENCES REGARDING WOMEN'S CAREER DECISIONS AND OPPORTUNITIES**

Making a career choice in the construction industry has not been a popular decision by women in South Africa. Sociocultural gender role expectations, have been explored in reference to the disparity of the number of women in construction. Numerous studies have been found to recognize the impact of gender influences within the family and society on the career decisions of women in both conventional and non-conventional areas (Powell, Bagihole & Dainty, 2009; Leeke, 2012). Findings from a study conducted by Haupt and Fester (2012) revealed in their study on women-owned construction enterprises that the decision of some women to pursue a career in construction was opportunistic and coincidental rather than an option. Lack of knowledge and understanding of the career opportunities available in the industry as well as the discriminatory environment are some of the main obstacles negatively impacting the career choices by women in construction (Madikizela and Haupt, 2010; English and Hay, 2012). Other barriers experienced by women in construction are sexual harassment, lack of education and training programmes suited to accommodate the roles of women as being mothers and career women (Haupt and Fester (2012).

Generally, sociocultural gender roles in most countries consider women to be homemakers and caregivers of their family. As a result of this, many women pursue careers like teaching that allow them spend sufficient time with their families and attend to their responsibilities of child birth and child rearing (Leeke, 2012). The ones that take up non-traditional careers find themselves declining promotions, facing career stagnation and eventually abandoning their careers. However, sociocultural gender roles give men the opportunity gain career advancement work longer hours.

Education and training play a vital role in the growth and development of an economy and is the path to upliftment at the social level (Madikizela and Haupt, 2008). In resolving inequality, providing women and girls with education is a critical issue (Evans, 2015). Madikizela and Haupt (2008) claims that the development and progress of girls is hindered by the conscious decision of parents to favour and value the boy child. Acquiring knowledge on the construction industry by women and its academic importance still lacks sufficient knowledge. Female entrants to the construction industry have been found to be in the industry as a result of recruitment campaign targeted at attracting them to the industry. Unlike men, they consequently have little or no knowledge, no career exploration and understanding of the masculine culture of the industry (Haupt and Smallwood, 2004). This image problem makes a large number of women uninterested in taking up construction professions. Amaratunga *et al.* (2007) reveals that there is a biasness in the trainings provided by schools, organisations and employers due to the male-dominated environment

masculine culture employers which creates problems for women. Furthermore, research shows that women lack access to development opportunities and are less likely to have role models in the industry that could eliminate gender stereotypes and broaden their resolve to make educational progress (Chant & McIlwaine, 2016; Reichlin and Shaw, 2015).

Family, education, culture, socio-economic status, religion and ethnicity all play an important role in gender-role internalization (Madikizela and Haupt, 2008). Ohio Career Development Systems study (2009) identifies parents and other family members as the greatest influence on career decision making. Ethnic or tribal backgrounds and communities where people live were also found to influence work values and career choices. The differences in the tribal backgrounds of women may influence the extent to which socio-cultural factors affect their career decisions more than others. Recent studies have begun to dismiss the assumption that references made to women include all women and that all women have similar experiences (Byrd, 2009; Flores, Ramos, and Kanagui, 2010; Rosser-Mims, 2010). Fouad and Byars-Winston's (2005) review of publications found that very few studies compared several ethnic groups. In these studies similar career aspirations were discovered for all the racial groups while perceptions to realize them differed amongst the groups. Leeke (2012) noted that women of different races may have differential education and work experiences, not only as individuals, but also as members of their races. Marthur-Helm (2005) explained that Black African women are faced with more cultural barriers than their counterparts due to their traditional customs which are very patriarchal. In South Africa, it has been discovered that a gendered pattern of unemployment prevails within all racial categories (Statistics South Africa, 2017). The unemployment for colored women was 21.3% as against 17.9% for colored men; 15.7% for Indian/Asian women against 10.8% for men and 5.8% for white women against 3.6% men. The rate of employment was found to be particularly high amongst African (Black) women with 31.3% against 23.4% for their male counterparts (Ibid).

Women in urban environments confront more formidable career barriers and equalities compared to rural women (Chant & McIlwaine, 2016; Reichlin and Shaw, 2015). Pozarny (2016) indicated urban girls are more advantaged and exposed to opportunities than their rural counterparts. In a study conducted by Vermeulen and Minor (1998) on the influences on occupational decisions of women from rural and urban communities as well as how the context of their lives influenced their career decisions over time, the lack of information and career exploration was found to be a major affecting women from rural backgrounds as opposed to women from urban communities. Influence from family members, schools and the community were also found to be major influences on the career decisions of the women from rural backgrounds. Similarly, in a study conducted in the South Asia region by Baloch and Shash (2014) majority of students from rural communities were discovered not to be aware of their

strengths and talents as opposed to students from urban communities who had better ideas about their career choices.

Chileshe and Haupt's (2009) study on the factors impacting career decisions in the South African construction industry which revealed that out of 491 female high school students, 424 of them reported that they had not considered a career in construction or building. The study further revealed that factors such as family tradition, teachers and career guidance were found to have greater influences on the decision making on the females compared to their male counterparts. A similar study found that women who take up careers in teaching, paralegal and secretarial positions are influenced by their mothers because these jobs are considered to be family friendly due to their shorter work hours. The study further revealed that women who took up engineering related careers did so based on the recommendation of their fathers ;often a father who is in the engineering profession (Whitmarsh, Brown, Cooper, Hawkins-Rodgers, & Wentworth, 2007; Mattis, 2007). In studies conducted by Haupt and Smallwood (2004); Rosser (2006); Mattis (2007) salary differentials between men and women, working conditions, opportunities for promotion and lifelong learning were found to be the predominating factors influencing the career decisions of women in construction. Futhermore, issues such as complexities of balancing work and family responsibilities were also discovered to negativley influence the problem of women in the construction profession.

## **5. CONCLUSION AND RECOMMENDATIONS**

It is found through literature review that the construction industry is still viewed as an environment filled with aggressiveness and hostility. These issues make the construction industry less attractive and prevent women from considering careers within the industry. Research on women in construction bears significance to the the career planning, development, recruitment and retention of more women in the construction profession. Issues regarding the challenges and successes women face within and outside the construction workforce plays a huge role in their retention and job satisfaction. Influences from the society and culture combined with the negativity they experience have been discovered to contribute to the few numbers of women in the construction profession, therefore resulting in a low number of mentors to attract young women into the profession.

The study identifies education, parental, and environmental influences as the major sociocultural factors in gender roles pertaining to construction career planning. These factors have been elaborated and issues of gender socialization and how society's values and culture influence recruiting and retaining women in the construction industry has been discussed. The study recommends the management of issues of gender bias and in

equality facing women with reference to a career choice in construction at the same time focusing on factors that influence their career decisions.

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## **Evaluation of the efficiency of contractor's assessment process during mentorship programmes**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose:**

The purpose of this study is to evaluate the efficiency of contractor's assessment process during their mentorship programme.

#### **Design:**

A quantitative research approach was adopted. Data were collected by means of a questionnaire survey with closed-ended questions on CIDB grade 3 to 5 emerging contractors. Mean ranking scores were computed from the collected data and used for analysing and ranking of the identified variables.

#### **Research limitations:**

None of the respondents had a tertiary or a post-graduate qualification which would have given the respondents more about the construction industry than a mere site experience. The study was conducted in the Western Cape provinces, other provinces were not reached.

#### **Findings:**

The study revealed that pre-evaluation, formative, and summative assessment were not practiced. The lack of evaluation of contractors'

development needs prior to the commencement of mentorship, the lack of formative evaluations to uncover areas of improvement, the lack of a graded assessment at the exit of the programme has impliedly been identified as sign of inefficiency. **Practical implications** - Research compels CDP to consider incorporating various steps of assessment into mentorship programme.

**Response to conference theme:**

Revisiting the current mentorship processes of Contractor Development Programme (CDP) incorporating a thorough assessment improved outcomes of the programme in the Western Cape and other CDP's in South Africa. The study is in line with SME contractor development theme of the conference.

**Keywords - Emerging contractors, mentorship programme, pre-evaluation, formative evaluation and summative evaluation**

## 1. INTRODUCTION

The development of a mentorship programme to emerging contractors is viewed as a positive step undertaken by the South African government through the Construction Industry Development Programme (CIDB). The rationale for this initiative is to provide mentorship to contractors who encounter both managerial and technical challenges in running their businesses in the construction industry. Various authors such as Argote and Ingram (2000:161), Hamburg and Miriam (2012:24), Watt (2004:1), Bilesanmi (2011:98), Pompa (2012:8), Schlee (2000:322), and Cunningham and Eberle (1993:55) have recognised the rationale and benefits of implementing a mentorship programme as a mechanism to transfer knowledge and skills from mentors to mentees. However, it is not evident at what extend the process of evaluation of the contractor qualifying to enter the mentorship programme from the recruitment till the end of the completion is efficient enough. Little is known about the efficiency of the evaluation process of contractors throughout the mentorship programme.

Shelton (2006:27) highlights that the mentorship programme takes on a number of phases namely organisational needs analysis, selection of candidates, orientation, candidates' needs analysis, implementation, feedback and dissolving the relationship. It is crystal clear that the mentorship programme should go through all the phases, as such the evaluation of contractors is paramount as it forms part of the phases of mentorship. Hattings, Coetzee, & Schreude (2004:44) concur with the latter and suggest that an evaluation strategy of a mentorship programme should make use of multiple methods to obtain both quantitative and qualitative

data that should be in place at the beginning of the mentorship programme. Arguably, the information collection for the purpose of a mentorship programme might be about the mentees' developmental needs, gaps and capabilities. The most used forms of evaluation in a mentorship programme is pre-evaluation, formative evaluation and summative evaluation (Shelton, 2006:26). The first form of an evaluation is conducted at the beginning of a mentorship programme solely to evaluate the mentees developmental needs. The second form of evaluation is conducted on an on-going basis to make improvements throughout the cycle, this can be done either fortnightly or monthly. The third and the last form of evaluation is conducted at the business end of a mentorship programme to determine the success of reaching specific goals. This research attempts to identify gaps in terms of the implementation of the evaluation processes for the CDP mentorship programme. It explores all the evaluation stages undertaken by CDP such as, pre-evaluation, formative evaluation and summative evaluation. Against this background, the purpose of this paper is evaluation of the efficiency of contractor's assessment processes during mentorship programme.

## **2. ASSESSMENT PROCESSES IN A MENTORSHIP PROGRAMME**

### **2.1 Pre-evaluation**

Lazarus (2005:72) states that pre-evaluation of mentee's is conducted by way of an assessment tool which assesses the emerging contractor's construction industry experience, management experience, level of development and access to skilled resources. Such an evaluation is paramount for the delivery of mentorship, it is often done before the commencement of a mentorship programme. The designing of a mentorship programme is informed by the types of results received from pre-evaluation exercise. Moreover, once the developmental areas have been identified then a tailor made mentorship should be implemented to address the mentees developmental needs (Jacquet, 2002:08). Dlungwana, Noyana, & Oloo (2004:38) highlight the need to understand the levels of contractors' capabilities in order to provide appropriate development support and the need to match a contractor's capability to a project with an appropriate level of complexity.

### **2.2 Formative evaluation**

The formative evaluation is conducted on an ongoing basis during the implementation process of a mentorship programme. The main purpose of evaluation is to provide mentors with information regarding the progress of mentees on the mentorship programme. Worthen, Sanders, & Fitzpatrick (1997:1) indicate that formative evaluation is conducted at various stages

throughout a program's operation to provide information that can be used to improve the program. Klasen & Clutterbuck (2002:6) reiterate that formative evaluation ensures quality assurance of the programme. Moreover, formative evaluation focuses on the delivery of mentorship rather than the outcomes of the mentorship programme. Jacquet (2002:08) highlights that evaluation process can track the development of mentees overtime, if skills deficiency is identified then an intervention should be introduced. Formative evaluation serves as an early warning system to alert the project team to areas of weakness experienced by the mentees, and allows for early intervention and corrective measures.

### **2.3 Summative evaluation**

The summative evaluation is designed to evaluate mentees at the end of a mentorship programme to determine the success of reaching specific goals. Summative evaluation on the other hand, is much more formal and enables one to determine whether a programme has ultimately achieved its objectives (Brown and Gerhardt, 2002:953; Klasen and Clutterbuck, 2002:6). This evaluation is appropriate where the intention is to form a judgement on whether or not to continue with the mentorship programme. Summative evaluations seldom rely entirely on qualitative data because of the decision makers are interested in measurable outcomes but qualitative data can be used to add depth and detail to the evaluation (Wall, 1994:1). The outcome evaluation becomes relatively easy when goals and objectives have been set from the beginning of a mentorship programme. Summative evaluations are typically conducted in later stages and provide information regarding the program's worth or merit (Shelton, 2006:120). The evaluation of mentorship is consist of examining the information received during mentorship in order to make judgements about what you have achieved and the difference your work has made to the contractors. Hauptfliesch (2008:1) agrees that it is imperative that at the end of mentorship participants should be tracked in order to carry out an evaluation process that would quantify the results of mentorship. It is very clear that a mentorship programme must be evaluated at its completion to determine its effectiveness, and make necessary adjustments to meet its objectives. During the evaluation process of the mentorship programme content one will be able to:

- assess whether the mentee has achieved what the mentor had set out to achieve;
- find out how mentee have benefited from the mentorship programme;
- give more structure to mentoring/befriending service; and
- identify gaps in mentorship programme (Hauptfliesch, 2008:1).

Clutterbuck (2009:1) argues that one of the paradoxes of formal mentoring is that it allows space to discuss in private a wide range of issues that would help the mentee to cope and learn from issues they encounter on a daily basis. Furthermore, the measurement that is done during the evaluation process provides a foundation on which the formal relationship can grow. It therefore allows:

- scheme co-ordinators to recognise where additional support is needed and to improve the operation of the scheme – not least the training; and
- mentors and mentees to work together to build the relationship, understanding more clearly what each can and does bring to the discussions (Clutterbuck, 2009:1).

### 3. RESEARCH METHODOLOGY

The study has adopted a quantitative research approach. A questionnaire survey with closed-ended questions were conducted in the Western Cape and distributed to 16 CIDB grade 3 to 5 emerging contractors in August 2017. The emerging contractors were selected in terms of non-probability sampling method. The non-probability sampling method can only be used when it is highly difficult and impossible to select a sample (Leedy & Ormrod, 2010:211). The questionnaire comprised of 7 point Likert scale questions which established how emerging contractors were affected by the evaluation processes on the mentorship programme. The scale Likert scale was organised as follows: 1 = Not affected, 2 = Slightly affected, 3 = Moderately affected, 4 = Affected, 5 = Highly affected, 6 = Extremely affected, 7 = Completely affected, U = Unsure. In addition, the questionnaire consists of two sections, namely Section A and Section B. Section A consisted of biographical data of emerging contractors, whilst Section B focused on questions pertaining to the CDP assessment evaluation processes. Respondents were first informed of the focus and the purpose prior to the commencement of the survey.

Leedy & Armrod (2010:260) highlight that to analyse quantitative data one would use descriptive and/or inferential statistics. As for the purpose of this study a Statistical Package for Social Sciences (SPSS) software version five was used to capture and analyse the descriptive data. Descriptive analysis measures the central tendency and is divided into three categories namely mode, mean, and median. A reliability testing was conducted by making use of Cronbach's alpha. According to Welman, Kruger & Mitchell (2005:142), reliability is concerned with the findings of the research and relates to the credibility of the results. Cronbach coefficient alpha is a reliability test for a single occasion data collection which is an estimate of internal consistency of responses to different scale items (Welman et al, 2005:147). Reliability in terms Cronbach's alpha coefficient varies from 0 to 1; the closer the coefficient is to 1, the more reliable it is.

## 4. RESULTS AND DISCUSSION

### 4.1 PROFILE OF RESPONDENTS

#### 4.1.1 Gender

With reference to Table 1, the study sought to establish gender distribution of the 16 respondents, from the table below it is shown that of 81.3% (13) of respondents were males and 18.8% (3) were females, and this suggest both genders were represented, although females were underrepresented in the study.

Secondly shows the age distribution of respondents, where 37.5% were aged between 21 and 30 years, 12.5% were aged between 31 and 40 years, 50% were aged between 41 and 50 years.

Lastly, presents the race groups of the respondents, 6.3% of respondents were white, 31.3% black, and the 62.5% which is the majority comes from coloured race group.

**Table 1** Gender, age and race of respondents

Gender	No.	%
Female	3	18.8
Male	13	81.3
<b>Total</b>	<b>16</b>	<b>100</b>

Age group	No.	%
21-30 years	6	37.5
31-40 years	2	12.5
41-50 years	8	50.0
<b>Total</b>	<b>16</b>	<b>100.0</b>

Race group	No.	%
White	1	6.3
Black	5	31.3
Coloured	10	62.5
<b>Total</b>	<b>16</b>	<b>100</b>

#### 4.1.4 Formal qualification

It is clear from Table 2 that more than 56.3% of respondents have a matric certificate while 43.8% have not completed secondary education. It is of a

concern that none of the respondents have a tertiary or a post-graduate qualification, this could be problematic with regard to not having a tertiary qualification that would give respondents an academic experience of what the construction industry is about than a mere site experience. Furthermore, respondents could also have a challenge in understanding the business and construction related issues on the advanced phase of the programme.

**Table 2** Age group of respondents

Qualification	No.	%
Secondary - not completed	7	43.8
Matric certificate	9	56.3
<b>Total</b>	<b>16</b>	<b>100.0</b>

## 4.2 RELIABILITY TESTING

The reliability of scaled questions was tested with the use of Cronbach's alpha coefficient. Table 3 shows a summary of the reliability test for conducted for questions 1.1, 1.2 and 1.3. The Cronbach's co-efficient for the scaled questions was 0.76, which satisfies the reliability test requirements (Maree, 2007:216).

**Table 3** Reliability testing

Question No.	Theme	Number of times	Cronbach's alpha coefficient
1.1	Pre-evaluation	15	0.95
1.2	Formative evaluation	14	0.82
1.3	Summative evaluation	14	1.00

## 4.3 EVALUATION OF CONTRACTORS

### 4.3.1 Pre-evaluation

The respondents were asked to indicate whether CDP conducts pre-evaluation of mentee's to identify contractors' developmental needs prior to joining the mentorship programme and how it has affected contractors.

With regard to pre-evaluation, Table 4 indicates that there is no effective tool to determine contractors' experience in the construction industry is ranked first with a mean score of (3.93), followed by there's no effective tool to determine contractors' abilities in the construction industry (3.80). According to Lazarus (2005:72) pre-evaluation of mentee's is conducted by way of an assessment tool which assesses emerging contractors It has

emerged from the findings that contractors are not evaluated prior to the commencement of mentorship; the general assumption that all contractors have the similar challenges takes centre stage. The real developmental needs of contractors are often ignored rather contractors receive skills transfer in all aspects of mentorship as prescribed by CDP. The average mean of (3.84) suggests that the importance of conducting a pre-evaluation exercise on contractors to ascertain their developmental needs and further develop a tailor made mentoring mechanism based on the contractors' evaluation.

**Table 4** Evaluation of contractors before joining mentorship

Statement	No.	Mean	STD	Rank
There's no standard tool to assess contractors before joining the programme to identify their developmental needs	15	3.93	0.79	1
There's no effective tool to determine contractors' experience in the construction industry	15	3.80	0.77	2
There's no effective tool to determine contractors' abilities in the construction industry	15	3.80	0.94	3
<b>Average</b>	<b>15</b>	<b>3.84</b>	<b>0.80</b>	

#### 4.3.2 Formative evaluation

The respondents were asked to indicate whether CDP conducts formative evaluation on an on-going basis to measure contractors' development of the mentorship programme and how it has affected contractors.

With reference to formative evaluation, in Table 5 it is indicated that no programme information guides are provided, this is ranked first with a mean score of (4.14), monthly meetings to give feedback on contractors' progress made are not conducted is ranked second with a mean score of (3.64) and mentor monthly evaluation sheets to assess contractors on on-going basis are not conducted are ranked second and third respectively. It is found that contractors are not evaluated on an on-going basis to measure their performance on the mentorship programme with a mean score of (3.64). The formative evaluation process can track the development of mentees overtime, if skills deficiency is identified then an intervention should be introduced (Jacquet 2002:08). Moreover, there are no monthly meetings or monthly evaluations conducted between mentees and mentors to discuss feedback and point out areas of improvement. The average mean of (3.71) means this aspect of mentorship has slightly affected the delivery of mentorship warranting an intervention from the

CDP to implement proper mentorship mechanisms so that contractors receive proper mentorship in all respects.

**Table 5** Evaluation of contractors during mentorship

Statement	No.	Mean	STD	Rank
No programme information guides are provided	14	4.14	1.09	1
Monthly meetings to give feedback on contractors' progress made are not conducted	14	3.64	1.00	2
Mentor monthly evaluation sheets to assess contractors on on-going basis are not conducted	14	3.64	1.00	3
Having no standard guidelines as part of mentorship programme on how contractors should be monitored	14	3.64	1.00	4
Mentee monthly evaluation sheets to assess mentors capabilities are not conducted	14	3.50	1.09	5
<b>Average</b>	<b>14</b>	<b>3.71</b>	<b>.79</b>	

#### 4.3.3 Summative evaluation

The respondents were asked to indicate whether the CDP conducts summative evaluation on contractors when they exit the mentorship programme has affected contractors.

With regard to summative evaluation, Table 6 indicates that evaluating the entire programme after its first implementation is not conducted is ranked first with a mean score of (3.64), no standard tool to assess contractors when they exit the mentorship programme is conducted (3.64), is ranked second, followed by no standard tool to assess contractors during mentorship programme to track their progress is not conducted. According to (MBF, 2011:4) evaluation of mentorship consists of examining the information received during mentorship in order to make judgements about what you have achieved and the difference your work has made to the contractors. The findings show that contractors are not evaluated when they exit the mentorship programme and makes it difficult to ascertain any development in terms of mentorship. The other failure of CDP is the mentorship programme itself whereby CDP is unable to self-evaluate at the completion of the mentorship to identify any gaps of the mentorship programme. The mean score of (3.64) suggests that the evaluation process of mentorship is slightly affected and warrants the introduction of sound evaluation processes so that development is measured when contractors exit the programme.

**Table 6** Evaluation of contractors at the end of mentorship

Statement	No.	Mean	STD	Rank
Evaluating the entire programme after its first implementation is not conducted	14	3.64	1.00	1
No standard tool to assess contractors when they exit the mentorship programme is conducted	14	3.64	1.00	2
No standard tool to assess contractors during mentorship programme to track their progress is conducted	14	3.64	1.00	3
<b>Average</b>	<b>14</b>	<b>3.64</b>	<b>1.00</b>	

#### 4.3 DISCUSSION

The study has shown that the selection of the contractor enrolled into mentorship is not efficient enough since the contractor does not go through a thorough evaluation as a criterion for recruitment. It is therefore difficult to know whether the mentee will cope with course content. The lack of a pre-evaluation test would result into attrition when contractors find the offered course is beyond their intellectual capacity. Expectantly, the mentorship of contractors has been interrupted on a number of occasions and resulted in mentorship being delayed or taking longer to complete the mentorship.

It was found no formative evaluation is conducted in a form of evaluation sheets and guides to assess contractors' development during the mentorship programme. In addition, there were no monthly meetings or monthly evaluations conducted between mentees and mentors to discuss feedback. Consequently, the lack of formative evaluation has made it impossible to measure contractors' development or to identify areas of improvement in as far as contractors' progress is concerned. However, the lack of formative evaluation of contractors could have undesired consequences for CDP. The lack of formative evaluation could result in the mentorship programme not meeting the expectations of contractors.

It was found no summative evaluation is undertaken to evaluate contractors and the programme after the first phase of the implementation process. The failure to conduct summative evaluation on the mentorship programme could lead to contractors not knowing what they have learned upon exiting the mentorship programme. Furthermore, it could also lead to the entire mentorship programme not meeting its own objectives.

#### 5. CONCLUSION AND RECOMMENDATIONS

The findings do confirm that a problem exists in the CDP mentorship programme with regard to the evaluation of contractors. It has been revealed that the CDP mentorship programme has challenges in terms of implementing and managing a successful mentorship programme. In terms of achieving success with regard to implementing sound evaluation

processes. At the completion of recruitment and selection processes of contractors for the mentorship programme, CDP should have pre-evaluation sheets to evaluate contractors' developmental needs prior to the commencement of the mentorship programme. Mechanisms to evaluate contractors on an on-going basis to measure contractors' progress on the mentorship programme. Meetings should be arranged between mentors and mentees to give feedback in terms of mentorship. Upon exiting the mentorship programme CDP should evaluate contractors to ascertain whether the contractors' developmental needs have been addressed. CDP should at the end of the first implementation phase conduct a thorough evaluation of all implementation strategies employed and pave a way forward for the next implementation phase.

Further research should be done on whether other mentorship providers/facilitators encounter similar challenges in terms of the evaluations of contractors. The development of the content to be used for contractors should be informed by the evaluation results rather than relying on generic course content that does not reflect the developmental needs of contractors. The Department of Transport and Public Works should revisit its teaching content on the advanced phase of the programme and aligned either to the developmental needs of contractors or to the objectives of the mentorship programme.

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## Effectiveness of Contractor Development Programme in Kwazulu Natal

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### ABSTRACT AND KEYWORDS

**Purpose of this paper.** The study aims to investigate the satisfaction of Contractor Development Programme participants in terms of its effectiveness.

**Design/methodology/approach.** A cross-sectional mixed methods approach (combination of quantitative and qualitative approaches) was employed. The method enabled collection of both statistical and in-depth information on the perceptions of participants on Contractor Development Programmes. A survey was conducted to collect data from 364 participants in KwaZulu-Natal. The detailed narrative data was gathered from six participants in focus group interviews.

**Findings.** The study found that participants not only deemed the programme unsatisfactorily, but they have also reported an overall bad/low experience with the programme. The study confirmed that although the aim of the programme is to accept all contractors who were regarded as previously disadvantaged, the openness and easy access to the programme has proven to be counter-productive with unintended consequences.

**Research limitations.** The study was limited to KZN only and therefore may not necessarily be generalized to the entire national population.

**Practical implications.** The success of the Contractor Development Programme should not be based on the number of tenders given out to contractors, but rather on the developmental, growth and improved prospects. These areas would swiftly graduate contractors to different grades; and ultimately unlock growth constraints, develop sustainable contracting capacity and elevate enterprise development of previously disadvantaged contractors.

**Original/value of paper.** This study is instrumental and valuable to the academic community and professional bodies as it invites more impact assessment studies and further uncovered knowledge on how gaps in the programme are defeating its objectives. The study has uncovered lack of empirical support that the programme is claiming to be rendering to its participants.

**KEYWORDS:** Contractor Development Programme, Construction Industry Development Board, Contractor Performance, Contractor Growth and Contractor Development.

## 1. INTRODUCTION

The contractor development programme focuses on the development of contractors, more socially those previously marginalised- primarily black owned and emerging ones. In the context of this study, an emerging contractor is a “sole trader, partnership or legal entity that adheres to statutory labour practices, is registered with the South African Revenue Service and is a continuing and independent enterprise for profit, providing a commercially useful function” (Public Works, 2004). By focusing primarily on emerging contractors, the programme focuses on emerging contractors in CIDB grades 2 and 3 who display potential to develop. Through learnerships and mentoring the emerging contractor’s skills in the business side of contracting such as, for example, tendering, pricing, financial management, marketing, contract administration are developed.

Particular to this study, the Construction Industry Development Board’s (CIDB’s) lowest contractor grading, Grade 1, offers “no barrier” to entry into the industry, making it difficult for companies/clients to select high-potential entities from the “magnitude” of those registered. Moreover, this open access to all interested parties is counter-productive resulting in programme’s goals not being achieved. This study is therefore approached with the assumption that, while the contractor development programmes are critical in assisting contractors to achieve overall improved performance,

growth and development, the open access to such programmes by all interested parties is counter-productive resulting in these goals not being achieved.

## 2. THEORETICAL BACKGROUND

### The construction industry in South Africa

Construction industry plays a crucial role in fostering development in the formal and informal sector of the South African economy. The industry is instrumental for overall investment and serves as a key driver of economic development. Although the industry contributes to the economic development just like other economic sectors such as manufacturing, agriculture and mining, the industry is apex in that, it provides means for other sectors to realise growth. For example, construction within agriculture is crucial for the sector to expand.

According to PWC (2016), the construction industry in South Africa is also the main contributor to employment and growth. In 2012, the industry created one million work opportunities, with additional estimate of 424 000 individuals employed in the formal sector (Public Works, 2012). In the period between September 2005 – 2006, an annual employment growth indicates that there was 9.5% in growth, with this sector increasing its figures by 390 000 people in a period between 2001 – 2006(reference). Moreover, the industry has seen a significant increase in growth of 14%. This is 4% increase from 10% in 2005. Furthermore, figures indicate that, notwithstanding domestic and global economic challenges, the industry's confidence in South Africa has improved slightly in the first quarter of 2017(reference). This follows a mild improvement in construction activity and drop in the investor confidence in the period between 2011 - 2015 (Stats SA, 2016). While overall investment in the economy contracted by 4.4% year to year in the fourth quarter, the real growth in construction works was 2.3% year on year in the fourth quarter of 2016 up from 1.3% in the third quarter (Stats SA, 2016).

Historically tracking, public sector infrastructure expenditure has increased by 15.8% per year between 2003/04 and 2006/07 financial years (Public Works, 1999). The construction industry alone has successfully contributed 35% to the total gross domestic fixed investment. In this process, close to 230,000 work opportunities have been created and poverty gap was slightly decreased. Combined, the total value of the construction industry in 2006 was estimated at R122, 345 billion. This is 38% of the total gross capital formation. The government alone through its public infrastructure investment remains the single main contributor of construction, thus contributing between 40% and 50% to the entire construction expenditure. The government's infrastructure investment has seen government houses, bridges, roads, schools, clinics and many more infrastructures being constructed. All these have seen influx of

entrepreneurs under the small and medium categories trying to venture into the construction sector. These entrepreneurs are attracted to the returns that the industry brings (Chadhliwa, 2015). The system controls in place to regulate the influx of emerging contractor appears to be weak, thus opening up to any individual to qualify to be an entrepreneur. The fact that government is the main driver of construction investment is good in that it can easily roll out empowerment programmes such as contractor development programme and should be able to regulate this programme through incentives and punitive measures if it wants to realise its goals to empower the previously disadvantaged groups.

Frost and Sullivan (2015) and Smallwood and Rwelamila (1996) have indicated a number of challenges facing the construction industry in South Africa. These challenges were assessed or observed when projects were being rolled out. Although a number of challenges such as poor performance, decrease in market capitalisation, poor marketing strategies, lack of opportunities, compliance and most importantly, lack of necessary skills to compete better in the construction market.

In fact, shortage of skills and poor management were identified as the biggest challenge facing the South African construction industry. In a survey conducted by Business Day (2007), Grant Thornton indicated that a shortage of skilled workers is the main obstacle to expansion of 58% of medium-to-large business in South Africa.

Some of the main contractors have no idea of basic construction requirements. Some have qualifications in construction but lack basic management skills, this which leads to mismanagement of funds, poor operations, not meeting project deadlines- accurate predictions of project completion and meeting completion dates result in clients being satisfied; giving contractors a comparative advantage over others.

This lack of skills in the industry appears to link with very low survival rate in the South Africa's SME sector (Mahembe, 2011). This is a major concern because those emerging without skills or resources or management skills are bound to fail. In addition, the failure of emerging contractors due to lack of necessary skills is linked with the fact that, many obtain opportunities through corrupt means, for example, a contractor without any skill would secure a tender before establishing a business. HSE (2016) indicated that some companies pay governmental departments to have tenders secured or fast tracked, thus leading to entity failure and other challenges. For most of the emerging entrepreneurs, instead of possessing necessarily required skills, most have required capital (Thwala & Mofokeng, 2012). So, even though skills developed by the contractors on the development programme are a priority, this area remains a challenge and hindrance to achieving objectives of the programme. The inability to wholly understand the construction process, lack of project management skills, complexity of the project, uncertainty, poor communication, inadequate integration of tasks and inadequate coordination of tasks all result in delays in project delivery (Aiyetan, Smallwood & Shakantu, 2011).

### **Historical overview of Contractor Development Programme**

The economic exclusiveness of South Africa emanates from the economic structures designed by the apartheid regime to protect the interests of the minority (Govender & Watermeyer, 2000:3). In this process, economic opportunities favoured mostly whites and saw blacks being systematically side-lined. The access of economic opportunities by black majority began in 1994 after the first democratic elections. To redress the economic consequences of apartheid, South Africa, under the new government introduced a number of reforms seeking to ensure inclusive economy. Such instruments seeking to redress the effects of the apartheid system include policies, strategies, plans and programmes of actions. Moreover, a number of legislative organs such as parliament and government structures are used as tools to promote inclusive socio-economic opportunities. Such tools include public sector procurement systems which seek to “increase the base of economic activity, provide economic opportunities for the previously disadvantaged individuals and to address skewed racial ownership patterns as indicated in the PPPFA Act 23 of 2000” (PPPFA Act 23).

Employment and business opportunities for previously marginalised individuals and communities are provided through targeted procurement, and through a variety of techniques, all which seek to provide opportunities to the targeted enterprises. According to Watermeyer, Gouden, Letchmiah and Sheze (1998) targeted procurement in a practical, realistic and measurable manner, allows government to achieve certain socio-economic objectives, through engineering and construction works contracts. In addition, it is an enabler for organs of state to “operationalise policies in a transparent, targeted, visible and measurable manner when engaging in economic activity with the private sector, without compromising principles such as cost, efficiency, competition, transparency and equitability” (ibid). In the context of construction industry, government through Public Works has in 1996 introduced affirmative procurement policy in the quest to redress the economic burdens of apartheid. For many in the industry, this was the first attempt to ensure that construction firms (primarily black owned) previously disadvantaged are awarded an equal opportunity to those owned by whites. So, this policy mainly targeted affirmable business enterprises (ABEs)-defined as enterprises registered with South African Revenue Services (SARS), conforming to labour standards and which black persons own, manage and control and with turnovers within prescribed limits (ibid). Consistency in capitalization for the words Whites and Blacks” to be maintained

The introduction of affirmable business enterprises was followed by another policy by government seeking to transform the economy to include more blacks. This reform policy is called Black-Economic Empowerment (BEE). It follows a research by Spencer (2005) which indicated that the historical and deliberate marginalisation of black South Africans from contributing freely in the mainstream economy resulted in a society marked by vast inconsistencies and inequalities. Resulting from this, the Government’s BEE policy objective was centred around strengthening South

Africa's shared economy in order to meet the needs of all the people of South Africa and significantly minimise the gulf between citizens irrespective of the race; in terms of skills and opportunities in the shortest possible time. However, due to sluggish implementation of this policy, frustrations began to arise and those promised to benefit from this policy immediately accused it of lacking commitment and the fear that it may not meet its objectives (Ibid). Sluggish transformation through BEE has seen construction industry suffering transformation and inclusive.

The more frustrated was those contractors who did not possess all the necessary resources, capacity or expertise with which to fulfil contracts in their own right are (ibid) So in a nutshell, construction industry was never spared from sluggish implementation of BEE and thus, the development of contractor development programme premise on the compelling need to unlock growth constraints, to develop sustainable contracting capacity and to elevate enterprise development of previously disadvantaged individuals as per above (Construction Industry Development Board, 2009, 2011 & 2016).

The contractor development programme is public sector led, comprising of a partnership between the Construction Industry Development Board, National and Provincial Public Works and other willing stakeholders and partners.

The main objectives of the programme are to increase (1) the capacity, (2) equity ownership, (3) sustainability, (4) quality and (5) performance of Construction Industry Development Board registered contractors. The ultimate goal is to effectively raise contribution of the construction industry to South Africa's accelerated and shared growth initiative.

To achieve this objective, participants within the NCDP should commit to all or some of the following developmental outcomes:

- Improve the grading status of contractors in targeted categories and grades;
- Increase the number of black women, disabled, and youth-owned companies in targeted categories;
- Create sustainable contracting enterprises by enabling continuous work through a competitive process;
- Improve the performance of contractors in terms of quality, employment practices, skills development, safety, health and the environment; and
- Improve the business management and technical skills of these contractors (ibid).

### **Selection criteria**

As outlined in the programme framework, the targeting of specific contractors forms an integral part of the design of a CDP and the following guidelines should be followed when identifying target groups:

- Ownership: CDPs should target the development of black, women, disabled, and youth-owned companies. Specifically, CDPs should

target the development of companies in those Classes of Works (CoWs) and Grades where imbalances in such ownership exist.

- Supply and Demand: CDPs should target the development of new contracting capacity only where demonstrable shortages exist that are aligned with the service delivery objectives of the client.
- Performance Improvement (or competence development): CDPs should target to improve the performance of contractors – in particular in those areas which are aligned with the service delivery objectives of the client.
- Local Economic Objectives: Where feasible, targeting of contractors should reflect local economic objectives. (Construction Industry Development Board, 2016)

### **Programme support initiatives**

As envisioned in the contractor development programme implementing manual, the most critical element in any CDP is the support initiatives provided or arranged by clients which include mentoring, technical skills development, business and financial management training, access to finance or a combination of the above.

- *Training:* This initiative requires the client to organise training with an accredited institution. The training should be aligned with the Requirements and Guidelines for CIDB Contractor Competence Accreditation which is available from the CIDB, which are deemed to be minimum standards necessary for running a contracting enterprise and for supervising building and construction works within the fields of:
  - Business management;
  - Building and construction works management (operational and supervision);
  - Legislative issues; and
  - Training strategy

A training strategy determines the overall training programme and logistics to conduct training. It should address the training approach, objectives and outcomes, based on the contractors training requirements started above, and also the process of identifying and mobilising training institutions which can provide the required training. The following logistical arrangements should be addressed:

- The number of people to be trained
- The venue and date of the training
- The training materials required
- The expected input and output of the training
- The training service provider must identify suitable training service providers to provide the training. The training should be accredited with the Construction Education and Training Authority.

The training should be provided and structured so that the contractor can meet the requirements for CIDB Contractor Competence Accreditation. This typically involves the attainment of formal NQF level qualifications, or work place training and experience leading to the equivalent competence.

- *Mentoring:* A contractor's mentorship needs are to be identified and an appropriate mentorship intervention should be developed. Mentorship should revolve primarily around the contractor's business management skills and knowledge, such as tendering and marketing. Mentors must be registered as mentors with the Council of Project and Construction Management Professionals.

### **Contractor Assessment**

The purpose of the assessment is to select contractors that meet the entry level requirements in line with the focus of the CDP and to determine their developmental needs. All contractors applying for development must be registered in the CIDB Register of Contractors (Construction Industry Development Board, 2011).

- **Criteria for access**

Clients should apply the following criteria to determine which contractors get access to contractor development programmes (Construction Industry Development Board, 2011:13):

- Competence
- Financial upgrading; and
- Socio-economic goals

- **Competence**

The contractor must be assessed to determine their level of competence, as outlined in the Requirements and Guidelines for CIDB Contractor Competence Accreditation. The competence assessment can be done in terms of formal qualifications and experience requirements, or in terms of the requirements for an external competence assessment undertaken by a CIDB recognised external Competence Assessment Panel. The competence assessment will then also be used for evaluating the mentoring and training requirements of contractors that are enrolled within a CDP.

- **Financial upgrading factor**

The contractor must be assessed to determine a financial upgrading factor and to measure how close the contractor is to upgrading to the next grade designation. The financial upgrading factor is determined in line with the requirements of the CIDB Register of Contractors based on the following:

- best annual turnover;
- largest contract; and
- available capital (based on the current CIDB requirements).

Once the rate for each area has been determined, the client should allocate an overall financial upgrading factor rating using the following formula (Construction Industry Development Board, 2011:14):

Best annual turnover + largest contract + available capital = Overall financial upgrading factor rating

- ***Awarding points for Socio-Economic Goals***

The selection process for the contractors should give preference to enterprises with Historically Disadvantaged Individual equity ownership which have Women, Disabled and Youth ownership. Therefore, contractors must be scored out of a maximum of 20 points for socio-economic goals in line with the preferencing policy of the department (Construction Industry Development Board, 2016).

- ***Selecting contractors for development***

The contractor rating (out of 80) should be added to the points awarded for socio-economic objectives (out of 20) to determine the overall score awarded to the contractor. Contractors should then be ranked from highest score to lowest score and the cut-off point is determined by the budget available. In order for a contractor to be selected for contractor development, a minimum score of 20 should be obtained for the overall score awarded (Construction Industry Development Board, 2011:16).

- ***Shortcomings of the programme***

The assessment of the programme has shown that although there are many successes achieved by the programme, the following shortcomings remain challenging to the programme and to certain extent hinder greater achievements (Construction Industry Development Board, 2017).

- Poor coordination of subcontractors

Most of the emerging contractors are subcontracted and these subcontractors need to be properly coordinated by the prime contractor to ensure timeous delivery of assigned aspects of works. However while main contractors are expected to swiftly coordinate sub-contractors, this has proven to be a major challenge- a challenge that at times leads to the suffering of all those involved in the project.

- Inappropriate construction methods

Construction industry is a complex industry that requires activities to be carried out using best practices, tools and techniques. When construction procedures are flawed, errors occur, thus leading to rework and delays. A

plan that is not realistic and that does not conform to construction methods will lead to a delay in project completion or in a worst case scenario, could lead to the collapse of a project. At times local contractors fail to comply with practicable work programmes at the initial stage of project planning, which in turn impairs monitoring of project progress against the stipulated time.

- Inadequate experience

Experience in the construction industry could be a matter of life and death for a project or even the business of the contractor. Particular to this study, contractors simply gaining entrance in the contractor development programme without prior experience in construction are among those who hinder progress of the programme.

- Incompetent and poor management

Important to this study, proper construction management is the backbone of any successful construction business. Contractor's employees that are not skilled in project management are not able to manage their project site appropriately, thus, culminating in faulty work, reworks and delay in completion of tasks. In addition, a study by Construction Industry Development Board (2013) on lack of management shortcomings on sub-contractors has identified the following:

- o overall, management practices of specialist subcontractors were considered by main contractors to be good, but for generalist and trade subcontractors were considered to be fair to poor;
- o financial management skills and business management systems of general subcontractors were poor, with business management skills and management and supervision being fair;
- o lack of financial pricing and estimating skills;
- o lack of access to finances and continued support from CDIB;
- o poor health and safety management practices; and
- o reluctance to train employees.

- Lack of skills

Proper management, financial management, and overall technical skills in the construction industry are apex. Without these skills, construction activities could potentially be a dangerous activity, a fruitless exercise and a losing game. Although the principal aim of the contractor development or emerging contractor development programme is to address the need to unlock economic growth constraints, develop sustainable contracting capacity and to elevate enterprise development of previously disadvantaged individual; there is less in terms of literature evaluating if these objectives are being achieved. This study therefore argues that while contractor development programmes are important to assist participating contractors to achieve overall improved performance, growth and development, the open

access to such programmes by all interested parties is counter-productive resulting in these goals not being achieved. This problem statement will therefore be investigated with the following limitations: a sample of CIDB-registered Kwa Zulu Natal contractors in grades 1 to 3 ( GB contractors); a select number of appropriate case studies will be done which involve projects and contractors in the KwaZulu-Natal province; and the study will be done within ten months.

## **DESIGN/METHODOLOGY/APPROACH**

The mixed methods design (flexible and fixed) was employed to investigate the problem statement. The design enabled the use of quantitative and qualitative research approaches. The approaches enabled the researcher to conduct a cross sectional semi-structured survey and focus group interviews, which enabled gathering of narrated views. According to Grbich (2013:27) the advantage of using both approaches is that on the one hand combined approaches complement each other, thereby strengthening validity and reliability of the study. Using mixed methods also increases the capacity to cross-check one data set against one another, thereby strengthening validity and reliability of results. A non-probability convenience sampling was used to draw the 364 respondents who participated in the survey. A purposive convenience sampling was used to sample six participants who participated in the focus group interviews. Questionnaire was used as data gathering technique for survey. The questionnaire included closed-ended options, contingency questions, ranked questions as well as inventory questions which offered respondents an opportunity to choose from multiple options instead is being limited to one option. The questionnaire also included open-ended questions which require respondents to briefly narrate their responses. The satisfaction construct was mainly measured through a Likert scale with 5= Totally satisfied, 4= Satisfied, 3=Neutral, 2= Dissatisfied, 1= Totally dissatisfied. The experience construct was also measured through a Likert scale wherein 5=Strongly agree, 4=Disagree, 3=Neutral, 2=Agree, and 1=Strongly agree.

## **FINDINGS**

### **Profiling of Contractor Development Programme Participants**

Evidently from Table 1, 259 (71.2%) of respondents were owners/ founders of their companies while 105 (28.8%) of respondents co-owned/founded the company they represented in the study. Most respondents (62.1%) were males, and were Black (83.0%). Interestingly, there were also White participants (1.1%). Further, most participants (33.2%) had matriculated while 28.3% had some form of basic education. However, a further 23.6% reported having no education.

The median years of experience was 6 years, with the maximum being 11 years and the minimum being one year. Most respondents (85.7%) regarded themselves as general contractors. Most contractors participating in the contractor development programme (15.1%) came from the district of UThukela.

The annual mean turnover in the past three years was R355, 000 with the minimum turnover being R100, 000 and the maximum turnover being R1, 000,000. Most participants (39.3%) had not registered on the contractor development programme on their own and were assisted or registered by a family member or a friend.

**Table 1: Profiling of participants**

Profile	Distribution	N	%
Position	Owner/founder	259	71.2%
	Co-owner/founder	105	28.8%
Gender	Male	226	62.1%
	Female	138	37.9%
Population group	Black	302	83.0%
	White	4	1.1%
	Colored	33	9.1%
	Asian/Indian	25	6.9%
Qualifications	Master's Degree	1	0.3%
	Honours/BTech/BSc	3	0.8%
	Diploma	20	5.5%
	Certificate	30	8.2%
	Matriculation Certificate	121	33.2%
	Basic Education	103	28.3%
	No Educational Qualifications	86	23.6%
Experience	Years (Max) Min	1 year	
	Years (Median)	6 years	
	Years (Min) Max	11 years	
Type of business	General Contractor	312	85.7%
	Sub-contractor	12	3.3%
	Civil contractor	22	6.0%
	Specialist contractor	7	1.9%
	Home building contractor	10	2.7%

	Other	1	0.3%
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**Measurement of the Constructs**

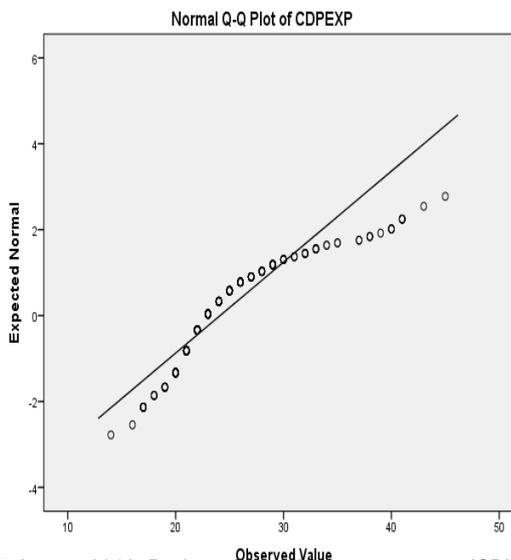
The reliability of the scaled responses was tested by using the Cronbach's alpha reliability coefficient to establish if the 5-point Likert scale employed was internally consistent in measuring the constructs. A Cronbach's alpha reliability co-efficient > 0.8 is indicative of good reliability while a coefficient between 0.6 and 0.8 would indicate acceptable reliability. The reliability coefficients of each construct are shown in Table 2. It is evident that the reliability of the scale for overall satisfaction was good and overall contractor development program experience was acceptable.

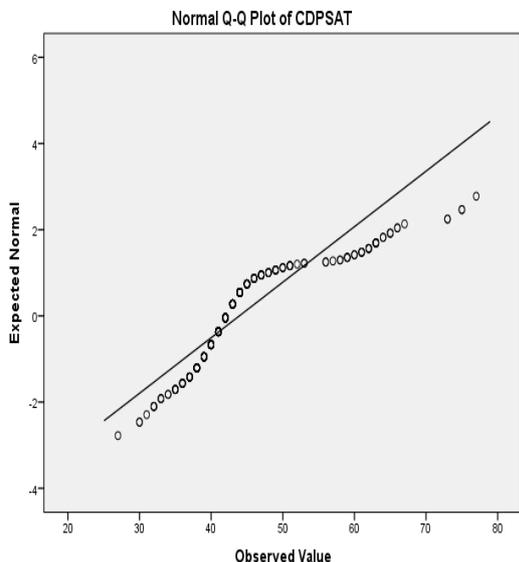
**Table 2: Cronbach Alpha Reliability Statistics**

Reliability Statistics			
Construct	Cronbach's Alpha	N of Items	Reliability
Overall Satisfaction	0.829	16	Good
Overall contractor development program experience	0.667	10	Acceptable

A normality test was also conducted to compare the shape of the research sample distribution to the shape of a normal curve. The test assists in assuming that if the sample is normally shaped, the population from which it was drawn from could also be predicted to be normally distributed (Hain, 2010). In a theoretical normal distribution, probabilities with > 0.05 mean are regarded as normal, while probabilities with < 0.05 mean would be regarded as not normal. In the actual testing of normality, a theoretical normal distribution was compared with the actual distribution of the data.

There are two methods used to assess normal distribution of data, these are statistical and graphical testing. In statistical testing, the techniques Shapiro-Wilks and Kolmogorov-Smirnov tests were used. Graphical normality tests are in particular very useful when the sampling size is huge. The sampling size of 364 is considered huge. The results of the graphical normality tests are shown in figures 1 and 2.





**Figure 1: Satisfaction Normality Test**

**Figure 2: Experience Normality Test**

Figures 1 and 2 cast a doubt that the sample is coming from a normally distributed population (Hain, 2010). It is important to state that in the bigger sampling size, normality parameters becomes more restrictive and it becomes harder for the data to meet the requirements of normal distribution. So for very large data sets, normality testing becomes less important (Ghasemi, 2012, Bera 1993). With this statistical significance of .000, and not all graphic data plots following a bell-shaped curve without any data skewed above or below the mean, the study’s data does not meet the criteria for a parametric test (not normally distributed, equal variance, and continuous). As such the data was analysed with a non-parametric test (Neideen & Brasel, 2007). For this reason, Spearman rank coefficient was therefore used to determine how well two variables for individual points or constructs predicted each other.

**Correlation Coefficients**

**Table 3: Correlation Coefficients**

**CORRELATIONS**

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			CDPSAT	CDPEX P	Population Group	Construction Industry Development Board Grading	District of Operatio n	Gende r	Registration on CDP
<b>Spearman's rho</b>	CDPSAT	Correlation Coefficient	1.000	.190**	-.023	-.104*	.020	.006	-.254**
		Sig. (2- tailed)	.	.000	.660	.047	.698	.903	.000
		N	364	364	364	364	364	364	364
	CDPEXP	Correlation Coefficient	.190**	1.000	.041	-.068	.129*	-.050	-.154**
		Sig. (2- tailed)	.000	.	.433	.193	.014	.342	.003
		N	364	364	364	364	364	364	364
	Population Group	Correlation Coefficient	-.023	.041	1.000	.122*	-.046	.072	.173**
		Sig. (2- tailed)	.660	.433	.	.020	.385	.171	.001
		N	364	364	364	364	364	364	364
	Construction Industry Developmen t Board Grading	Correlation Coefficient	-.104*	-.068	.122*	1.000	-.048	.044	-.039
		Sig. (2- tailed)	.047	.193	.020	.	.359	.405	.461
		N	364	364	364	364	364	364	364
	District of Operation	Correlation Coefficient	.020	.129*	-.046	-.048	1.000	-.014	-.052
		Sig. (2- tailed)	.698	.014	.385	.359	.	.796	.324
		N	364	364	364	364	364	364	364
	Gender	Correlation Coefficient	.006	-.050	.072	.044	-.014	1.000	-.085

		Sig. (2-tailed)	.903	.342	.171	.405	.796	.	.104
		N	364	364	364	364	364	364	364
	Registration on CDP	Correlation Coefficient	-.254**	-.154**	.173**	-.039	-.052	-.085	1.000
		Sig. (2-tailed)	.000	.003	.001	.461	.324	.104	.
		N	364	364	364	364	364	364	364
**. Correlation is significant at the 0.01 level (2-tailed).									
*. Correlation is significant at the 0.05 level (2-tailed).									

Correlation of various constructs was conducted to measure the magnitude of any linear associations between them (Rodgers & Nicewander 1988). Determining the level of correlation entails a statistical method that determines the degree of relationship between two or more variables. Evident in table 3, it would seem that although not significant, the relationship between the two constructs which are satisfaction and experience is strongly positive (.190) at significance level of 0.00. There is a strong negative (-.254) correlation between registration on the contractor development programme satisfaction at significant level of 0.00. Table 3 further indicates another strong negative relationship (-.154) between the construct- experience and registration on the contractor development programme at a significant level of 0.03. There is observed strong positive relationship (.173) between population growth and registration on the contractor development programme, at a significant level of 0.01. Due to constructs being considered not normal, the correlation was performed using Spearman's correlation test. A test of the significance of Pearson's  $r$  would more likely to inflate type I error rates and reduce power (Bishara & Hittner, 2012); subsequently Spearman was considered as alternative method to determine correlation coefficients.

### **Satisfaction measurement with overall registration on the Contractor Development Programme**

According Bless, Highson-Smith & Kagee, (2013), the best approach to estimate satisfaction level is by considering one value which represents all other values. The mean was considered to be the most informative measure of central tendency and was used to identify key findings. Participants were presented with 16 statements on aspects of their overall satisfaction with the registration process of the contractor development programme and asked to indicate their level of satisfaction on a 5-point Likert scale where 1=totally

dissatisfied, 2=dissatisfied, 3=neutral, 4=satisfied and 5=totally satisfied. Their responses ranked by the means are shown in Table 4.

**Table 4: Satisfaction with Contractor Development Programme**

Statement	Mean	Std. Deviation	Satisfaction Level	Mean Rank
Own registration on the system	4.154	0.7774	High	1
Ease of registration on the CIDB	3.898	0.8833	High	2
Ease of registration on the CDP	3.802	0.8873	High	3
First time registration on CDP	3.786	0.9201	High	4
Understanding of being grade 1,2 &3	3.679	1.1002	High	5
Understanding of objectives of the Programme prior to registration	3.486	0.9165	Medium	6
Compliance with system requirements	3.475	0.8378	Medium	7
Benefits of being a beneficiary on the contractor development Programme	2.297	0.9060	Low	8
Benefitted from tender since registered on the contractor development Programme	2.135	0.9684	Low	9
Extent to which you have been identified as a potential contractor	1.984	0.9089	Low	10
Growth and development since joined the Programme	1.962	0.9670	Low	11
Performance since joined the Programme	1.887	0.9991	Low	12
Overall experience with contractor development Programme	1.885	1.0030	Low	13
Training received from contractor development Programme	1.860	0.8263	Low	14
Possession of construction experience prior registration	1.827	0.9032	Low	15
Effectiveness of communication	1.824	0.8076	Low	16

From Table 4, it is evident that of the 16 statements about registration respondents expressed high levels of satisfaction with five statements with means ranging from 4.154 to 3.679, and average or medium level of satisfaction with two statements with means ranging from 3.486 to 3.475. Participants further expressed low levels of satisfaction with the remaining nine with means ranging from 2.297 to 1.824. It seems that respondents were not satisfied with the benefits of participating in the contractor development programme including their actual performance, growth and development, training and effectiveness of communication about the programme itself. This is confirmed by the focus group thematic analysis

which indicates that training, performance and growth were less mentioned during the interviews.

### Contractor Development Programme Experience

**Table 5: Contractor Development Programme Experience**

Statement	Mean	Std. Deviation	Level of agreement	Mean Rank
The contractor development Programme is beneficial to contractors	3.810	1.0149	High	1
Intending to remain a member of contractor development Programme in future	3.217	0.9733	Neutral/Moderate	2
The role of CIDB is clear	2.975	1.2295	Neutral/ Moderate	3
Full compliance with legislative requirements as contractor	2.931	0.6456	Neutral/ Moderate	4
It directly or indirectly worsened my finances	2.027	0.9147	Low	5
Enjoying support depends on geographical location (rural vs urban) of contractors	1.915	0.9005	Low	6
Improvements are needed in the contractor development Programme	1.893	0.9460	Low	7
The Programme gave me high expectations	1.802	0.9589	Low	8
Benefits the political connected instead of those previously disadvantaged	1.799	0.9066	Low	9
It should be wholly reviewed to empower emerging contractors	1.753	0.8524	Low	10

Evidently from Table 5, of the ten statements on experience with contractor development programme, respondents expressed low levels of agreement with one statement with a mean score of 3.810. Moreover, they expressed neutrality or average agreement with three statements with means ranging from 3.217 to 2.931. They further expressed high levels of agreement with experience with the remaining means ranging from 2.027 to 1.753. The statement with which most respondents did not agree is:

- The contractor development Programme is beneficial to contractors (mean= 3.810)

The contractors evidently did not agree that the contractor development program (CDP) was beneficial to them. Contractors felt that participating in the CDP affected their financial position, that their geographical location affected the level of support they received, that the CDP needed improvement, that the CDP created expectations that were unfulfilled, that the CDP benefited only those with political connections and that the entire

program needs to be reviewed to ensure that the target group, namely emerging contractors, were beneficiaries and empowered.

- It directly or indirectly worsened my finances (mean= 2.027)
- It should be wholly reviewed to empower emerging contractors (mean= 1.753)
- Improvements are needed in the contractor development Programme (mean= 1.893)
- The Programme gave me high expectations (mean= 1.802)
- Benefits the political connected instead of those previously disadvantaged (mean= 1.799)
- Enjoying support depends on geographical location (rural vs urban) of contractors (mean=1.915)

### Qualitative analyses

When analysing the focus group data, a thematic analysis was conducted. Thematic analysis is a method of identifying, analysing and reporting patterns (themes) within data (Fereday & Muir-Cochrane, 2006). Data themes patterns are crucial to the description of a phenomenon and should be linked with objectives, hypotheses and objectives of the study. Following transcription of data collected through technological device, the thematic analysis was performed by extracting, coding and categorising data text in developed themes, based on the data's characteristics (Bowen 2009). In the analysis process, emerging themes linked with contractor development challenges were developed. The coding of responses into emerging themes was performed on Microsoft Excel. In terms of Communication mediums as emerging theme, 66.66% indicated to have used personal or manual registration to register on contractor development programme, 16.66% indicated telephone while the same percentage indicated postal services. . The thematic analysis indicates that participants in the contractor development programme are more frustrated with communication processes in the programme. A verbatim quote regarding communication "*We never receive feedbacks, I don't even know who to contact when experiencing challenges*". Training also emerged as emerging theme and the analysis shows that 50% of participants were concerned with lack of training. A verbatim from participants includes: "*We have never received any training from any stakeholders in the contractor development programme*" They all indicated to have never received training since joined the programme. Moreover, programme frustration emerged as strong emerging theme of the thematic analysis. The analysis shows that 66% were generally frustrated while 50% were frustrated with the selection criterion. Verbatim quote regarding communication "*We never receive feedbacks, I don't even know who to contact when experiencing challenges*".

## Overall Challenges Experienced

**Table 6: Challenges experienced by contractors**

No.	Challenges experienced	Frequency	%
1	Financial constraints and limited access to funding	303	96.40%
2	Late payments by clients.	271	86.30%
3	Lack of sufficient resources and capital equipment.	269	85.60%
4	Poor communication.	266	84.70%
5	Skills shortage.	241	76.70%
6	Intense competition.	203	64.60%
7	Difficulty ensuring regular materials supply	202	64.30%
8	High skilled workers turnover.	199	63.30%
9	Limited access to professional advisors.	171	54.40%
10	Complicated contract procedures.	169	53.8%

Participants were asked to rank programme challenges according to their seriousness. They were asked to rank these from the highest priority to the lowest. Evident in table 6, only 314 (86.2%) successfully ranked items according their preference. Financial constraints and limited access to funding were challenges experienced by almost all of the participants. Late payments by clients (86.3%), lack of sufficient resources and capital equipment (85.6%) and poor communication (84.7%) were the next dominant challenges that were experienced.. Skills shortage is also one of their major concerns (76.70%). In terms of this, they indicated that training is needed and distribution of work be looked into to benefit contractors. A verbatim from thematic analysis includes: "We have never received any training from any stakeholders in the contractor development programme" Limited access to professional advisors (54.4%) and complicated contract procedures were experienced by just more than half of the respondents.

## OVERALL INTERPRETATION OF RESULTS

Participants in the study reported low levels of satisfaction with these critical areas of contractor development. Their level of satisfaction with growth and development since joined the programme was low, while their level of satisfaction with performance since joined the programme was also low. Thematic analysis further indicates less frequency of training, growth and development in the contractor development programme. This finding is further validated by Construction Industry Development Board, which confirmed that it has been very difficult to obtain reliable information on the growth and performance of contractors that have participated in the contractor development programme (Construction Industry Development Board, 2009).

The open and easy access when registering on the contractor development programme allows any interested person to automatically become a contractor creating the possibility of abuse of the programme. The aim of the contractor development programme is to elevate previously disadvantaged and marginalised contractors (CDP). The challenge with this open access is that it is difficult to establish if those in it are disadvantaged or not. Without clear criteria to include only the intended beneficiaries, namely previously disadvantaged and filter out the opportunistic contractors, it would be difficult for the programme to realise its objectives. Therefore, the study has found that open or easy access by all interested parties to participate in contractor development programmes is counter-productive with unintended consequences.

## **CONCLUSION**

Summarily, the study has found that contractors did not agree with the general belief that the contractor development programme (CDP) was beneficial to them. It further appears that respondents were not satisfied with the benefits of participating in the contractor development programme including their actual performance, growth and development, training and effectiveness of communication about the programme itself. This is confirmed by the focus group thematic analysis which indicates that training, performance and growth were less mentioned during the interviews. The findings further indicate that contractors felt that participating in the CDP affected their financial position due to late payments, that their geographical location affected the level of support they received, that the CDP needed improvement, that the CDP created expectations that were unfulfilled, that the CDP benefited only those with political connections and that the entire programme needs to be reviewed to ensure that the target group, namely emerging contractors are adequately supported and empowered. These findings are imperative for improvement of contractor development programme to achieve its goals. In the current form, the study simply revealed that the programme is working against its own objectives. There is

a need to reform and improve the programme so that it can benefit deserving contractors, and ultimately achieve its objectives.

### **RESEARCH LIMITATIONS/IMPLICATIONS**

The study had highlighted researchable areas in pursuit of addressing number of gaps in the contractor development programme. It recommends that more studies be conducted to expand this study, with particular focus on registration aspects which appear to allow influx of contractors, thus stressing on the capacity to cater for the needy contractors. Moreover, similar studies focusing on longitudinal analysis of effectiveness of contractor development programme covering a broader scope.

### **PRACTICAL IMPLICATIONS**

The developmental, growth and improved prospects of the Contractor Development Programme should be looked into. These areas are imperative to swiftly graduate contractors to different grades, thereby enabling the programme to unlock growth constraints, develop sustainable contracting capacity and elevate enterprise development of previously disadvantaged contractors.

### **ORIGINAL/VALUE OF PAPER**

Chiefly, the study has uncovered gaps in terms of the vagueness in identifying the Contractor Development Programme participants, the openness and easy access currently leads to deserving contractors not benefiting. Moreover, the study has uncovered lack of empirical support that the programme is claiming to be rendering to its participants.

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## **The Impact of Foreign Constructions Firms on the capacity building of local contractors in Ghana**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose:**

This research seeks to investigate how the presence of foreign construction firms in Ghana has affected the capacity building of the local contractors.

#### **Research Design:**

The research instrument used is the interview guide made up of both tick box and open-ended questions to interview 36 contractors and consultants operating in Accra, Ghana. Other sources of data included archival records such as contracts awarded, the current public procurement regulations, and manuals.

#### **Research Limitation/Implications:**

Only construction firms based in Accra were interviewed

#### **Findings:**

The findings show that, the presence of foreign construction companies in Ghana has not had any positive effects on the local contractors with respect to transfer of knowledge and technical knowhow. Thus, local contractors are outcompeted in the execution of major developmental projects embarked on by the Ghanaian government.

#### **Practical Implications:**

This research has developed that if followed by the Ghana Government would utilise the presence of the foreign construction firms towards positive transformation of local contractors with respect to knowledge, skills and technical capabilities. Thus, this would empower and engender capacity

building among local contractors to actively participate in the execution of all the government projects. The study also provides recommendations to the stakeholders in the Ghanaian construction industry.

**Conference Theme:** Local construction industry development

**Key Words:** Foreign firms, Public procurement Act 663, Local construction

## 1. INTRODUCTION

In an attempt to attract foreign investments and economic growth, many African countries have embraced the business friendly economic reforms that will make it easier for foreign firms to operate in their respective countries. Indeed, Amisah and Stack (2016) suggest that, while economic policy reforms have largely removed the direct barriers to investment in most African countries, it is believed that many indirect barriers remain in place, which rather constrain an inward investment drive. Foreign investment according to Amisah and Stack (2016) represents an important channel through which resources, human capital and technological progress are transferred to developing countries thereby increasing capacity of their local counterparts.

Specifically, as Girma (2002) puts it, “the presence of foreign firms supplements the necessary capital accumulation in production that can improve growth prospect”. Foreign firms are also perceived to be the conduit through which the human resource base in developing countries are enhanced as a result of managerial experience, entrepreneurial expertise and technological skills they possess (Amisah and Stack (2016). These skills according to Gorg et al., (2004) can be passed on through joint partnerships with domestic firms and training programmes, thereby improving both the quantity and the quality of output. Furthermore, foreign firms bring technological know-how and expertise that contribute to the upgrade of production processes and the efficiency of output. In addition, foreign firms engaged in trade, generate foreign exchange through exports – a welcome benefit for developing countries which run current account deficits (Gorg et al., 2004).

However, according to Masino (2016), the debate surrounding the impact of foreign investment inflows on domestic investment in Africa for that matter, Ghana has traditionally been a battle between the “modernisation theory” type of arguments and the “dependency theory” type. Masino (2016) further suggests that, the first theory relies on endogenous growth theories’ attribution to Foreign Direct Investment (FDI) with potential to foster economic development through capital accumulation, efficiency spill overs, and transfer of technological knowledge. To the contrary, the second theory posits that the contribution

of FDI to local development is more controversial, owing to a number of factors. Lall and Wangwe, (1998) argued that, due to the nature of foreign companies, the internal multiplier effect generated by foreign investment is not unlimited. Kaplinski et al., (2003) and Lin and Chang, (2009) supports this view by stating that, the structuralist industrial policy literature emphasises the importance of capability building and linkage formation as key in overcoming exclusive reliance on foreign investors.

Most investment projects undertaken in developing countries involve foreign participation, as either investors or sponsors of the project. Since 2008, global investments in infrastructural projects have tilted in favour of the developing countries in their drive to stimulate economic development and poverty alleviation (UNCTAD, 2015). It is suggested that the presence of foreign investors in a country is not bad phenomena as there could be benefits of foreign firms transferring technology and knowledge to local firms in the host countries (Osabutey, William and Debrah, 2014). This, according to Pack & Saggi (1997), is more provident particularly the case of developing countries that are lagging behind the technology frontier. Supporting this view, Lim (2001), states that, FDI is a conduit for transferring advanced technology to host countries. However, Pack and Saggi (1997), again suggest that because such inflows and the domestic abilities to utilise them are complex, considerable effort to promote assimilation is required.

Ghana was one of the first sub-Saharan African countries to carry out market friendly economic reforms (Amisah, 2016) coupled with a political stability since 1992. This therefore paved the way for influx of FDI (Barthel et al., 2008) such as construction companies who are currently executing most of the government infrastructural projects. The question is, have the presence of these foreign construction firms in Ghana have any positive effect on the local contractors? This research therefore seeks to find out the answer to this question.

### **1.1 Research Objectives**

The main research objectives are as follows;

1. To find out how the foreign construction firms operating in Ghana has affected the capacity building of the local contractors
2. To find out the level of engagement between the local and foreign construction firms operating in Ghana

## **2. PROBLEM OF THE CONSTRUCTION INDUSTRY IN GHANA**

Studies show that the construction industries of developing countries, including that in Ghana, face many problems (Ofori, 2012). According to Ofori, (2012), there are three main reasons for these problems. First, the economic weaknesses which these countries face mean that there are

inadequate resources earmarked for improving the industry thereby stiffening job opportunities as well as the market forces which support innovation. Secondly, many of the governments of these countries do not recognise the importance and needs of the construction industry, and hence do not formulate and implement programmes for upgrading the industries. Finally, the inherent underdevelopment of the construction industries in these countries means that they are unable to deal with their weaknesses, to make a strong case for help or to contribute to the efforts which the government makes to develop the industries.

Owing to these problems enumerated by Ofori (2012), the performance of the construction industries on projects in developing countries, including Ghana, is poor in most respects including cost, quality and productivity. On most construction projects undertaken in the developing countries, the results fall short of the targets set by the participants themselves in terms of budgets (cost), schedules (time) and specifications (quality) (Ofori, 2012). The constructed items in these countries are also unsatisfactory in terms of their maintainability and durability. As constructed items involve huge investments and are expected to last for several years, this has significant economic and social consequences. Moreover, the performance of the construction industries in these developing countries compares unfavourably when viewed against those of their counterparts in industrialised nations.

Ghana's construction industry has several of the characteristics of the construction industries in developing countries highlighted above. Whereas governments tend to use investment in construction to regulate the economy, bottlenecks in the administration of public-sector projects often leads to lower levels of implementation than the stated targets, thus limiting the impact of the government's pump-priming efforts (Ofori, 2012). If a nation is to derive the maximum from the construction activity that takes place within it, then it is important that this activity does not result in increases in importation or in transfer of earnings by foreign firms, but leads to further activity in other sectors of the domestic economy including the local construction industry. Ghana must therefore institute policies to address the challenges facing its domestic construction industry to realise the benefits of construction sector in its GDP growth.

A study conducted by Laryea (2010), revealed many challenges faced by the contractors in Ghana. Among these challenges are presence of foreign contractors and lack of contractor's capacity. Laryea (2010) found out that most major projects in Ghana are awarded to foreign contractors and this necessitated a suggestion from the Association of Road Contractors, Ghana to government that when a job is awarded to a foreign contractor, the firm should be encouraged to sublet about 25% of the work to local contractors with known capability. The Association of Road Contractors argued that much of the jobs done by staff of the foreign contractors could be done by local experts and professionals. However, as Laryea (2010) puts it, the call has not been heeded by government.

According to Laryea (2010), some contractors complained that there are cases when some expatriates brought in to work for foreign construction firms do not even possess any relevant qualifications in construction. Another problem identified by Laryea (2010) includes low capacity of indigenous Ghanaian contractors and that local contractors do not oppose competition; however, the low capacity of the local contractors makes it difficult for them to compete.

Ofori (2012) therefore suggests that a systematic and coordinated approach to the management and development of the industry in Ghana is a key issue for the nation and that the existing organizational network for this purpose should be strengthened, and provided with the necessary resources on a sustainable basis. It has been identified by Amoah and Shakantu (2017) that, the preferential policy in the current public procurement law is inadequate in facilitating capacity growth of the local construction industry and hence government should institute policies to address this deficiencies in the procurement law. This lack of support by the government in dealing with the relationship between foreign and local contractors necessitated the issuance of the below statement by the local contractors in their 2014 Annual General meeting (See Figure 1).

**Statement: Government accused of side-lining local contractors**

*Mr Martins Kwasi Nnuro, President of the Association of Building and Civil Engineering Contractors of Ghana has taken a swipe at government for side-lining local contractors when it comes to the award of government contracts. "Our people are often side-lined and ignored when it comes to a lot of large, very good or sustainable construction contracts," he said.*

*Speaking at the association's Annual General Meeting, Mr Nnuro also took a swipe at government for failing to pay local construction companies on time for jobs executed. He said many of their members were drowning in debt because of government's failure to pay for projects on time.*

*Mr Nnuro described the situation as 'serious' saying the construction industry in Ghana was lurching to a 'crisis.' The construction industry is estimated to contribute between 10 and 15 percent to the Gross Domestic Product.*

*Mr. Nnuro said the situation has made it difficult for many members of the association to upgrade their skills and pay salaries for employees, adding "Government for the past two years has not been awarding new construction contracts due to lack of funds". "With interest rates hovering between five and six percent per month and contractors' payments for claims delaying for over a year, construction companies say they have become enslaved to financial institutions".*

*The association also expressed concern over donor driven construction projects saying they favoured foreigners while locals were only being engaged as sub-contractors. Mr Nnuro said the association is taking steps to have policies enacted making it mandatory to allocate 30 percent of the work and its management to local contractors. Nnuro questioned the*

*rationale behind using all money raised in the recent Eurobond to defray payment claims of only foreign contractors.*

**Figure 1: Government accused of side-lining local contractors**

Source: Peace FM, (2014: online)

### 3. RESEARCH METHODOLOGY

In order to achieve the purpose of this study, an integration of in-depth literature review supported by semi-structured interviews was adopted. A prior arrangement with the interviewees was done via telephone. Originally, the study population targeted to be contacted for interview were 68 construction firms. However, 36 were reached for the interview. The interview techniques adopted for this study was face-to-face guided by semi-structured interview made up of both closed and open ended questions. In some instances, the interviewees were given the questionnaire to fill in whilst the interviewer waits and clarify questions asked by the interviewees. In other instances the interviewer asked the interviewee questions and filled in the questionnaire.

Purposive sampling was adopted since the subject under investigation is of specialized nature. According to Leedy and Ormrod (2014), the typical research sample size of the phenomenological study such as this study, making use of unstructured interview guide may range from five (5) to twenty-five (25) participants. Agreeing with this position, Cassim (2011), posits that, in qualitative research, by the time you reach a research sample size of 30 participants, the research would have reached the theoretical saturation point, where little or no new information can be gained. Considering the views of Leedy and Ormrod (2014) and Cassim (2011), the 36 respondents interviewed is enough for statistical analysis. The characteristics of the respondents are as follows;

#### 3.1 Profile of the interviewees

The people contacted for the interviews are familiar with the Ghanaian construction industry. They were authorized by their organizations to grant the interview as they are actively involved in both public and private tender processes for their respective organizations and also the construction activities of their respective firms. Their views on the research topic are therefore very reliable and valuable. The figure 3.1 shows the profile of the respondents.

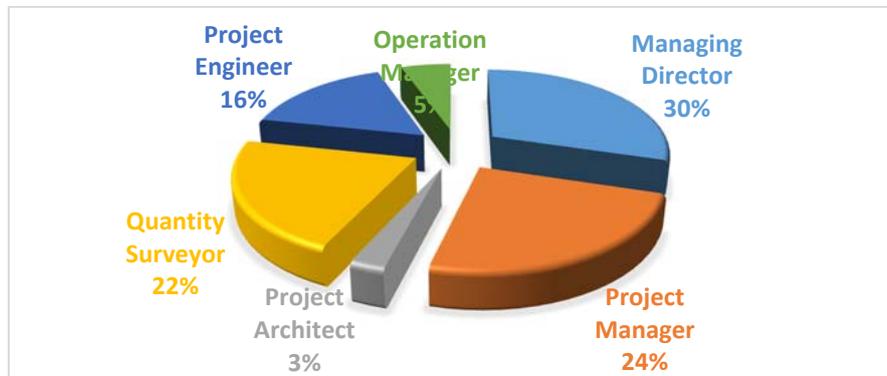


Figure 3.1: Profile of interviewees

### 3.2 Interviewee's construction industry profile

The analysis of the interviewee's industry profile is indicated that 69% of them are in the building construction industry, 19% are consultants in the construction industry and 12% are in the road construction sector.

### 3.3 Experience of the interviewee's organization in construction business

Forty one percent (41%) of the respondents organizations have been in business for 1 to 5 years; 35% have been operating for 6 to 10 years; 11% for 16 to 20 years; 8% has been in business for 11 to 15 years and 5% have been in operation for 21 to 25 years. This indicates that most of the businesses have been operating in the construction for a reasonable number of years and hence would be able to know how the foreign contractors operating in Ghana has affected their business.

### 3.4 Interviewees work experience

Twenty one (21) interviewees (representing 57%) have worked between 6 to 10 years, 8 of them (representing 22%) have worked for 11 to 15 years, 5 interviewees (representing 14%) have worked in the construction industry for 1 to 5 years, 2 of them (representing 5%) have worked for 16 to 20 years and 1 interviewee (representing 3%) has worked for 21 to 25 years. Thus a substantial number of the interviewees have experience of working in the construction industry for quite a long time and hence have insight about the topic under study.

## 4. FINDINGS AND DISCUSSION

### 4.1 The Effects of foreign Contractors on the local contractors

The findings indicates that, there have not been any significant effects in terms of technology and knowledge transfer from the foreign contractors to the local contractors. Fifty nine (59%) of the respondents rated technology transfer as very important, however this does not happen after the work has been awarded. They would therefore be happy if the foreign contractors transferred modern technology to them as this would also help them carry out maintenance works on the completed projects, especially the projects executed by foreign contractors.

As one interviewee puts it:

*“The procurement agency should consider this factor especially when evaluating the tender submitted by the foreign contractors so that they would be able to see the plan they have for the local contractors they are going to engage as subcontractors. They need to transfer some of the technology to us, so that we can carry out maintenance works after their departure. My brother, nothing of this sort is currently happening and these guys (referring to foreign contractors) are still called upon again by the government to come and do the maintenance works.”*

This was evident on the nature of projects executed by the local contractors and that of their foreign counterparts. Most of the projects awarded to the local contractors are minor works devoid of complexity (see table 4.1 and 4.2) whilst their foreign counterparts were awarded with major government developmental projects (see table 4.3). This development were mainly due to the inability of the local contractors to executive these major project due to lack of capacity and technological knowhow.

As one respondent suggests:

*“You (referring to the interviewer) go round and visit all the major road projects currently going on in Ghana. They are all done by foreign contractors but these works can be done by us. So why do they prefer the foreign guys to us. We may not have all the equipment for these projects but I think that is where government comes in to assist if they really care about the local construction industry.”*

**Table 4.1 Building contracts awarded to local contractors**

	<b>Project description</b>	<b>Tender amount (in Thousands)</b>
1	Construction of classroom block and KVIP Toilet	US\$ 26
3	Rehabilitation of Bedroom Bungalow and Office Block	US\$ 10
4	Construction of District Quarters	US\$ 22.6

5	Construction of classroom block and KVIP Toilet	US\$ 27.2
6	Construction of classroom Block	US\$ 29
7	Construction of classroom Block	US\$ 46
8	Building Construction	US\$ 3.0
9	Renovation and Painting works	US\$ 16
10	Renovation and Painting works	US\$ 3.81

Source: www.ppaghana.org

Table 4.2 Road contract awarded to local contractors

	Project description	Tender amount (In millions)
1	Road construction	US\$ 2.63
2	Road construction	US\$ 2.74
3	Road construction	US\$ 2.32
4	Bridge construction	US\$ 3.32
5	Road resurfacing	US\$10.66
6	Road upgrading	US\$ 0.34
7	Road upgrading	US\$ 0.34
8	Road rehabilitation	US\$ 0.27
9	Partial road reconstruction	US\$ 0.32
10	Road resurfacing	US\$10.66

Source: www.ppaghana.org

Table 4.3 Contract awarded to foreign contractors

	Project description	Tender amount (in millions)
1	Construction flyover and Interchange - KNC	US\$100
2	Construction of Interchange - KAS	US\$170
3	Airport project - HO	US\$ 25
4	Airport Expansion project - TME	US\$174
5	Airport Expansion Projects - KIA	US\$274
6	Airport Expansion Project - KUMA	US\$ 29
7	Military Hospital Project - KUMA	US\$180
8	Road Construction - TETEMADI	US\$21.70
9	Hospital Expansion Project - RIDGE	US\$250
10	Bridge Renovations - ADOMI	US\$12.90

The road sector is doing well based on the contracts amounts awarded to the local contractors and if this trend continues local contractors will be empowered to execute most of the road works in Ghana in the near future. However, a careful observation of the project descriptions shows that these projects are minor road works (see table 4.2) which involve

mainly resurfacing and upgrading of already existing road mainly in the townships and between communities. Again, all these road works are less than 50 kilometers long. This also shows that huge road projects such as high ways and overpass bridges, airport runway expansions are still in the hands of foreign contractors (see table 4.3).

#### **4.2 The level of relationship between the local and foreign contractors**

It was revealed that, there are no formal relationships between the local and foreign contractors during project execution such as mentorship and joint venture arrangements that will facilitate capacity building, technology and knowledge transfer. The level of engagement only end at sub-contracting arrangement, where the foreign contractors engage the local contractors as subcontractors and assign them some section of the works. There are no proper policies regarding this arrangement and hence the foreign contractors dictates the terms and conditions.

As one respondents puts;

*“They (referring to the foreign contractors) decide the rates they want to give us and if you object, you will not be given the work. There is no job for us so you just have to accept their rates. As the saying goes, half of a loaf is better than nothing. At times we even incur losses by the time the project is done.”*

The major problem facing the Ghanaian government is lack of funds for infrastructural projects; hence, the government mostly relies on loans from multilateral institutions such as the World Bank and the International Monetary Fund (IMF) as well as countries in Europe, Asia and South America. The Government of Ghana also, in some cases, funds her developmental projects through donations from other countries. Almost all donations and loans come with some form of conditions such as engaging contractors or suppliers from the donor or lender countries to execute these projects. These conditions attached to donations and loans therefore inhibit the government from implementing policies (such as mentorship) that will benefit the local contractors as the implementation of any locally favoured policy would go contrary to the terms and conditions attached to these loans and donations.

The government must therefore institute measures to generate income needed for its infrastructural projects locally and this can only be possible if the local industry is developed to a level of self-reliance in order to execute the country's infrastructural projects. Government must also be able to negotiate with donor countries, at least, some terms that would improve skills and technology transfer from the foreign contractors emanating from the donor countries, through policies such as mentorship and joint ventures. The mentorship policy would engender skills and technology transfer to the local contractors thereby increasing their capacity to execute future projects when the country's economic situation improves and government is able to fund its own developmental projects.

Again government could negotiate with the donor countries to at least agree on a certain percentage of the works to be done by the local contractors. If local contractors are able to execute at least 20% of these huge infrastructural projects, it would go a long way to developing the local contractors. To achieve this, the Ghanaian government must institute a new procurement policy whereby the foreign contractors especially those from donor and lender countries are welcomed, but their presence in the country would contribute to the development of the local contractors.

### **4.3 Proposed policies to boost local construction industry development**

The policy divides procurement into two stages, namely pre-contract stage and post-contract stage

#### **4.3.1 Pre-contract stage**

At pre-contract stage, procurement can be categorized into two, namely; international competitive tendering and National competitive tendering. A preference points should be allocated for each evaluation criterion in conjunction with price points. These preference points, are mainly as a policy tool for ensuring local contractors are benefiting from the foreign contractors in terms of skills and knowledge transfer. The international competitive tendering should have bigger contract amounts than the national competitive tendering.

##### **4.3.1.1 International competitive tendering**

In international competitive tendering, both foreign and local contractors should be allowed to tender. Since the contract amount involved is huge, most of the local contractors may not have capacity or resources to tender, hence a preferential policy in the form of a capacity building strategy of the local contractor should be required from each tenderer. A point for the capacity building strategy should be awarded to each bidder based on how comprehensive and feasible the submitted strategy is, in the tender document as shown in table 4.4. The capacity building strategy plan should detail how the bidder intends to train and transfer skills and construction technology knowhow to the local contractors who would be engaged on the project.

A two points systems should be constituted, namely 60/40 point system where price points is 60 and preferential policy points is 40 or 70/30 point system; where price points is 70 and preferential policy points is 30.

The 70/30 or 60/40 point systems can be adopted depending on the weight the government wants to place on the local contractors development. For example, where post construction maintenance is a major issue, 60/40 preferential points should be adopted when it comes to skills and technical

knowledge transfer strategy to ensure contractors/consultants submit detailed proposals as to how skill and knowledge transfer would be executed for post construction maintenance by local contractors/consultants.

**Table 4.4 Price and preferential points for knowledge and skill transfer strategy**

<b>Preferential points for capacity building strategy of the bidder company</b>	<b>Point for 60/40</b>	<b>Points for 70/30</b>
Extremely good strategy	40	30
Very good strategy	32	24
Fairly good strategy	24	18
Acceptable strategy	16	12
Not bad strategy	8	6
No strategy	0	0
<b>Maximum point to be awarded</b>	<b>40</b>	<b>30</b>

#### 4.3.1.2 National competitive tendering

In the national competitive tendering, only construction companies who are registered and operating in Ghana should be allowed to tender. The government should institute preference points for the joint venture arrangement between the local and foreign contractors tendering for the project. The proposed preference points for the company ownership are shown in table 4.5. The higher an indigene stake in the company, the higher the points awarded. This preference point's strategy would also encourage partnerships and joint ventures among foreign and local construction companies and hence help skill and technical knowhow transfer from the foreign contractors to the local contractors.

**Table 4.5 Price and preferential points for Joint Venture strategy**

<b>Preferential points for joint venture arrangement</b>		<b>Point for 60/40</b>	<b>Point for 70/30</b>
<b>Local contractor</b>	<b>Foreign contractor</b>		
70%	30%	40	30
60%	40%	24	24
50%	50%	18	18
40%	60%	12	12
30%	70%	6	6
Below 30%	Above 70%	0	0
<b>Maximum point to be awarded</b>		<b>40</b>	<b>30</b>

### 4.3.2 Post-contract monitoring

At post contract stage, the government should institute stringent monitoring tools to ensure the arrangement agreed upon in the pre-contract stage are followed by the foreign contractors. A comprehensive progress report should be submitted by the foreign contractors on monthly bases before payments are made for work done. Government must also visit the project sites to interact with the local contractors as to how they are benefiting from the programme and any concerns they may have for better implementation of the agreement. This would ensure skills transfer and development of the local contractors and subcontractors working on the project.

## 5. CONCLUSIONS AND RECOMMENDATIONS

The study concludes that, the foreign constructions companies operating in Ghana have not had any positive impact in terms of capacity building (skills and technical knowledge transfer) of the local contractors. Local contractors are still struggling to compete with the foreign contractors in the execution of major government developmental projects and leaving these massive projects in the hands of the foreign contractors whilst they are engaged as subcontractors, executing minor works. The value of contracts awarded to the local contractors are minute as compared to that of their foreign counterpart due lack of skills and technical knowhow.

It is therefore recommended that, local contractors should try and form joint venture or consortium to increase their capacity in tendering for major government projects. Government should also institute measures (beyond just the subcontracting arrangements) that will be incorporated into the contract to take advantage of these foreign contractors in Ghana to facilitate the skills and technical knowledge transfer to the local contractors. Thus, it is recommended that government adopt the preferential point's strategy proposed by this study to help improve on the transfer of skills and technical knowhow from the foreign contractors to the local contractors.

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## **Academics Perspectives on Alternative Assessment**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

There is a need for educators to use a variety of different strategies to assess student readiness and properly plan how they instruct students to meet their student's needs. The primary purpose of this paper is to find assessment strategies used by the academics to prepare students for summative assessment and explore the perception of academics on alternative assessment strategies. This study proposes several alternative assessment strategies which will not only help students in their studies but also later in life.

#### **Design/methodology/approach**

Qualitative semi-structured interviews were conducted with ten academics from the Civil Engineering, Surveying and Construction Disciplines at the University of KwaZulu-Natal (UKZN). Data collected was analysed using thematic analysis.

#### **Findings**

The most common assessment strategies used by academics were group and individual assessment, peer evaluation and observation. None of the other alternative assessment strategies such as analogies, video recordings, checklists, front loading, interviews and student composed questions were utilised. There were some strategies that the lecturers used that were not previously mentioned, such as sharing their life experiences and conducting revision.

**Research limitations/implications**

This study only focuses on a small number of academics in three disciplines and should be expanded both to other disciplines and institutions.

**What is original/value of paper?**

This information is useful for exploring alternative assessment strategies that can enhance effective student assessment providing timeliness of results that will enable educators to adjust instruction quickly, while learning is in progress. Students who are assessed are the ones who benefit from the adjustments by improving their own learning as well as achievement.

**Response to the Conference Theme**

Construction Education, Training & Skills Development

**Keywords:** Alternative assessment, Formative, Summative, peer assessment

**1. INTRODUCTION**

Assessment of student learning is known as a systematic process of collecting information about student progress towards the learning goals. In the past, assessment was primarily seen as a means to determine grades; to find out to what extent students had reached the intended objectives. Today, there is a realisation that the potential benefits of assessing are much wider and impinge on all stages of the learning process. Therefore, the new assessment culture strongly emphasises the integration of instruction and assessment, in order to align learning and instruction more with assessment (Segers et al. 2003). The purpose of this paper is to explore alternative assessment strategies used by academics from the faculty of Engineering in the University of KwaZulu-Natal and provide alternatives that are not utilised.

**2. LITERATURE REVIEW**

Assessment is defined as *“the process of collecting and organising information from purposeful activities (for example, tests on performance or learning) with a view to drawing inferences about teaching and learning, as well as about persons, often making comparisons against established criteria”* (Peter, 2014:12). In all fields of education, assessment results are used to decide about students (such as student progression), to decide about teaching and learning (such as curriculum decisions) and

increasingly assessments are linked with certification of competence and the validation of performance on job-related tasks (Liljedahl, 2010).

Assessment is an umbrella term, encompassing a range of methods and techniques (Biggs & Tang, 2007). It encompasses many different educational practices, such as portfolios, case studies, presentations, simulations or computer-based activities (Lamprianou and Athanasou, 2009). Using the word assessment avoids many of the negative connotations of the word 'test'.

Assessment and instruction go hand-in-hand in a classroom that focuses on the student (Regier, 2012). Therefore, educators need to use a variety of different strategies to assess student readiness for a particular unit of study and to plan their instruction around the needs of the students (*ibid*). There are two different types of assessment, formative and summative assessment. Wiliam and Thompson (2008) argues that the use of assessment for student learning is the main feature of formative assessment. Summative assessment, on the other hand, is bound to assigning grades to the tests and making administrative decisions, that is whether or not students progress in terms of level of study. Table 1 shows the difference between formative and summative assessment (Black and William, 2003).

Table 1. Difference between formative and summative assessment (Black and William, 2003).

	<b>Formative assessment</b>	<b>Summative assessment</b>
What is it	Assessment that gathers information about student learning.	Assessment that shows what students have learned.
When is it used?	During a lesson or unit of study.	At the end of a lesson or unit of study.
Why is it used?	To track students' understanding and progress and to make improvements to instruction.	To provide evidence of what students learned and understood.
Grading	Usually not graded	Usually graded
Purpose	Improvement: to give feedback to instructor and students about how well students understand specific material	Judgment: to derive a grade, and to allow students to work intensively with course material
Focus	Focused on whether students have acquired specific skills	Allows students to demonstrate a range of skills and knowledge
Effort	Requires little time from instructors or students; simple; done in class	Requires more time from instructors; complex; done outside of class
Examples	Self-assessment, peer, group, interviews, etc.	Tests, exams, projects, etc.

### 2.1 Summative assessment

Summative assessment is a means to gauge, at a particular time, student learning relative to content standards (Garrison and Ehringhaus, 2013). It is

used to measure what students have learnt at the end of a unit, to promote students, to ensure they have met required standards on the way to earning certification for school completion or to enter certain occupations, or as a method for selecting students for entry into further education (CERI, 2008). Examples of summative assessment strategies include tests, exams and assignments. Assignments are mostly classified as summative assessment when they are graded and less focused on specific skills or information; whereas it also allows students to demonstrate a range of skills and knowledge (Garrison and Ehringhaus, 2013) and is classified as formative assessment when feedback is provided to the students about how well they understand specific material which prepares them for their tests and exams (Crouch and Mazur, 2001).

## 2.2 Formative assessment

Formative assessment was introduced as an ongoing process of evaluating students' learning, providing feedback to adjust instruction and learning, improving the curriculum and preparing students for summative assessment (Wiliam and Thompson, 2008).

Formative assessment strategies are used to check for understanding of student learning and to make decisions about current and future instruction (Regier, 2012). *'Through formative assessment, educators can discover the rate at which students are learning, the current knowledge of students, what information or skills students still need to learn, and whether the learning opportunities they are providing for students is effective or if they need to change or adapt their instruction'* (Regier, 2012:6). If students are doing well and progressing as expected, educators remain with their current instruction practices. If students are not progressing as expected and are missing key information or skills, educators plan other learning opportunities to assist students accomplish the information or skills they need to be successful (Wylie, Lyon and Goe, 2009).

## 2.3 Alternative assessment

According to Herrera, Murry and Cabral (2007) students are now being asked to use their cognitive development, academic knowledge, and language skills to read, comprehend, synthesize, analyse, compare, contrast, relate, articulate, write, evaluate and more. This encouragement builds the foundation for alternative forms of formative assessment to be used in the classrooms so that the instructors can "*measure incremental gains*" (Herrera, Murry & Cabral, 2007:22). Alternative assessment is developed in context and over time, the teacher has a chance to measure the strengths and weaknesses of the student in a variety of areas and situations (Law and Eckes, 1995). This type of assessment focuses on the growth and the performance of the student (*ibid*). Alternative assessment is

an ongoing process involving the student and teacher in making judgments about the student's progress using non-conventional strategies (Hancock, 1994).

William and Thompson (2008) stressed that deciding on what type of formative assessment strategy to utilise will rely upon various factors. Educators need to determine what aspect of student learning they want to measure. They at that point need to consider the learning preferences of their students. Formative assessment strategies can be given to students individually, as partners, in small groups, or as a class (Regier, 2012). The type of grouping used for the formative assessment will also influence the choice of strategy. Educators should not rely on one type of assessment strategy. A variety of individual and group formative assessment strategies should be used. Individual strategies allow teachers to get a clear picture of each student and their understanding of the concept or skill being measured (Lamprianou and Athanasou, 2009). Group strategies provide teachers with general information about student learning that can be used to plan instruction (*ibid*).

The information provided by formative assessment strategies can also be used to help students reflect on current learning goals or set new goals. This information is derived from different formative assessment strategies utilised by both educators and students depending on the course objectives.

Table 2 indicates some of the alternative formative assessment strategies from which both educators and students may chose depending on the objectives of an educator and students as related to the course.

Alternative assessment strategies			
Name	Definition	Benefits	References
Analogies	Asking students to create an analogy between something they are familiar with and the new information they have learned.	It helps students find it easier to understand a lesson when educators form connections between the new topic and what has already been taught.	Meagher, 2017
Audio/ video recordings	They are defined as any media on which sound has been recorded and may be played back. It is a great way of engaging and directing students.	It helps both educators improve their teaching and students in assessing their performance and provide feedback for improvements.	Jackson, Smallwood, Watson and Wilson, 2002
Automated assessment	A tool for the assessment of programming assignments, which supports a variety of assessment styles and strategies, and provides maximum support to both teachers and students.	Instructors can monitor the progress of each student in real-time and give help & guidance to students.	Joy and Griffiths, 2017
Checklists	It is a strategy to monitor specific skills, behaviours, or dispositions of individual students or all the students in the class.	Checklists keep students on task. Rather than losing focus and forgetting where they left off or abandoning the task all together, they always know where they are in a task or project. (Or should know.)	Burke, 1994

Direct Observation	It is a process whereby an observer is present who sits passively and records as accurately as possible what is going on.	Classroom observation as feedback tool may enhance improvement in teaching practice.	Fromme, <i>et al</i> , 2009
Examples/Non-Examples	Students provide the lecturer with examples and non-example of a topic being studied	It helps students learn about concepts through generalisations while it refines students' ability to make accurate generalisations.	Denton, Bryan, Wexler, Reed and Vaughn, S, 2007
Front loading	It is a strategy that teachers use to provide students predetermined guidance and reminders for applying necessary skills, strategies and behaviour to be successful in the days' learning.	It involves the students accessing prior knowledge about the new content, learning essential vocabulary that will be used throughout the lesson and using their prior knowledge and new vocabulary to develop predictions.	Rohrbaugh, 2010
Group assessment	It involves students being given a group work and being able to criticise each other's work while getting to understanding different views from the group.	It can help students develop skills specific to collaborative efforts, allowing students to tackle more complex problems than they could on their own.	Falchikov, 2004;
Interviews	They are a formal meeting conducted to elicit information from a person or group. It can either be 'of' students or 'by' the students.	Lecturers can get more in-depth information from students about the knowledge they have on a certain topic or subject.	McCarthy, 2015
Journals/ diary	Journals and logs are places where students record important information, express personal reactions, and to wonder about new knowledge, events, themes, and ideas.	It would be a unique record of what stands out for the student in each lesson and the development of incorrect ideas could be caught at an early stage when they are more open to modification.	Dyment O'Connell, 2003 Williams, 2002
Know, Wonder, Learned (KWL) Charts	They are graphic organisers that help students organise information before, during, and after a unit or a lesson.	It helps students to monitor their comprehension and knowledge about a specific topic.	Clarke, 2005 Cohen, 2014
Peer assessment	It is defined as a set of activities through which individuals make judgements about the work of others.	it encourages transfer of learning, encourages reflection and can enhance the students learning experience.	Spatar, Penna, Mills, Kutija, and Hernandez, 2010
Portfolios	A purposeful collection of samples of student work accompanied by clear criteria for performance which evidence student effort, progress or achievement	It helps the students gain the important abilities such as self-assessment, critical thinking and monitoring one's own learning.	Birgin and Baki, 2007
Self-assessment	Students regularly view and review their own conservation(s) on video to assess themselves in short and long term.	It enhances students' awareness of their own learning and thinking processes, and it helps learners see gaps in their own learning and initiate self-repair to redirect their learning toward the learning goal.	Garrison and Ehringhaus, 2013 Logan, 2015
Show of Hands	A simple strategy that is used to gauge the understanding level of your students is through a show of hands.	It allows students to gauge their relative understanding and it may benefit students as different perceptions are discussed.	Regier, 2012
Student Composed Questions	Have students write "test" questions, and read through the questions and answers to get a feel for what the students have learned about a topic.	This increase student participation and encourage active learning.	Regier, 2012. Spatar, Penna, Mills, Kutija, Cooke, 2015

### 3. RESEARCH METHOD

The qualitative method was used for data collection to understand the feelings, values, and perceptions of the participants (McMillan & Schumacher, 2001). The qualitative data was collected in the form of semi-structured interviews with the aim of finding the lecturers' perception on alternative formative assessment strategies. The use of semi-structured interviews was considered appropriate as the researchers were trying to understand the perception from academics. Ten academics availed themselves for the interviews which took approximately thirty minutes each. The data collected from the semi-structured interviews was analysed using the thematic analysis as it provides a highly flexible approach that can be modified for the needs of many studies, providing a rich and detailed, yet complex account of data (Braun & Clarke, 2006). The thematic analysis was approached in an inductive way where coding and theme development were directed by the content of the data. Ethical clearance was obtained from the university before the collection of the data.

### 4. ANALYSIS

The analysis is discussed under the following themes, assessment in general and alternative assessment strategies.

#### 4.1 *Assessment in general*

Eighty percent of the participants agreed that '*assessment is the process of deciding what level a student is at, or how much progress they are making*', but the other 20% believed that assessment measures '*the level of understanding acquired by the student and not progress*'.

The course outline is an essential document which contains vital information used to plan the syllabus of a module and to guide the educator. This document is used by all the academics interviewed. It contains how and when the students will be assessed including the marks and outcomes of each assessment strategy, and they also use it as a source of reference for meeting objectives of their respective modules. To ensure that students have achieved the intended objectives, all lecturers observe the participation of students during the lecture and tests.

All the participants use both formative and summative assessments in the form of tests, group assignments, individual assignments and examinations.

The participants agreed that formative assessment prepares students for summative assessment and if students perform well in their formative assessment they are more likely to pass their tests and examinations. One participant stated however "*that not much emphasis is placed on formative assessment as it is time consuming and some*

*students don't and wouldn't participate fully*". Another participant stated that *"formative assessment encourages students to wish to know more as it links the topics together and creates a general understanding before learning in depth"*. All the participants provide students with feedback for assessments which they believe improves their work and performance at a later stage.

#### 4.2 Alternative assessment strategies

The academics utilised peer assessment but 40% of them do not wish to use it in the future because of the *"tension and drama it causes between students"*, while the other 60% said it *"builds familiarity and confidence with peers"*.

All the academics use group assessments so that students are able to work with other people as it is required by the construction industry which requires different people to work on one project to meet the client's expectations. One lecturer said *"the industry requires people who can lead, manage and better communicate with other colleagues even under pressure"*. Academics recommend to their students to use self-assessment before submitting their work as it *"helps students find the mistakes they made and fix them before handing in their work"*. But one academic stated that *"students leave assignments to the last minute therefore it's ineffective"* and another said that *"students have to be mature when utilising this strategy"*.

Some academics utilise peer evaluation strategies where students rate each other and give reviews regarding performance, and contribution. Only one participant knew what the Know, Wonder, Learned (K-W-L) chart assessment was and is using it with students. The other 90% did not know about it but once the researchers showed them how it works they were all keen to use it in the future. All the participants use the observation assessment to measure performance of their students during lectures and can determine if a student is having problems.

None of the other alternative assessment strategies such as analogies, video recordings, checklists, front loading, interviews and student composed questions were used. The academics did however mention other strategies not on the list such as sharing their personal experiences with their students which seems to improve the students focus towards their studies and performance. Sixty percent of the participants use revision which they conduct in the last week of lectures, while 30% recommend that students read additional books, articles and notes.

## 5. CONCLUSION AND RECOMMENDATIONS

The main aim of the assessment strategies employed by universities are to prepare students to become professionals and to prepare them for real life.

The most common assessment strategies used by academics were group and individual assessment, peer evaluation and observation. None of the other alternative assessment strategies from Table 2 were utilised. There were some strategies that the lecturers use that were not previously mentioned, such as sharing their life experiences and conducting revision.

It is important for educators to be mindful of the goals of their assessment and how they plan to use assessment results, so that they choose the best tools to accomplish this.

Further research could be done on the assessment and evaluation techniques that could reduce the academics workload on marking and feedback, and yet maintain quality. Research is also needed to develop teacher friendly methods and tools in assessing students in large classes. Current technology should also be used to enhance students' learning and teachers' teaching.

Finally, any formative assessment strategy should encourage and foster motivation on progress and achievement of learners rather than failure.

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## **Building Construction Skills Training for Standards Compliance: The Case of Nigeria**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

This study aims to identify and examine the gap in construction skills in Nigeria and the effects on overall compliance with building regulations and standards.

#### **Design/methodology/approach**

The construction processes of 104 building projects across the country were assessed over a 6-month period using 29 indicators taken from the standards/regulations compliance conformity form for the structural aspects of buildings. A purposive sampling technique was used for data collection and the resulting scores were classified as full compliance, partial compliance and non-compliance for the four building stages (foundation, foundation + slab, foundation + slab + wall, and foundation + slab + wall + roof).

#### **Findings**

It was observed that the majority of core activities in the foundation and floor slab construction were non-compliant. The findings strongly suggest that there are inadequate foundation skills, lack of technical knowledge in constructing floor slabs, and inadequate standards/regulations compliance skills among the professionals and workers, which impact significantly on overall compliance with the buildings standards.

**Research limitations/implications**

This study focused on the skills of professionals and workers employed in the standards and regulations compliance measurement of mid-rise residential building projects in Nigeria.

**Practical implications**

This study has highlighted areas of improvement in training and development for lack of skills in foundations, floor slab construction, and standards and regulations, which impacts negatively on the overall compliance with standards and regulations for the construction of mid-rise residential buildings in Nigeria as revealed from this study.

**What is original/value of paper?**

The study has demonstrated the current state of construction skills shortages in Nigeria, and can be used to inform, code officials, inspectors and policy makers who should increase monitoring to ensure enforcement of the regulations.

**KEYWORDS: Construction, Skills, Training, Quality, Compliance, Regulation**

**1. INTRODUCTION**

The global construction industry is complex and skill labour-intensive, especially in developing countries where the use of advanced technology during the production process is scarce (Muya *et al*, 2004).

The aim of this paper is to identify and examine the skills gap and the effects on the overall standards of compliance, whilst at the same time establish skills compliance practices for structural building development projects in Nigeria. In particular, this paper investigates the effect of professionals' skills and craft skills practices within the construction sector in compliance with standards and regulations, on which other skills are dependent for best practices.

**2. LITERATURE REVIEW**

The results of this investigation provide a directional policy approach for standards and regulation compliance in order to drive the other required skills within the construction sector among professionals and skilled labourers, as called for by Kuroshi (2015) for professionals and vocational trade operatives within the Nigeria construction industry. Skills training and development within the construction industry not only enhances construction quality, but also improves the productivity (ratio of input to output) and the rate of meeting the industry desired output for standards

and regulations compliance (Opaluwah and Opaluwah, 2015). Consequently, construction projects are poorly finished, structural aspects are prone to collapse and other structural defects are present within the Nigerian building industry as a direct result of a shortage of skills among professionals who manages the builders (Oladiran, 2015). Construction skills training in the United Kingdom (UK) is organised via training centres across the country, while in Zambia trade schools similarly exist but lack some of the required construction skills programmes, which leads to informal apprenticeships with training in some aspects acquired on the job, thereby placing the industry in danger (Muya *et al.*, 2004). These are different from academic qualifications (Adavbiele, 2013 cited in Kuroshi, 2015), which must include foundation skills, structural construction skills, information and communication technology (ICT) skills, software analysis of practical skills, regulation compliance skills, entrepreneurial skills and supervisory skills, among others. The construction industry in this digital age is characterised by advanced technology, modern construction methodology, and high-tech materials, all of which requires skills to be constantly improved in order to meet the appropriate industry needs (Agapiou *et al.*, 1995 cited in Yakubu, 2017).

## **2.1 Construction Skills Identification and Training Provision**

Implementation of compliance of any programme requires basic identification of skills gaps (Dyke, 2015). And the Nigerian construction industry is no exception. It is anticipated that this training innovative solution will enhance the Nigerian building construction industry as training skills will be comparable to that of the United Kingdom or Zambia. The skills identified in Zambia as lacking within the construction industry as roofing, paving, scaffolding, glazing, light/ventilation, crane operative and steel fixers (Muya *et al.* 2004). In the UK, Agapiou *et al.* cited in Yakubu (2017) identified possible areas of construction skills training, such as plumbing and sheet metal work, carpentry/joinery, bricklaying, plastering, painting/decoration/sign-writing, scaffolding, electrical, roofers, paving, glazing, plant operatives, bar bending, steel erecting, flooring, and crane drivers. Ujene and Umoh (2015), Author professional experience identified skills development and training gaps in Nigeria for brick laying, plumbing installations, welding and fabrication, glazing, tiling/flooring, painting/decoration, electrical installations, plastering/ finishes, roofing, floor construction, bar bending, and crane operators. In which trade group training, apprenticeship programmes of the government agencies, such as the National Directorate of Employment (NDE), Industrial Training Fund (ITF) Centres established by Act and the recent N-Built of the N-Power training of the Federal government are sources of skills acquisition in the country at the moment.

## 2.2 Drivers of Need for Construction Skills Training

Shortages in quality skills result in the continuing import of required skills from neighbouring countries, the poor quality of finished buildings, structural failures, and the collapse of structural aspects of building development projects. New legislation and regulatory requirements, together with new technologies and the introduction of new construction practices, also drives the need for construction professionals and skills training for workers (CITB, 2014; Agapiou *et al.*, cited in Yakubu, 2017).

Consequently there is a rise in the demand for specialised skills in Nigeria, which highlights the need for skills training and development within the construction industry. Alternative construction recruitment strategies have been advocated to avoid skills shortages in the future through upgrading the existing workforce, together with investment in training to address the persistent problem of skills shortages within the construction industry (Jayawardane and Gunawardena cited in Muya *et al.*, 2007).

Funding has been identified as one of the major challenges to the acquisition of required skills training in the construction industry globally, and Agapiou cited in Yakubu (2017) stressed that training costs can discourage small organisations that cannot bulk buy products and negotiate price discounts.

## 2.3 Construction Skills Compliance Development Framework in Nigeria

The National Board for Technical Education (NBTE), in line with identified skills gap in industries which require vocation education and training, announced the National Vocational Qualification Framework (NVQF) on the 16th December 2010.

The NVQF established by the NBTE in 2010 aimed to train and develop workers in the construction industry. In addition, national standards were set for workers with different skills who have not attained a formal qualification, thereby making them comparable to their formally educated counterparts.

Both the UK and Nigerian NVQF are based on national standards with regards to technology, market and employment patterns, and are regulated by similar bodies, the NBTE in Nigeria and the National Council for Vocational Qualifications (NCVQ) in the UK. However, the UK NVQ has been employer-led rather than education-led or government agencies-led, whereas in Nigeria it has been driven by the creation of jobs and is not really concerned with the issue of the lack of quality skills in the Nigerian building construction industry. This was also an investment opportunity for the creation of private technical and vocational training centres within Nigeria which would teach and award qualifications guided by the NVQF, as in UK training centres (Agapiou cited in Yakubu, 2017). Okwa and Musa (2015) have described the education and industry qualifications in order to

act as a guide to the equivalence of each qualification. Although education, academic and industry qualifications measure different aspects, the National Vocational Qualification measures competence in a particular job, while academic qualifications measure an individual's knowledge.

### **3. DATA COLLECTION AND METHODS**

#### **3.1 Data Collection Process**

This paper is a case study research, targeting construction projects sites for measurement, inspections and compliance to standards and regulations. This type of method is adopted in order to actually describe the existing current professionals' and workers' skills practices (real-world behaviour) and its meaning with respect to standards and regulations skill compliance in a natural setting rather than relying on derived data (Bromley 1986, p.23 cited in Yin, 2012). This inspection and case study measurement approach was chosen to measure and inspect based on the standards/regulations compliance conformity form for the structural aspects of buildings to establish professionals' and workers' skills compliance. This approach was also used by Baiche *et al.* (2006) for a rigorous inspection using a non-compliance checklist of regulations in Oxfordshire and Gloucestershire during the construction of housing projects by visual observation. Yin, 2012 also supported the use of this approach for in-depth understanding of the real world situation, for descriptive questions of how and why for the collection of data in natural setting, and in the evaluation research.

A purposive sampling technique was used in the selection of six states in Nigeria for data collection, in which 104 mid-rise residential building development projects were identified and investigated. The selected states consisted of Abuja (31 projects), Lagos (20 projects), Port-Harcourt (22 projects), Enugu (10 projects), Kaduna (6 projects) and Lokoja (15 projects). The objective criteria for the main instrument for data collection were the compliance form requirements for the structural aspects of the Nigeria Building Regulations 2006 which is pending ratification in this year 2018 in the National Assembly. Table 1 present the data parameters for the case study measurement

**Table1: Parameters for the case study measurement**

S/no	Parameters	S/no	Parameters	S/no	Parameters
1	Foundation	14	Hard-core sizes	25	Ceiling height of rooms/hallways
2	Floor slab	15	DPC/DPM provision	26	Roof frames & pitch
3	Walls and roof,	16	Iron bars placement/sizes	27	Wall plate/Roof beam provision
4	Soil strata analysis report	17	Thickness of Slabs	28	Professional supervision
5	Depth/with of foundation	18	Conc. Mix design	29	Thickness of upper floor
6	Treatments	19	Conc. placement methods		
7	Thickness of the footings	19a	Allowable time before placement of conc.		
8	Foundation base	20	Curing process and time		
9	Columns/ground beams	20a	Work start-up		
10	Earth filling	21	Room area		
10a	Depth and compartment methods	22	Staircase requirements provision		
11	Type of foundation	23	Height of walls		
12	Sizes of external/internal	24	Lintel prov/thickness		

### 3.2 Data Analysis

The 29 indices were classified for compliance using the following grading system: 0-49%, non-compliance; 50-69%, partial compliance; and 70-100%, full compliance. This was based on an assessment of the indicators over a 6 month period.

To validate the percentage of compliance levels, measurement data were aggregated between 0% and 100% for multiple buildings within the four measurement stages (foundation, foundation + slab, foundation + slab + wall, and foundation + slab + wall + roof) and where data was not aggregated for multiple buildings, each building's measurement data were treated individually to determine the validation of the compliance grading level. A grading between 0% and 49%, of non-compliance, despite any mitigating circumstances, were considered risky. Tables, percentages, and

graphs on the data compliance measurements were employed to analyse and investigate the data collected.

#### 4. RESULTS

A total of 104 mid-rise residential buildings in six cities were identified and investigated using 29 indicators of standards/regulations compliance requirements for professionals and workers' skills. Table 2 presents a summary of the buildings assessed.

**Table 2: Distribution of the buildings assessed**

Cities	Number of buildings measured	Percentage representation %
Abuja	31	30
Lagos	20	19
Port-Harcourt	22	21
Kaduna	6	6
Enugu	10	10
Lokoja	15	14
<b>Total</b>	<b>104</b>	<b>100</b>

Table 2 shows that 30% of all the buildings assessed were in Abuja in the Federal Capital Territory (FCT) of Nigeria, while 19% were in Lagos in the south west, 21% in Port-Harcourt in the south-south, 6% in Kaduna in the north, 10% in Enugu in the south east and 14% in Lokoja in the north central region of the country.

#### 4.1 Impact of Current Skills Practices on Standards and Regulations Compliance

To examine the impact of regulatory skills compliance, 29 indicators were investigated and measured on site to enable grading using the Nigerian standards and regulations skills compliance requirements form of current practices in building projects. This assessment gave a final measure of the level of compliance between 0% and 100%. Figure 1 presents a summary of the skills of professionals and workers employed in the standards and regulations compliance measurement.

#### 4.2 Developmental Stages of Building Measurement

The measurements for the developmental stages of building projects are shown in Table 3 and indicate the skills gaps that are affecting compliance and require urgent training and development within the Nigerian construction industry. It was observed that the majority of core activities of

stages 1 and 2 (foundation and foundation + slabs (ground floor and upper floor slabs)) scored between 0% and 49% and therefore those activities were considered risky and non-compliant to building standards and regulations. The whole building as divided into four developmental stages as described earlier and the buildings assessed in each city were classified as full compliance, partial compliance or non-compliance within each of the four stages.

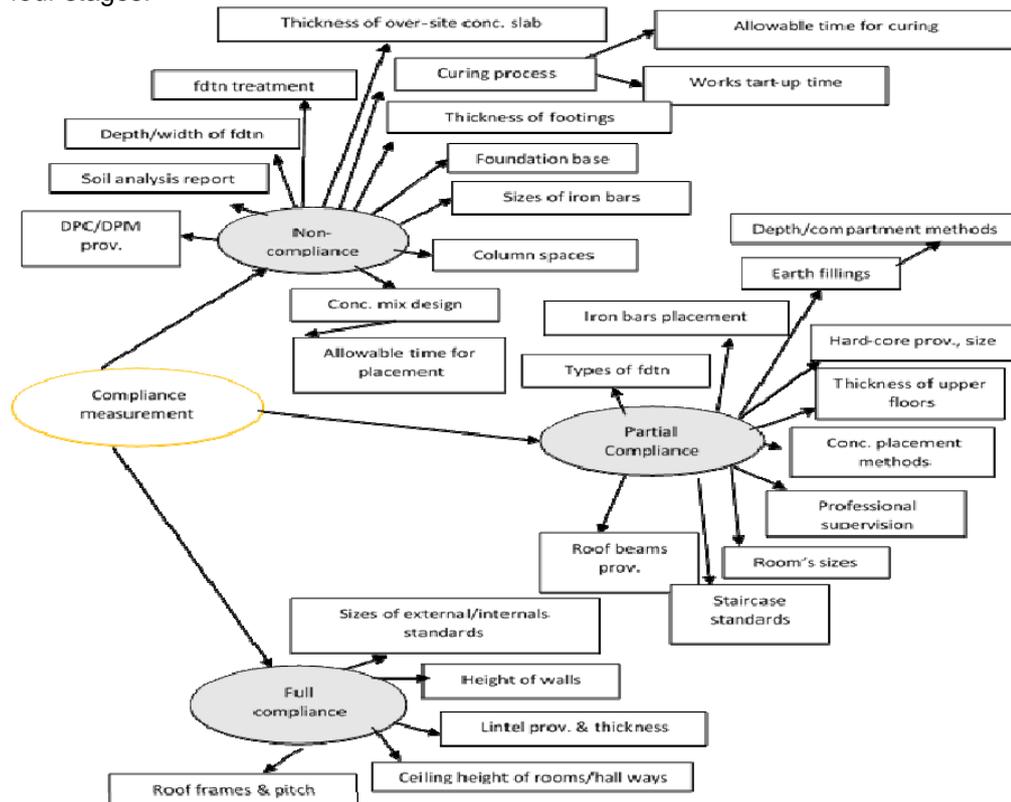


Figure 1: Professionals' and workers' skills standards and regulations compliance measurement.

**Table 3: Assessment of building development projects in each city**

Var	Stages of Case Measurement												Total
	Foundation			Foundation + Slab			Foundation + Slab + Wall			Foundation + Slab + Wall + Roof			
	Non-compliance	Partial Compliance	Full Compliance	Non-Compliance	Partial Compliance	Full Compliance	Non-Compliance	Partial Compliance	Full Compliance	Non-Compliance	Partial Compliance	Full Compliance	
Abj	8	2	1	3	4	1	2	3	3	0	2	2	31
Lag	3	2	0	4	2	0	1	3	0	0	3	2	20
PH	5	4	0	3	2	0	1	1	3	1	0	2	22
KD	2	0	0	1	1	0	0	0	1	0	0	1	6
En	2	1	0	2	2	0	1	0	1	0	1	0	10
Lkj	4	0	0	2	1	0	2	2	2	0	1	1	15
Total	24	9	1	15	12	1	7	9	10	1	7	8	104

### 4.3 Degree of Skills Compliance in each City

Table 4 presents the degree of compliance for the measured buildings in the different cities in order to establish the effects of gaps in professionals' and workers' skills in the Nigerian building construction industry. The measurement indicates that 45% of the buildings assessed were non-compliant, 36% were partially compliant and only 19% showed full compliance across the six geo-political zones of Nigeria.

Table 4: Degree of compliance

Variables	Non-compliance	Partial compliance	Full compliance	Total
Abuja	13	11	7	31
Lagos	8	10	2	20
Port-Harcourt	10	7	5	22
Kaduna	3	1	2	6
Enugu	5	4	1	10
Lokoja	8	4	3	15
Total	47	37	20	104
% compliance	45%	35.5%	19%	100

## 5. DISCUSSION AND POLICY

Construction skills in foundations and floor slabs have been revealed as having the greatest impact on overall compliance within the construction of mid-rise residential buildings in Nigeria. These involved core activities for structural aspects of buildings associated with skills in foundations, including the depth/width of foundations, thickness of footings, treatment of foundations, a soil analysis report before beginning the foundations, concrete mix-design for foundation work, and time allowed for placement, foundation column spaces, size of iron bars, curing process, time allowed for curing and work-start up time, provision of a DPC/DPM, and thickness of oversite slab. From a critical analysis of the results, 11 indicators were identified as being associated with partial compliance, including type of foundations selected, earth fillings, hard core provision and sizes, iron bars placement, thickness of upper floor slab, concrete placement methods, professional supervision, area of rooms, provision of roof beams, and staircase construction requirements. This findings also support the work of Kuroshi (2015), Ujene and Umoh (2015) and Oladiran (2015), which called for professionals in the industry to receive urgent training to address the knowledge gaps concerning specialised technical skills and managerial skills, including foundation skills and regulatory compliance skills. These findings indicate that skills in foundations, as well as in standards/regulations, require urgent training and development for professionals and workers involved in the construction of mid-rise residential buildings in Nigeria.

### 5.1 Research Policy Focus

These research findings should help building code officials, government enforcement agencies (inspectors), building industry professionals, and other relevant stakeholders to make well-informed decisions concerning future building skills implementation strategies, together with enforcement and compliance to minimise the effects observed in this study. Skills training and development for specialised skills shortages, such as foundation skills, floor slab constructions skills, and standards and regulations policy framework skills, should be introduced by government enforcement agencies and industry professional systems for structural buildings. This should include the introduction of compliance certification awards at the critical stages of foundation and slab construction. The Nigerian Government should delegate building inspections to an independent body and act as the regulator of the regulators, as enshrined in the modern credible regulatory theory for proper assessment, monitoring, evaluation and reporting of practices within the building sector.

## 5.2 Implications from Research Findings

Construction industry provides job opportunities and promotes increased investment in the country, but this cannot be realised without adequate training and development of specialised skills, such as foundation skills, floor slab construction skills, and standards and regulations skills. Information delivery via better communication skills are necessary for achieving technical skills such as foundation skills, floor slab construction skills, and regulatory compliance skills, and act as a sustainable basis for core skilled workers in the building construction industry as argued by Agapiou *et al.* in Yakubu, (2017). This study has highlighted that a lack of skills in foundations, floor slab construction, and standards and regulations, impacts negatively on the overall compliance with standards and regulations for the construction of mid-rise residential buildings in Nigeria

## 6. CONCLUSIONS

This study concludes that the findings highlight the shortage of building construction skills and the results should help inspectors, policy-makers and relevant professional bodies to address this issue through adequate monitoring processes, evaluations, and certification at critical stages following residential building inspections. An analysis of the results indicates that the majority of core structural activities were non-compliant during the first stage (foundations) and second stage (foundations + slab) of the building development projects assessed and there is an urgent requirement for training and the development of skills. The findings strongly suggest that there are inadequate foundation skills, a lack of technical knowledge in constructing sustainable floor slabs, and inadequate standards/regulations compliance skills among the professionals and workers, which impact significantly on overall compliance with the buildings standards.

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## **Online Assessment in Construction Programmes: The Case of UKZN**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The purpose of this paper is to provide the academic and observational feedback obtained from running online assessment tests with the intention of discovering if blending different assessment methods together will offer a more valued learning experience.

#### **Design/methodology/approach**

A qualitative action research approach was adopted. Ethnographic data from observations made during the implementation of the online assessment tests by the researchers were collected and interviews were held with five members of staff at the Construction Studies Discipline at the University of KwaZulu-Natal (UKZN) as well as.

#### **Findings**

The findings of the interviews showed that the academics were in favour of using online assessment strategies and that when it is incorporated in a blended approach it can be useful in certain areas of teaching and learning. The availability of useful statistics such as time taken to complete a test and average scores per question allow for more responsive feedback and more efficient and engaging contact sessions. There were technological constraints such as not being able to draw which is a core component of certain construction technology modules.

#### **Research limitations/implications**

This study was restricted to the core modules in the Construction Studies discipline at the University of KwaZulu-Natal (UKZN).

**What is original/value of paper?**

This study focuses on improving the teaching and learning environment and the learning experience of students.

**Response to the Conference Theme**

Construction Education, Training & Skills Development

**Keywords:** Assessment, ethnographic, student/lecturer, blended-assessment, online

**1. INTRODUCTION**

Higher education institutions are now incorporating Information Communication Technologies (ICT) into the teaching and learning environment which now needs to become more flexible and portable (Tondeur, 2017). In searching for better and more efficient methods of delivering instruction and learning, many universities have expanded their use of online learning commonly referred to as e-learning (Graff, 2003). Assessment, as defined by Dhinsar, Omar and Waldrip (2007: 1261) is “*a systematic process for gathering data about student achievement*”, is a vital indicator of teaching. The way a student thinks about class assessments is related to his/her learning approach.

The purpose of this paper is to provide the academic and observational feedback obtained from running online assessment tests in place of traditional hand-written assessments with the intention of discovering if blending different assessment methods together will offer a more valued learning experience.

**2. PRINCIPLES OF ASSESSMENT**

An assessment is considered to be valid only when it measures that which it was set out to measure, namely the procedures, methods, instruments and materials used are useful and meaningful in their purpose. There needs to be correlation between content being assessed and the learning outcomes that have been established (SAQA, 2017).

With regards to higher education, assessment can refer to a wide range of different methods and tools which lecturers use in order to evaluate, measure and document the academic readiness, learning progress, skills acquisition or the educational needs of students.

There are also several different recognised types of assessments.

- Formative assessment is one that is designed to supplement further learning. It consists of a range of formal, non-formal and informal formative assessment procedures that are designed to place emphasis on teaching and learning and ultimately improve learner success (SAQA, 2017).
- Summative assessments are usually conducted at the end of a predetermined section of work which are used to evaluate learning related to a particular qualification, part-qualification or professional designation (SAQA, 2017).
- Integrated assessment is a combination of the range of assessments that encompass the required tasks that are required for a qualification, part-qualification or professional designation (McPhun & Helen, 2013).
- Diagnostic assessment can be thought of as a pre-assessment which is done to identify the strengths and weaknesses of the learner with the main purpose of this assessment to use the obtained information for the justification of creating the suitable learning environments (Dumit, 2012).

In terms of assessment there needs to be accountability, fairness and impartiality. This ensures that students are assessed on what they know and what they have been taught in assessment practices that do not advantage or disadvantage particular learners or groups of learners (SAQA, 2017).

### *2.1 Online Assessments*

Assessment techniques should provide learners with a reason to want to step into a classroom in a manner in which they *want* to apply themselves. Lecturers should display a willingness to give extra help and encouragement as well as give varied and meaningful assessments (Marshall, 2003).

Using online assessments can be beneficial to students by allowing them to practice specific skills and focus on specific areas of the module. It can also provide a tool that will allow them to monitor their own progress and work at a pace convenient to them (Ghilay & Ghilay, 2012).

Some of the principle reasons of using computer-aided assessment (CAA) include the need to motivate students to learn consistently and encouraging skills practice; to increase the range of content assessed and improve the degree of feedback from both students and lecturers (Ozden, *et al.*, 2004).

Online assessment requires a more ongoing and systematic approach to be used in conjunction with traditional principles (Cross & Palese, 2015). It should therefore incorporate the use of open-ended questions that allow for a better judgement of knowledge and understanding. There should be emphasis placed on the process of learning and not the end product. In the case of an ePortfolio or generating some form of product such as a computer programme or prototype fundamental skills such as communication and collaboration should be included in the process. The assessment tasks should be coherent with the stated learning outcomes and encourage the appropriate use of online resources that will enable students to examine and present many different viewpoints (Crisp, Guardia & Hiller, *et. al.*, 2017).

Online assessment techniques include the development of realistic scenarios for learning, alignment of learning objectives, development of suitable software and programmes that are compatible to the specific needs of the subject of assessment, the availability of support systems to aid the integration process and assist students, delivery of on-site, instructor-based training that is responsive to individual student learning differences (Boyle & L'Allier, 2003).

Some of the obstacles in using computer-aided assessment include:

- There are certain questions that cannot be marked automatically;
- Data security can pose an issue as the identity of the person taking the test cannot be determined with accurate;
- Students unaccustomed to this delivery format or who have poor ICT skills may be at a disadvantage;
- Accessibility for physically disabled students need to be considered as many of the online assessment tools hold limited features for disabled students; and
- The implemented assessment software needs to be user friendly because if it cumbersome to use, students may focus less concentration on their responses (Singh & de Villiers, 2010);

## *2.2 The University Of KwaZulu-Natal's Construction Studies Discipline*

The UKZN Howard College Campus reinstated its Construction Studies Discipline with the revival of the Property Development undergraduate degree in 2014. This bachelor of science degree is a three year undergraduate degree which flows into a postgraduate honours degree. The two current honours programs available is a Bachelor of Science

(Honours) Construction Management or a Bachelor of Science (Honours) Quantity Surveying (University of KwaZulu Natal, 2018).

The BSc Property Development degree is undertaken over six semesters or three years on a full-time basis. There are 29 registrable modules and minimum of 432 credits that must be completed in order for the degree to be conferred (University of KwaZulu Natal, 2018).

The UKZN Property Development Degree has three core modules which are undertaken in all three levels of study (University of KwaZulu Natal, 2018), namely Construction Technology & Processes, Construction Economics & Management and Design Appraisal and measurement.

### 3. RESEARCH METHOD

This action research study focused on discovering the effects of using online assessments for the first time in the Construction Studies discipline through observation and academic feedback. *“Action research is the research approach most suited to teachers and schools, as it readily fits in with everyday practice and focuses closely on the participants’ concerns”*(Somekh, 2002, p. 1). Within education, the intention of action research is to determine the ways of enhancing the lives of both student and professionals (Hine, 2013).

This study was conducted in two phases, phase 1 involved the implementation and running of online tests and phase 2 involved collecting feedback from academics via interviews.

#### 3.1 Phase 1

Online tests were implemented for three core modules (Construction Technology & Processes 2A, Construction Economics & Management 2A and Construction Economics & Management 3A) instead of the traditional paper tests. These were modules which were identified as the most suitable for implementing online tests in place of their traditional paper-based semester tests based on the ability to transfer the tests into an online format. Design Appraisal & Measurement was not used in this study as the transition from paper-based to online assessment was challenging due to the unique equipment and assessment procedure that is used in this module. Therefore this module would require further research in the future to determine how an online assessment format can be introduced to suit the demands of this course. These trial online assessments provided the researchers with data in the form of observations made whilst the students were exposed to online tests for the first time in this programme.

#### 3.2 Phase 2

Data was collected from staff members with the aid of an interview schedule. The interview sought to understand from a lecturers perspective, as to whether online assessments could improve the value of the teaching and learning environment in the Construction Studies Discipline. The quantitative data that was collected was analysed using Thematic analysis.

## 4. ANALYSIS

### 4.1 Researchers observations

During this study the researchers were able to make various observations from the beginning of the study when the tests were being converted and captured on the computer to the point at which students completed the tests.

These online tests were created using Moodle which is a learning platform used by many higher education institutions. The Moodle Quiz activity allows a teacher, lecturer, course coordinator, *etc.* to design and build quizzes that consist of a multiple choice questions, true-false, short answer, essay questions, etc. These questions can also be stored in a question bank that can be to be re-used later in future courses (Moodle, 2017).

Since the lecturers for the respective modules of this study were not accustomed to online assessment, the researchers were responsible for capturing the tests onto Moodle Quiz. The tests were set by the respective lecturers which simply had to be transferred to Moodle. The tests were a combination of multiple choice and short-answer type questions. The model answers were also provided and entered into the programme so that the multiple choice questions could be graded automatically. The answers for the short-answer questions were also programmed in but this needed to be marked by the respective lecturer as the system does not have an automated marking tool for questions other than close-ended questions. Once the tests were set they were dated and protected by a password that could only be used on the time and day of the test. This prevented anyone from trying to access the test prior to the date it was supposed to be written



Figure 1. Students undertaking an online assessment test for the first time

The tests took place in the lan (as indicated in Figure 1) which was reserved solely for the duration of the test. This meant that the only those participating in the test were allowed into the venue. Students were informed of the details as to when and where the tests was taking place. Students were told to arrive 15 minutes prior to the test for instructions. Students were seated with one space in between each other and no books/bags/learning material were allowed on the tables. Once all students were seated and logged in, they were given the password to login and began the test. The tests were all on timers from the moment they each logged on and they only had the specified amount of time to complete the test. Each test was given a 90 minute duration after which the test would close. Students were only given one attempt to complete the test but could change their answers to questions multiple times.

Whilst the test was being written there were no major issues that were raised by any of the students. All of the students completed the test within the time limit and saved their answers. Most of the students felt that the test went well with some of them mentioning that the noise from individuals typing on keyboards was distracting at times. There were also a few individuals who resorted to write out their answers on blank paper before typing out the full answers. The researchers also noticed that some students were not as well experienced with typing on a keyboard but this was not a major issue because as all students managed to finish on time without being under pressure.

#### *4.2 Analysis of the interviews*

Interviews were held with 5 staff members of the Construction Studies Discipline to gather information on their perceptions of implementing online assessment methods. The analysis of the interviews was broken down into 2 themes, an overview od the current assessment practices and online assessment for the construction studies discipline. The two academics who taught the modules in which the online assessments were carried out were also asked to provide feedback which is presented at the end of this section.

##### *4.2.1 Overview of current assessment practices*

A common point raised by all five interviewees was that assessments are about testing the understanding and analytical skills of a student. The problems that these academics experience is that most students will focus on memorising information and simply rewrite what they remember without analysing the problem and this was conveyed by one of the interviewees who said *“assessment in any format still promotes memorisation by students and primarily tests memory recall rather than understanding and interpretation”*.

With regards to assessment practices in the Construction Studies Discipline one of the interviewees was not in favour of written assessments *“because written assessments fail to test important skills such as communication and social integration”*. These are considered important skills especially in this area of expertise. Current assessment practices do not encourage students to demonstrate their understanding. It was mentioned that *“current assessment practices do not always give students a chance to or at least promote students to be more engaging, interpretive and analytical”*. Students are more likely to stick to class material without substantiating or expanding on the class content covered.

Traditional paper-based assessments are used throughout the Construction Studies Programme and this has been a constant format of assessment. Participants felt that these types of assessment are capable of determining a suitable level of understanding of a student's ranking amongst other students. However it was commonly stated that these paper-based assessments are not accurate in determining their performance. This is reflected by one of the statements by a participant who mentioned *“it allows you to categorise the student in terms of where they rank in the class but it is not an accurate reflection of their performance because someone who does not understand the work can still safely pass an assessment based on recall”*. Another point raised was that even though paper-based assessments do not provided an accurate picture to gauge a student's performance, this is not something dependent on the format of assessment whether written on paper or via a computer. An accurate measure of a student's understanding depends on the context and structure of questioning.

It is apparent that there is no one single format/method of assessment that can be applied to test all areas of students' understanding, analytical skills and interpretation. One alternative is the use of a blended assessment policy which combines different types of assessment methods and formats to have a more complete evaluation platform for student performance. When raising this statement to the participants it was apparent that all of the interviewees were in favour of a blended assessment policy with the comments such as:

- *“it would be possible and preferable to have multiple tools for assessment and not just one specific platform or format”*;
- *“that when you have multiple methods of assessment you can improve the learning experience and offer better value”*.

One of the participants who was in favour of a blended assessment policy raised the issue of the assessment policy at UKZN. It was emphasised that in order for this to work effectively you need to have firstly, an assessment policy that approves of the use of blended assessments and secondly, there needs to be freedom and consideration at programme level so that this blended assessment approach is properly coordinated because *“if this is coordinated properly with the University and other modules it would be*

*possible and provide a larger scope in which a student can be assessed in terms of performance and understanding”.*

#### 4.2.2 Online assessment for the construction studies discipline

Putting forward the idea of online assessments for the Construction Studies discipline yielded mixed responses from participants of this study. With online assessments there is a benefit from a lecturer perspective in terms of marking but this is only to the extent that it applies to close-ended questions. Setting close-ended questions can sometimes be a disadvantage *“because firstly you can only cover certain learning outcomes and students have a tendency to sometimes guess answers. When you work with short-answer questions or essay type questions you still have mark those questions as if they were on paper”.*

Feedback would be useful to lecturer because you can interpret student responses and identify topics that students might be having trouble with and as a result refine the contact sessions to address weaker areas of learning. This is useful especially *“...giving the strict conditions of the teaching work load for a lecturer. An online assessment format can allow you to understand and analyse the statistics and patterns of the class in general more efficiently and saves time spent on analysis”.*

Other benefits that were welcome by lecturers is the preference of marking typed out answers which may not seem as valuable but improves marking. Some modules in the Construction Studies Programme do not lend themselves to online assessment due to technological constraints. An example of this is being able to draw which in some modules is an important element of determining if a student understands a particular topic.

When looking at a new format of assessment it is important to consider the effects imposed on teaching style, philosophy and content delivery. Some participants were certain that a change in assessment would not have an effect in the classroom:

- *“because how you measure performance in terms testing does not affect how you teach and as such the manner in which the test is administered is irrelevant provided it tests the student’s performance as it should”.*
- *“it would not have a great deal of effect on the teaching style it may however, have a tendency to shift the learning environment to suit the assessment...in this situation you tend to waste the value of the lectures and as a result might tend to limit these good habits of teaching to what might appear to be more convenient from the assessment perspective. This may lead to a “superficial” learning experience.”*

Module instructors are always open to new teaching and learning methods to add more depth to student learning. In the case of online assessments many felt that online assessments could offer more depth and provide evidence of student learning depending on its implementation. A suggestion put forward was the use of smaller weekly tests *“which could be used as a tool for students to check their knowledge and understanding of the work covered in class periodically and as a result the teacher can monitor progress”*.

An important mentioned feature of online assessments is the ability to obtain efficient feedback that may be useful for the module instructor. In terms of feedback from online assessments being taken as a true reflection of student engagement and areas that need to be addressed participants were quick to point out that you would be able to monitor student performance in terms of topics *“but you would not be able to clearly identify the level of understanding and interpretation, these are dependent on the type of questions asked”*. However being able to track student performance along different topics allows you to identify areas in which students may be having difficulty and *“where there are weak areas in the class you can adjust your teaching programme to compensate for these areas”*.

In looking into online assessments for the first time in any programme there is the factor of experience and ability to conduct online assessments. From a teaching perspectives it appears that online assessment pose no obvious challenge on lecturers in adapting to this method of assessment however participants made it clear that there would need to be some training done on how to set up the tests and possibly an administrative facility to deal with an issues or queries one might have. However it is important to understand the intentions of online assessments *“because if it introduced in an attempt to simply change from using paper-based testing methods to using a computer then you are not changing much in terms of teaching and learning. Evidently all that would change is that a student will write the same answer except in this case it would be typed out”*. There needs to be control as to how far online assessments can or should be used in order to still remain valid in its underlining function which is to assess understanding and analytical skills.

#### *4.2.3 Academic feedback for the modules in which online assessments were conducted*

The overall feedback from lecturers who were part of the modules for which online assessments were conducted felt that the tests were executed smoothly and *“that the environment and equipment was sufficient for the tests and that students seem to be comfortable with the test as not many questions were asked during the test”*. It was however noted that the students seem to take slightly longer on the tests but not by much *“which could have been down to the fact that they were adjusting to the new method”*.

From an observational point of view there *“were no problems encountered during the online test and that the session ran efficiently without any issues”*. A common suggestion was that there should be a dedicated LAN to run online tests as *“it might be a good idea to have a separate LAN area to run the tests because the test was conducted in the Civil Lan which meant that nobody was allowed in the LAN expect students writing the test”*.

In terms of setting the tests the module instructors for each course felt that there were no major specific challenges faced in translating the test content into an online test format. The only point that was raised was in the case of *“setting the multiple choice questions it must be noted that these take longer to set because you have to ensure that all the possible answers are associated with each other as a result this sometimes takes a bit longer”*. An appreciated benefit was having the ability to create a question bank over time was welcomed by participants.

## 5. CONCLUSION AND RECOMMENDATIONS

Online assessment offers a new tool of student assessment that can be used as an aid to improve student learning. Marking, administering feedback and monitoring the overall class performance which as a result improves the efficiencies of the learning environment are welcomed elements as a result of this assessment method. The manner in which it is implemented needs to be investigated further as participants of this study outlined constraints such as technological short comings that do not facilitate services such as being able to draw and measure off plan drawings. It was noted that this type of assessment *“opens up new opportunities to assess levels of knowledge from students and force lecturers to think more creatively about assessment in general”*. Participants were satisfied overall with the execution of the online assessment tests and found it useful for the Construction Studies Discipline.

Based on the researchers observations, the students had no major issues in becoming accustomed to the system and if this assessment method were to be implemented formally then students would adjust to the process and procedures of this assessment format.

This study lacked feedback from the students perspective of their experience of being exposed to this method of assessment. A further study is going to be conducted to gather information from a students that could support some of the views shared by the academics and give a more conclusive image of the value of online assessments for construction programmes.

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## **The Role Of Accreditation on Quantity Surveying Programmes at Higher Education Institutes**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

Accreditation prides itself in providing numerous benefits and positive outcomes for both the institute and its graduates. As a result, Higher Education Institutes in South Africa, prides itself in providing accredited quantity surveying education which aims to equip graduates with the necessary knowledge, skills and associated competencies that the built environment industry requires. A successful accreditation status implies that the programme is of a reasonable level and is acknowledged by the educational community and industry. However, it has been noted that accredited quantity surveying programmes are not providing industry with entry level graduates who possess the appropriate competencies and skillset to perform efficiently within the built environment industry.

Therefore, this study seeks to discover whether accreditation of quantity surveying programmes by statutory councils, produce programmes that adequately equip graduates who were ready for professional practice.

### **Research Methodology**

This is a quantitative study whereby questionnaires were distributed via email and hand delivered to 15 employers 150 QS graduates within the Kwazulu-Natal region. The data collected was analysed using SPSS version 24. Mean values, standard deviations and reliability values were computed.

### **Findings**

Findings suggest that the criterion stipulated by the SACQSP for accredited quantity surveying programme design should adequately prepare graduates for the world of work, however, employers of built environment organisations were not convinced.

### **Response to Conference Theme**

This study highlights the requirements set out by CHE and the SACQSP for accredited programme design of quantity surveying programmes. Through critical analysis it highlights the criterion provide and if it meets the needs of the built environment industry and if it provides the necessary skills and competencies that are necessary for qs graduates to be successful at entry level positions and in professional practice.

### **Practical Implications**

Future research suggestions include; an increased involvement of the built environment industry, collaboration between the SACQSP, HEI's and industry and further development of HEI's programmes.

### **Research Limitations**

This study was restricted to quantity surveying programmes at higher education institutes within the Kwazulu-Natal region.

### **Value of the Paper**

The findings of this study provides guidance for the development of higher education qs programmes that are responsive to the needs of the quantity surveying profession.

### **KEYWORDS**

**Accreditation, Quantity Surveying, Programmes, Council for Higher Education, The South African Council for the Quantity Surveying Profession, South African Qualifications Authority, Skills and Competencies.**

### **Conference Sub-Theme: Construction Education**

## **1. INTRODUCTION**

The history of quality assurance within the African Higher Education system goes back to the founding universities in Africa; Fourah Bay College in

Sierra Leone 1827, The University of Cape Town in South Africa 1829, Liberia College 1852, Makerere University 1922, The University of Ghana, Legon 1948, The University College of Addis Ababa 1951 and The University of Dakar 1957. Quality assurance of higher institutions and their education programmes was the authority of governing boards, faculties or the affiliating institution. Through the involvement of an affiliating institution, African HEI's became part of the Portuguese, British, French and other respective systems which were subject to the same kind of quality control procedures. However, these governing bodies asserted a greater level of authority over decision-making and governance of HEI's but often lacked in proper quality control practices (Haupt and Armoed, 2017; Bloom, D. et al. 2006).

According to the Council for Higher Education (2002-2003), the concept of accreditation in South Africa dates back to the early 1970's. During the 1980's the process of accreditation was formalized with the National Calibration Services which had later dissolved and formed the South African National Laboratory Accreditation Service. In late 1994, the Department of Trade and Industry had recognized that a single national accreditation system was required. As a result, the National Cabinet approved the establishment of an accreditation system. A memorandum of agreement had formalized the relationship between the SANAS and the government. This agreement recognized SANAS as the single national authority that is responsible for accreditation (<http://www.sanas.org.za>)

The Department of Higher Education, South African Qualifications Authority and The Council of Higher Education (CHE) are respective institutions that are responsible for accreditation in South Africa. These were established as an independent statutory body in terms of the Higher Education Act (Act No 101 of 1997). CHE also plays an integral role with the development of the Quality Council for Higher Education in terms of the National Qualifications Framework Act (Act No 67 of 2008) and the Higher Education Quality Committee (HEQC) responsible for higher education audits (Haupt and Armoed, 2017; CHE, 2004).

The Council for the Built Environment (CBE) was further established by CHE under the Council for the Built Environment Act No. 43 of 2000. It serves as an all-encompassing body that co-ordinates six professional councils. These include the councils for Architecture, Engineering, Landscape Architecture, Project and Construction Management, Property Valuation and Quantity Surveying, all of which operate within the built environment industry. The built environment is comprised of buildings, products and spaces that are created or improved by people. These includes homes, schools, workplaces, recreation areas, greenways, business areas and transportation systems which impacts communities in residential, urban and rural areas through land use planning and policies. The CBE envisions an environment that is built to constantly meet individuals and communities needs and aspirations. They are tasked with the implementation of HEI's programmes and projects pride itself in

providing quality education regarding the construction industry which equip graduates with the necessary competencies, skills and knowledge that the built environment industry requires. It seeks to provide benefits and positive outcomes for both the institute and its graduates (Haupt and Armoed, 2017; <http://www.cbe.org.za>).

This study seeks to discover whether the accreditation of quantity surveying programmes by the SACQSP produce programmes that adequately equip graduates for professional practice by means of a quantitative study.

## **2. ACCREDITATION AND HIGHER EDUCATION INSTITUTES**

The Council of Higher Education (2016) states that registered professional bodies and statutory professional councils have a combined responsibility to produce competent and extremely capable graduates that are instilled with the right skillsets, competencies, values and attitudes. A student should be adequately equipped with the appropriate knowledge to develop as a competent and capable professional ready for the professional world of work. CHE, CBE, HEI's and statutory professional councils such as the SACQSP, play an integral role in the advancement of the teaching and learning process. This in turn would result in developing competent graduates fit for practice within the built environment. This requires creating a relationship based on collaboration and cooperation between the various role players, and the recognition of the of each role player's contribution to improve and enhance the quality of higher education (Haupt and Armoed, 2017; CHE, 2016).

The accreditation of South African HEI's and their programmes play an important role as a self-regulatory, programme enhancement mechanism and quality assurance tool that consists of an internal and external review process which is developed using relevant policies and procedures. This process is enhanced through consultation with HEI's and built environment professionals (Haupt and Armoed, 2017; CHE, 2006).

The Council for Higher Education Accreditation (2006), noted that accredited programmes were not providing the built environment industry with competent graduates who possess the appropriate skillsets. Glen (2011) highlights that specialized programme accreditation, has been a controversial topic in society as the requirements and processes have been considered as a tiresome endeavour to academic programmes at HEI's. Specialized accreditation processes and regulations have significant financial implications that have limited benefits. However, as the environment at HEI's have become increasingly competitive, they pursue every possible advantage. Therefore a renewed interest in specialized accreditation by statutory professional councils whom accredit higher education institutes and their processes, such as the SACQSP (Haupt and Armoed, 2017; Urofsky, 2013).

**The accreditation of HEI's programmes are conducted for three primary reasons, namely:**

- to establish a core curriculum for graduates;
- to ensure that a level of consistency is met across similar degree programmes at HEI's and;
- to improve the employment opportunities for graduates.

The cornerstone of academia is its excellence, therefore a constant search for high levels of excellence has resulted in a renewed sense of urgency within HEI's. HEI's therefore develop programmes that are accredited to create a balanced curriculum, which is designed to provide theoretical education along with practical experience to assist with the employability of graduates within the built environment industry (Haupt and Armoed 2017; van Dussen, 2012). Specialized professional accreditation of higher education qualifications and programmes, have an increased influence on the structure and intent of the programmes offered at HEI's. Accreditation bodies deem this as a response to HEI's inadequately preparing graduates for entry into the world of professional employment. However, HEI's are resisting the influence of accreditation bodies as they see it as an unreasonably directive process, a disregard for the academic freedom and to the independence of HEI's (Ballim, Mabizela and Mubangizi 2014).

### **2.1. Accredited Quantity Surveying Programmes and HEI'S**

The built environment industry and its professionals are facing a society that has continuously challenging expectations and demanding job experiences (Walkington, 2002; Yeomans and Atrens, 2001; Yokomoto and Bostwick, 1999; Memon et al., 2009; Fitzpatrick et al., 2009). As a result, built environment construction education should be cautiously planned and executed so that the students not only attain the necessary skills and competencies but also continue life-long learning. This ensures the development of successful professionals, who are capable to face such societal challenges. Built environment construction education programmes such as quantity surveying programmes, are designed to provide undergraduate education within the specific discipline. (Ibid).

The roles and responsibilities of a quantity surveyor in the current built environment industry uses their abilities to analyse cost components of a construction project in a scientific way and apply the results of his analysis to various of financial and economic problems confronting the developer and the designer. A high level of importance is placed on the fundamentals of building principles and design techniques which enables students to correctly identify and define problems, to develop construction concepts and find solutions. The success of a quantity surveying programme is measured by the high levels of competency from its graduates in their professional career, and the full satisfaction of their employers and society (Armoed, 2016; Walther et al., 2011).

The SACQSP as a statutory professional council is responsible for the accreditation of quantity surveying programmes in South Africa. The most common definition of a professional council was provided by the Minister of Higher Education and Training, Dr. Nzimande, as a group of people in a specific regulated occupation who are entrusted with maintaining control or oversight of the legitimate practice of the occupation and who have a significant influence on education linked to the professions, and ultimately have the final say as to who it will register as one of its own and who it will reject (Armoed, 2016; DHET, 2011).

The framework of criterion as stipulated by the SACQSP for the accreditation of quantity surveying programmes are based upon the knowledge base, skills and the behavioural characteristics that students acquire through the curriculum of a programme. The criterion set out is intended to assure quality programmes and to create the systematic pursuit of improvement of quantity surveying education. The accredited quantity surveying programme requires the satisfaction of its constituencies in a dynamic and competitive market. Quantity surveying programmes pursuing successful accreditation, need to keep track of the changes in its criterion and the changes of its policies and procedures so that it does not negatively affect aspects of the programmes educational objectives, student outcomes and programme criterion (Armoed, 2016; Khan, Mourad and Waleed, 2014).

HEI's that provide quantity surveying education, should strive to provide a level of quality education that aims to prepare students for the various facets within the construction industry, commercial property industry and a life in academia. Quantity surveying students should be educated and developed into multi-skilled professionals who possess , intellectual, emotional and mental resilience to succeed in built environment industry (Faculty of Engineering and Built Environment, Malaysia, 2010).

## **2.2. The Accreditation Process**

The SACQSP uses practices and procedures which includes an evaluation process conducted by a team of experts through on-site visits. A review process is followed by a decision made by the accrediting body regarding the accredited status. This review process is repeated every three to ten years if the institution or programme is required to sustain its accreditation. The periodic examination is conducted by professional bodies based on a set of standards which is carried out by the Department of Higher Education or in the private sector, CHE. A self-review process may also be issued by the the institution of the quantity surveying programme making sure to evaluate standards and relevancy of the progeamme (Ballim, Mabizela and Mubangizi 2014).

**Accreditation criterion highlight areas which include:**

Faculty, facilities, finances, student support services, curricula and student learning outcomes.

**Advantages of the SACQSP accreditation process:**

- The affirmation of the quality of education;
- The honour and prestige by the institution;
- The attractiveness of the institution to prospective students and their parents;
- International or national recognition of the degrees awarded by the institution;
- Incentives such as administrative and financial autonomy;
- The availability of funding and subsidies based on an objective study and data for performance;
- A culture of periodical evaluation and improvement;
- Peer recognition and ranking as a competitive institution.

As soon as the SACQSP awards a quantity surveying programme an accredited status, both students and the public can have a sense of confidence in the worth of an institution and that of the programmes it offers. That the programme fulfill its obligations and promises. And, that the degree holds substantial value in society and that of the built environment industry. Accreditation provides real life value for students in obtaining employment within the built environment industry (Council for Higher Education Accreditation, 2010).

**2.3. The SACQSP Framework of Accreditation For Higher Education Institutions**

The SACQSP accreditation framework, identifies a set of criterion that are used by HEI's. The HEQC programme criterion for all four academic qualification levels are applied. The accreditation framework aims at promoting principles of academic development and excellence within HEI's who provide quantity surveying programmes ([www.sacqsp.co.za](http://www.sacqsp.co.za)). Programme accreditation criterion serves as a programme evaluation tool. It provides HEI's a set of required outcomes for their programmes upon evaluation. It should be noted that a programme functions best if the HEI's actively monitor and promote quality quantity surveying programmes. Assessment tools may be used in order to assess the programmes and identify areas for further development. It is therefore imperative that these criterion assist programmes to be reflective and effectively isolate weaknesses and build upon its strengths (ACCE, 2014).

### **SACQSP Accreditation Policy and Programme Accreditation Criterion:**

- Criterion 1: Programme Design
- Criterion 2: Student Recruitment, Admission and Selection
- Criterion 3: Academic Staffing
- Criterion 4: Support Staffing
- Criterion 5: Teaching and Learning Strategy
- Criterion 6: Student Assessment Policies and Procedures
- Criterion 7: Infrastructure and Library Resources
- Criterion 8: Programme Administrative Services
- Criterion 9: Postgraduate Policies, Procedures and Regulations
- Criterion 10: Programme Co-ordination
- Criterion 11: Academic Development for Student Success
- Criterion 12: Teaching and Learning Interactions
- Criterion 13: Student Assessment Practices
- Criterion 14: The Assessment System
- Criterion 15: Coordination of Work-Based Learning
- Criterion 16: Delivery of Postgraduate Programmes
- Criterion 17: Student Retention and Throughput
- Criterion 18: Employability
- Criterion 19: Programme Effectiveness

### **3. RESEARCH APPROACH**

A quantitative analysis was conducted with data being collected through a survey questionnaire issued to both qs graduates and construction industry employers. A sample size of 15 employers and 150 qs graduates from various HEI's in Kwazulu-Natal. A total of 43 qs graduates and 11 employers responded to the survey questionnaire. A data set of descriptive statistics were derived using SPSS v24. Data presented included measures of central tendency and dispersion. An internal validity test was conducted through a set of scaled responses which was determined through Cronbach's alpha co-efficient for validity.

### **4. RESEARCH FINDINGS**

The research objective of the study was to identify the role higher education accreditation bodies such as the SACQSP impact quantity surveying programmes. The objective is to determine whether accredited quantity surveying programmes offered by HEI's adequately prepared graduates with the necessary skills and competencies required by the construction industry for entry level quantity surveyors.

#### 4.1. Profile of Respondents

##### Graduate Survey

The median age of a graduate quantity surveyor who participated in the study was 28 years old ranging from 23 years old to 53 years old. Just under three quarters (73.8%) of graduates were male. Almost all (97.7%) of graduates were actively employed and practicing quantity surveying in the construction industry in consulting or contracting firms. More than half of the graduates (52.5%) had attended a University of Technology and less than half (40.5%) had attended the University of KwaZulu-Natal. Almost all (95.0%) the graduates had graduated from an accredited quantity surveying programme (Haupt and Armoed, 2017).

##### Graduates Survey Responses Reliability

The Cronbach's alpha co-efficients for the various scaled responses indicate acceptable degrees of internal consistency for the all scales used, namely a Cronbach Alpha statistic which is greater than the rule-of-thumb 0.70 for acceptable internal scale consistency. Assessment of Academic Programme as per the SACQSP Programme Criteria indicates a statistical value of 0.893, Graduates Level of Work Readiness indicates a statistical value of 0.857 and Graduates Skills and Competencies 0.926(Ibid).

##### Employer Survey

Less than a third (30%) of employers were quantity surveyors by profession and 20.0% each were directors, contracts managers and project managers. Further, 81.8% of organizations actively recruited graduates to work in their businesses while 54.5% employed students from non-accredited programs. These organisations employed a median of 11 employees in their workforce ranging from 4 to 24 employees. The organisations have been actively practicing quantity surveying for a median of 4 years ranging from 1 years to 17 years.

More than three-quarters (81%) actively recruited graduates from all the universities in KZN. Organisations also reported that a median of two qs graduates were recruited annually ranging from 0 graduates to 10 graduates per year. However, more than half (54.5%) of organisations did not only employ graduates from accredited quantity surveying programs.

Most organizations (72.7%) did not require graduate employees to be registered with the SACQSP. Just over a quarter of graduates recruited either had a Bachelor of Science degree in Quantity Surveying (30.0%) or an Honours degree in Quantity Surveying (30.0%), with the remaining graduates holding neither an undergraduate Diploma nor a Bachelor of Technology degree in Quantity Surveying. Just less than half (45.5%) of qs graduates were actively recruited and employed by Quantity Surveying practices. Construction companies employed 27.3% qs graduates while other built environment organisations employed the rest.

### Employers' Survey Responses Reliability

The Cronbach's alpha co-efficients for the various scaled responses indicate acceptable degrees of internal consistency for the all scales used, namely a Cronbach Alpha statistic which is greater than the rule-of-thumb 0.70 for acceptable internal scale consistency. Graduates Skills and Competencies indicates a statistical value of 0.965.

**Table 1: SACQSP Programme Criteria for HEI – Academic Programme Assessment**

Statement	Mean	SD	Scale	Rank
Criteria One: Programme Design	3.47	0.613	Agree	1
Criteria Two: Student Recruitment, Admission and Selection	3.45	0.754	Agree	2
Criteria Three: Academic Staffing	3.79	0.816	Agree	3
Criteria Four: Support Staffing	3.40	0.894	Neutral	4
Criteria Five: Teaching and Learning Strategy	3.30	0.809	Neutral	5
Criteria Six: Student Assessment Policies and Procedures	3.55	0.707	Agree	6
Criteria Seven: Infrastructure and Library Resources	3.11	0.941	Neutral	7
Criteria Eight: Programme Administrative Services	3.59	0.788	Agree	8
Criteria Nine: Postgraduate Policies, Procedures and Regulations	3.41	1.406	Agree	9
Criteria Ten: Programme Co-ordination	2.69	1.006	Neutral	10
Criteria Eleven: Academic Development for Student Success	3.37	0.833	Neutral	11
Criteria Twelve: Teaching and learning interactions	4.15	3.381	Agree	12
Criteria Thirteen: Student Assessment Practices	3.55	0.884	Agree	13
Criteria Fourteen: The Assessment System	3.19	0.876	Neutral	14
Criteria Fifteen: Co-ordination of Work-Based Learning	3.15	1.045	Neutral	15
Criteria Sixteen: Delivery of Postgraduate Programmes	3.32	1.392	Neutral	16
Criteria Seventeen: Student Retention and Throughput Rates	3.32	0.833	Neutral	17

Statement	Mean	SD	Scale	Rank
Criteria Eighteen: Employability	3.75	0.915	Agree	18
Criteria Nineteen: Programme Effectiveness	3.21	1.006	Neutral	19

A list of SACQSP programme criterion were presented to qs graduates of which they had to respond to about their respective accredited programmes. The findings are shown above in Table 1. The statistical mean across the 55 statements of the 19 SACQSP HEI's Programme Criterion was 3.36, suggesting that overall qs graduates were neutral about the programme criterion and whether the respective qs programmes had adequately prepared them for the world of professional practice.

**Table 2:** Graduates views on their level of Work-Readiness

Statement	Mean	SD	Scale	Rank
I am expected to show commitment towards my work and towards tasks given to me	4.48	0.592	Strongly Agree	1
I am expected to have high levels of self-discipline at work	4.44	0.547	Strongly Agree	2
My success is driven by my own efforts and self-motivation	4.37	0.690	Strongly Agree	3
I am expected to develop and maintain effective relationships with colleagues and superiors	4.34	0.752	Strongly Agree	4
I am expected to have excellent written communication skills	4.32	0.565	Strongly Agree	5
I am expected to have advanced numeracy skills to execute my tasks effectively	4.32	0.565	Strongly Agree	6
I am expected to have excellent oral communication skills	4.30	0.604	Strongly Agree	7
I am expected to have high levels of self-confidence	4.30	0.772	Strongly Agree	8
I must be able to adapt to changing circumstances	4.25	0.693	Strongly Agree	9
I am expected to show effective problem solving skills	4.16	0.614	Agree	10
I am expected to be effective with my decision-making skills	4.16	0.659	Agree	11
When I started to work, I had efficient listening skills	4.16	0.614	Agree	12
I am expected to have good leadership skills	4.13	0.833	Agree	13

Statement	Mean	SD	Scale	Rank
I am expected to have high levels of innovation	4.13	0.742	Agree	14
I was able to function effectively in a team when I started working	4.06	0.593	Agree	15
When I started to work, I was able to use physical resources; computer/printer, effectively in an organisation	4.04	0.950	Agree	16
When I started to work, I was expected to independently plan my time at work	4.00	0.872	Agree	17
When I started to work, I was required to use quantity surveying computer software to execute daily tasks	3.79	1.059	Agree	18
I am expected to understand the impact of economic influences on the organisation	3.79	0.940	Agree	19
Having work based learning experience helped me to get a job	3.74	1.156	Agree	20
When I started to work I could effectively manage my time	3.62	1.000	Agree	21
When I started to work, I was able to effectively manage interpersonal conflict	3.60	0.954	Agree	22
Only graduates with quantity surveying diplomas are employed	2.58	1.179	Disagree	23
Only graduates with quantity surveying degrees are employed	2.51	1.202	Disagree	24

A list of work readiness statements were presented to qs graduates of which they had to respond to about their level of readiness. The findings are shown above in Table 2. The statistical mean across the 24 work readiness statements was 3.98 suggesting that regardless of being in an accredited qs programme or not, overall qs graduates had a combined perception of agreeance that they were ready for professional practice.

### Views on QS Skills and Competences

QS graduates and respective built environment organizations were presented with a list of skills and competencies that they were required to respond to regarding their importance within the qs programme and for professional practice. The findings are shown below in Table 3 where EI=Extremely Important and I=Important. The statistical mean across the 25 skills and competencies for both graduates and organizations was 1.51

suggesting, that both cohorts regarded the skills and competencies that they should possess as important to extremely important.

However, it should be noted that employers of these organisations and graduates ranked the skills and competencies in varying degrees of importance suggesting that the HEI's are not aligned with industry requirements. As a result, qs graduates have a distorted perception of what industry requires from them as entry level qs graduates, who are actively seeking employment or are employed at built environment organisations.

**Table 3: Views on QS Skills and Competencies**

Skills and Competencies	Employers Response				Graduates Response			
	Mean	SD	Scale	Rank	Mean	SD	Scale	Rank
<b>Traditional Skills and Competencies</b>								
Personal and Interpersonal Skills	1.09	0.305	EI	1	1.30	0.557	EI	8
Design Appraisal and Measurement (Quantity Surveying)	1.18	0.603	EI	2	1.20	0.599	EI	3
Project Valuation and Payments	1.18	0.603	EI	3	1.28	0.635	EI	7
Ethics	1.27	0.646	EI	4	1.25	0.581	EI	6
Leadership and Management Skills	1.36	0.674	EI	5	1.42	0.630	EI	10
Professional Practice and Ethics	1.36	0.674	EI	6	1.21	0.519	EI	4
Financial Reporting	1.36	0.809	EI	7	1.34	0.686	EI	9
Interpretation of Data, Information and Information Technology	1.54	0.687	EI	8	1.18	0.500	EI	1
Drawing Interpretation (Architectural)	1.54	0.687	EI	9	1.20	0.558	EI	2
Drawing Interpretation (Structural)	1.54	0.687	EI	10	1.25	0.581	EI	5
Construction Technology and Environmental Services	1.81	0.750	I	11	1.46	0.702	EI	11

Evolved and Emerging Skills and Competencies								
Accounting	1.18	0.404	EI	1	1.51	0.668	EI	3
Construction Contract Practice (JBCC/GCC)	1.36	0.674	EI	2	1.23	0.570	EI	1
Procurement and Financial Management	1.45	0.687	EI	3	1.53	0.667	EI	4
Construction Law	1.63	0.809	EI	4	1.30	0.557	EI	2
Project Management	1.63	0.809	EI	5	1.65	0.612	EI	7
Health and Safety Acts and Procedures	1.63	0.924	EI	6	1.58	0.793	EI	5
Site Surveying	1.72	0.786	I	7	1.81	0.763	I	10
Marketing	1.90	0.700	I	8	2.06	0.632	I	13
Insolvency and Insurances	1.90	0.875	I	9	1.90	0.750	I	11
Construction Economics	1.90	0.943	I	10	1.64	0.655	EI	6
Property Law	2.00	0.774	I	11	1.67	0.565	I	8
Facilities Management	2.00	0.774	I	12	2.07	0.600	I	14
Dispute Resolution and Associated Procedures	2.00	0.894	I	13	1.73	0.664	I	9
Research Methodologies and Techniques	2.09	0.943	I	14	2.02	0.780	I	12

## 5. CONCLUSION

HEI's qs graduates in Kwazulu-Natal reflected a neutral response regarding the 19-fundamental programme criterion set out in the accreditation framework by the SACQSP with regards to the programmes adequately preparing them for professional practice. The criterion serves as an evaluation tool by HEI's to ensure that programmes are continuously improved and to develop quality quantity surveying education that satisfies the needs of employers in a competitive construction market. The research findings highlight that HEI's programmes are not aligned with industry requirements. As a result, qs graduates have a distorted perception of what industry requires from them as entry level qs graduates.

However, qs graduates agree that in order to further develop quality quantity surveying programmes; traditional, evolved and emerging skills and competencies which are aligned with industry requirements are to be incorporated into an accredited quantity surveying programme. These

skills and competences are deemed to be extremely important for qs graduates to possess for entry level positions. The study also illustrated that qs graduates found no benefit in studying at an accredited quantity surveying program as they were still not adequately prepared for professional practice within the built environment industry.

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## Effective Assessment In The Process Of Learning In Higher Education In South Africa

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### ABSTRACT AND KEYWORDS

#### **Purpose**

The aim of this paper is to investigate how assessment can be used effectively as a learning tool to improve students learning in higher education.

#### **Methodology**

A comprehensive review of literature was conducted on the concept of learning and assessment to investigate the possibilities of using assessment as a learning tool in higher education.

**Findings**

The study identified some key features of an effective assessment practice that will improve student learning in terms of the behavioural, cognitive, and motivational aspects of self-regulation. This might help to identify areas in current assessment practices that might need to be strengthened. .

**Research limitations/implications**

This study presents findings from a review of literature and constitutes the first phase of an empirical research on the development of an appropriate and effective assessment tool in a constructivist learning environment in South Africa.

**Practical Implications**

The outcomes of this study will guide the development of an effective assessment model to measure student learning in constructivist learning environment, and this might be implemented in disciplines like construction management, engineering and the sciences. The research also identified how formative assessment in higher education can be improved.

**What is original/value of paper?**

The efficacy of improving assessment to improve students learning in higher education in South Africa was identified and this will lead to the evaluation of current assessment practises.

**Response to the conference Theme**

This study speaks to Construction Education, Training and Skills Development.

**KEYWORDS:**

Dynamic assessment; Formative assessment; Feedback; Learning; Self-assessment; Teaching and learning.

**1. INTRODUCTION**

One of the effects of harmonisation and globalisation of study models and educational structures is the profound programmatic and structural changes in higher education (Lucena et al., 2008, Brennan et al., 2009). This has led to the evaluation of the equality of education and quality of graduates produced in higher education. Even at the international stage measuring and modelling academic learning outcomes is been giving

priorities in recent years (Coates, 2014). Another challenge for education is how to support learners in learning. Institutions are also looking for ways of developing skills and habits in learners that will make independent (Schunk and Zimmerman, 2012). In this regards attention is given to the development of self-regulated learning (Paris and Paris, 2001, Pintrich, 2004) and assessment is progressively becoming an effective tool to equip students with the necessary metacognitive and cognitive strategies to make them more effective self-regulating learners (Black and Wiliam, 2009, Clark, 2012). Therefore it is necessary to investigate how assessment can be used effectively as a learning tool to improve students learning in higher education (Zlatkin-Troitschanskaia et al., 2015). In this paper a comprehensive review of literature was conducted on the concept of learning and assessment to investigate the possibilities of using assessment has a learning tool in higher education.

## **2. WHAT IS THE PURPOSE ASSESSMENT**

The effective use of assessment is important to assist teachers to improve teaching and learning (Chappuis and Stiggins, 2008, Harlen, 2005, Brookhart, 2016). However, it is important for teachers to get quality information from high-quality assessments to make appropriate decisions regarding how to evaluate student achievement and how to teach, what to teach, and how to teach (Brookhart, 2016, Chappuis and Stiggins, 2008). According to Brookhart (2016), assessment is 'a broad process for obtaining information that is used for making decisions about students, curricular programmes, and schools and educational policy' (p. 3), and he also argued that assessment should be distinguished from evaluation, measurement and testing. Broadly, assessment serves two purposes: formative and summative (Chappuis and Stiggins, 2008, Harlen, 2005). According to Wiliam (2011), formative assessment is "any assessment where its evidence about student achievement is generated, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction to improve learning" (p. 45). While according to [ARG] (2003), summative assessment is defined as the, 'process by which teachers gather evidence in a planned and systematic way in order to draw inferences about their students' learning, based on their professional judgment, and to report at a particular time on their students' achievements' (p. 4).

According to Corte (2004), there is a mismatch between current assessment practices and the demand for science or engineering based

competence. The current assessment tools focus on mastery of low-level skills and memorised knowledge instead of giving information related to the ability to communicate scientific principles and problem solving skills.

Assessment influences learning and its implications for learners' learning was demonstrated by a number of studies. Shepard (2000) and Dysthe (2007) identified the gap between common assessment tools and current theories of learning. They claim that the assessment tools focuses mainly on what was learnt or not learnt after the module has been taught. Some studies (Havnes and McDowell, 2007, Jönsson, 2008) have shown that assessment should be used for formative functions therefore there is the need to redirect assessment towards learning as assessment for learning and not just for summative assessment of learning. Many studies (Brown and Hirschfeld, 2008, Gijbels et al., 2008, Nijhuis et al., 2005, Struyven et al., 2003) have also shown that there is a strong relationship between assessment and teaching and learning, it affect the ways learners learn and also the way lecturers teach. The way leaners perceive their learning environment affect the approach to learning they will adopt more than the task itself (Entwistle and Entwistle, 1991). Also learners who use assessment as a means to take responsibility for their learning are known to acquire more learning (Brown and Hirschfeld, 2008). In addition the way learners view the purpose of assessment also affect learning. Assessment termed as "inappropriate" tends to encourage surface approach to learning while assessment termed as "fair" that is innovative assessment assist learner in adopting the deep approach to learning (Struyven et al., 2003). Adopting surface approach to learning involves the reproduction and memorization of what has been taught, without really understanding what is been taught while students who adopt deep approach to learning search for knowledge (Goodfellow et al., 2016). Learners who knows what is expected of them to achieve the learning outcomes tend to experience more freedom of learning and usually adopt a deep approach to learning (Gijbels et al., 2008), while learners who do not see the aims clearly, undergoes less freedom to learning so they adopt a surface approach to learning (LeCun et al., 2015, Entwistle and Ramsden, 2015). Therefore the choice of assessment strategy has a great impact on students engagement in the module. This paper looks at the role of assessment in learning and its impact on student learning by looking at the inter-relationship between teaching, learning and assessment.

### **3. ROLE OF ASSESSMENT IN STUDENT LEARNING**

In the context of a paradigm shift towards student-centred learning approaches, and at a time when there is need to develop more effective teaching, learning, and assessment strategies in higher education, the features of an effective assessment practices for students' learning should not be over looked. This will lead to the development of appropriate assessment strategies and learner-centred assessment practices which will meet expected quality. These features are enumerated below.

### **3.1 LEARNING CULTURAL SHIFT**

It is not enough to improve the content of assessment but it should also enhance learning. The culture of the students should shift from seeing the aim of an assessment as passing a test or acquiring a competence but acquiring real learning (Sadler, 1998). This was emphasized by Morrisette (2011) who wrote about "the long-term exposure of students to defective patterns of formative assessment" (p.77). Some students are willing to study harder so they prefer formative assessment. But others are imprisoned in the identity of a bad pupil and an opponent (Perrenoud, 1991). Therefore for effective learning to take place lecturers should use formative assessment to reconstruct the teaching contract so as counteract the "bad" habits acquired by students concerning assessment.

### **3.2 DYNAMIC, ON-GOING ASSESSMENT**

Assessment should play a central role between teaching and learning instead of postponing it to the end of instruction (Shepard, 2000) so dynamic assessment is encouraged. Dynamic assessment is discovering what a student can do independently and what can be done with guidance (Poehner and Rea-Dickins, 2014) and this is an integral to Vygotsky's idea of a zone of proximal development (ZPD). ZPD is a simple and powerful tool use in teaching. It states that lecturers should teach in such a way that it is slight hard for learners to understand on their own but easy to understand with assistance (Wass and Golding, 2014). This concept is illustrated in figure 1 below.

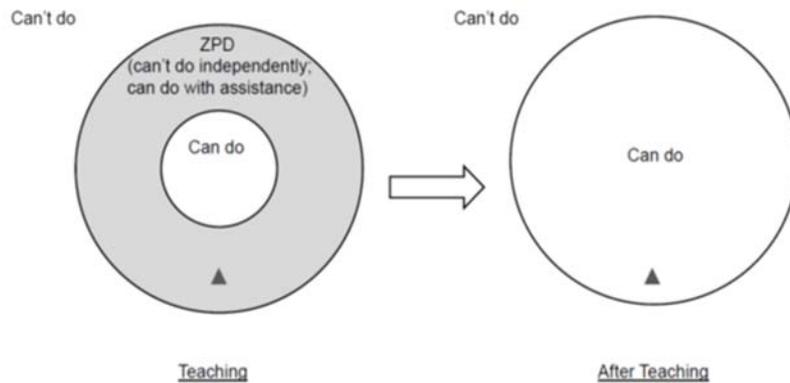


Figure 1: Vygotsky's zone of proximal development (Wass and Golding, 2014)

### 3.3 PRIOR KNOWLEDGE

As a result of changes in learning theories to better accommodate cultural and social contexts it is necessary to re-examine prior knowledge and feedback (Shepard, 2000). The use of open discussion and instructional conversation are better tools than using checklists to measure student reasoning and relevant experience brought from diverse communities (Tharp and Gallimore, 1991). It is very important to develop effective assessment strategies at the start of learning and also at every stage of learning.

### 3.4 FEEDBACK

Most lecturers undermine the positive influence of giving feedback to students about their performance which will lead to self-improvement and correction (Nathenson and Henderson, 2018). There is more to be learnt on the use of scaffolding and expert tutoring to assist students and also on the effective use of feedback (Lepper et al., 1997, Schneider, 2017). According to Lepper et al. (1997), most tutors do not routinely give feedback and correction to student's errors directly if the errors are inconsequential to the solution process. Instead they provide solutions to forestall errors the student made previously. As much as tutors and lecturers are trying to maintain students' self-confidence and motivation by using indirect forms of feedback, they should not ignore students' errors.

### **3.5 TRANSFER**

Truly understanding a concept and being able to transfer knowledge and use it in new situations are very closely related. In contrast to memorisation, true understanding is connected, flexible and generalisable (Neal, 2010). To support generalisation and robust understanding, good teaching involves: asking old understanding in new ways; calling for new application; and drawing for new connections. Good assessment strategy should follow suit (Shepard, 2000).

### **3.6 EXPLICIT CRITERIA**

According to Frederiksen and Collins (1989), students should have clear a understanding of the criteria that will be used to assess their work that is there should be transparency. Criteria for excellent performance should be transparent such that student can assess their own work the same way the lecturer would have done it. Clearly stating the assessment criteria shows fairness. However it shows a different and more fundamental sense of fairness if the student are given the opportunity to get good at exactly what the system requires. According to Palmer Wolf and Reardon (1996) as cited in Shepard (2000), this is like “making thinking visible” and making “excellence attainable” (p.12).

### **3.7 SELF ASSESSMENT**

This is both beneficial to the teachers and the students (McConnell, 2006), specifically if it is more focused on the students. It reduces teachers’ work load, provides feedback instantly and assist to eliminate certain “barriers” between students and teachers. It also makes the student less dependent, more responsible and autonomous; the student becomes proactive and self-confidence, while the effect of teaching can be evaluated more objectively and accurately (McConnell, 2014). It make students actively involved in the decision-making process about the evaluation process and the evaluation criteria of their own and other students’ works. According to Panadero et al. (2016) involving students in assessment builds their ownership of the assessment process and “makes it possible to hold students to higher standards because the criteria are clear and reasonable” (p.30). Students involvement in their own assessment is a step towards preparing them for work and life settings (Ćukušić et al., 2014).

### 3.8 EVALUATION OF TEACHING

Apart from using assessment to promote and monitor individual students' learning, it should also be used to improve and examine teaching strategies. This should include regular informal assessments of students' understanding to adjust teaching strategies. This is very important for the transforming of assessment culture and developing a community of learners who seek feedback and critique their own work. Lecturers should also model this commitment to improve the teaching and learning process.

In some institutions, this evaluation is used for formative purposes that is to provide feedback for the improvement of teaching and also for summative purposes like for institutional audits and administrative decision-making (Burden, 2008, Arthur, 2009). These dual usages of providing feedback on teaching leads to improved quality of teaching (Balam and Shannon, 2010) and also its use as a quality measurement (Chen and Hoshower, 2003) makes its fragile and has serious effects on a teacher's professional career (Kogan et al., 2010)

## 4. CONCLUSION

This article has argued that the improper use of assessment have slowed down the concepts of learning in higher education. Though students have been given the responsibility of been in charge of their own learning there is still reluctance in making them responsible for the assessment processes. If students are to be fully prepared for work place and life learning, they should be given the opportunity to develop the capacity to control their own learning as they progress through higher education. This article has identified ways in which feedback and formative assessment might be redesigned to support this development. It also identified some key features of an effective assessment practice that will improve student learning in terms of the behavioural, cognitive, and motivational aspects of self-regulation. Teachers should scrutinise their current assessment practices in relation to the self-regulation model propagated in this paper. This might help to identify areas in their current assessment practices that might need to be strengthened. However, the features of an effective assessment strategy presented here do not exhaust all that might be needed to enhance improved learning in classrooms using assessment. They merely provide a starting point. Further research in this area is needed to refine these features, identify gaps and to gather further evidence about the potential of using formative assessment and feedback to improve student learning.

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## Mediation of Cognitive Loading on Complex Questions and Schema Development in Students of Construction Programmes

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### ABSTRACT AND KEYWORDS

#### Purpose of this paper

The aim of the research is to assess the mediating effect of cognitive loading on the relationship between complex questions and schema construction.

#### Design/methodology/approach

The research used a self-administered questionnaire survey to collect data from a purposively selected sample of university students. The students were drawn from three public universities in South Africa studying towards undergraduate degrees in construction studies. The data were analysed using structural equation modelling and mediation analysis.

#### Findings

Cognitive loading has a fairly large mediating effect on the relationship between complex questions and schema construction. These findings corroborate other findings which show that complex questions induce fairly large amounts of cognitive loading which then impedes learning.

### **Research limitations/implications**

The results of the research are limited because the survey is based on purposive sampling. Also, the research is based on measurement instruments whose reliability and validity have not been extensively tested. Therefore, future studies can replicate the study with a random sample and with other instruments which have been extensively tested.

### **Practical implications**

Appropriate scaffolding should be used when questions which are perceived as being complex are administered to students. Scaffolding will help to manage the resulting cognitive loading and help students to achieve better learning outcomes. The scaffolding may include, but not limited to, supplementary lectures and seminars to provide students with the appropriate level of knowledge to deal with the perceived question complexity and subsequently reduce the cognitive loading.

**Keywords:** Mediation, Cognitive Loading, Complex Questions, Schema Construction, Construction Education

## **1. INTRODUCTION**

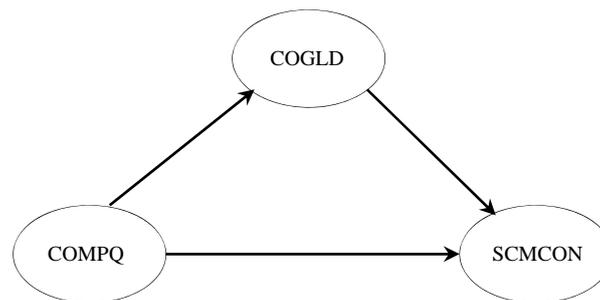
Cognitive loading is the mental load on working memory expended in executing cognitive functions such as perceiving, thinking and learning (Sweller & Paas, 2017). These mental functions are performed in working memory. Working memory is used for conscious activity in organizing, contrasting, comparing and working on information. It can hold about seven items at a single time but can only process two or three items simultaneously and it is the only memory which can be monitored (Kirschner, 2002; Sweller, et al., 1998). Long term memory (LTM) on the other hand, has an unlimited capacity but its contents cannot be directly monitored unless they are loaded onto working memory. Because working memory has a very limited capacity, it tends to get overloaded and overwhelmed when its limits are stretched (Leppink, 2017). Therefore, lower levels of cognitive loading induced in students will work to yield more effective learning than when the memory limits of students are ignored and the cognitive load is left to exceed the memory limit. This is based on the cognitive load theory (CLT) which posits that since working memory has a very limited capacity, it can be easily overloaded with activities that impede rather than aid learning. Subsequently, effective learning happens when the cognitive load in working memory is directed towards construction and automation of relevant schemata (Sweller et al., 1998).

The information processing theory suggests that knowledge is stored in LTM as schemata. A schema is anything that is learnt and is treated as a single entity by working memory and can incorporate a large and complex amount of information (Kirschner, 2002; van Bruggen, Kirschner, & Jochems, 2002). Schema can combine elements of information and

become automated therefore needing less storage capacity and processing (van Bruggen et al., 2002).

In order to achieve learning or schema construction, students are often administered complex questions. Questions may be classified as complex when their answers need to be collated from information scattered in many different documents (Chali, Hasan, & Mojahid, 2015) or from different bodies of knowledge in different disciplines. Using complex questions is expected to challenge students to acquire knowledge they previously did not possess and therefore achieve learning. However, based on the CLT, complex questions are also expected to induce large amounts of cognitive loading.

While it is understood that complex questions induce cognitive loading and that cognitive loading impedes learning it is not clear as to what extent complex questions achieve learning. Also, it is not clear as to the extent to which cognitive loading mediates the relationship between complex questions and schema construction. Therefore, this study aims to assess the mediating role of cognitive loading on the relationship between complex questions and schema construction. The resulting conceptual model is shown in Figure 1.



**Figure 1:** Conceptual Model of the Mediating Role of Cognitive Loading on the Relationship between Complex Questions and Schema Construction

**Legend:** COMPQ = Complex Questions; COGLD = Cognitive Loading;  
SCMCON = Schema Construction

## 2. RESEARCH DESIGN, STRATEGY AND PROCEDURES

A quantitative research design with a positivist philosophy and a deductive research approach were used because the study sought to test hypothesized relationships among the study variables to which the quantitative design, a positivist philosophy and a deductive approach are all well suited. The favoured data collection method was a cross sectional questionnaire survey due to the objectivity and low cost associated with its use compared to other methods of data collection. Non probability sampling was used for convenience and economy.

The target population for the study were students undertaking construction studies at public universities in South Africa. Three public universities in the KwaZulu-Natal province were conveniently selected for the study. All students present in class at the time of the data collection were included in the sample. In keeping with ethical research conduct, the students were informed of their right to not participate in the study and to withdraw at any time for any reason. The students were also assured of both confidentiality and anonymity if they chose to participate. A sample of 543 students studying towards bachelor's degrees in either Construction Management, Quantity Surveying or Property Studies at the three public universities was obtained.

Table 1 shows the profile of the respondents. All academic years of study from first to fourth year were represented in the sample with first year students accounting for the highest number (34.10%) followed by fourth year students (23.00%) and then second year students (23.20%). With no single year of study being markedly larger or smaller than any other, the distribution of the academic year of study is representative of a typical four years' university program. The gender distribution has more males (59.80%) than females which is consistent with the general gender distribution at public universities in South Africa. Therefore, the gender distribution is also representative of the population of interest. The programs of study sampled were from the disciplines of Construction Management, Quantity Surveying, Property Studies and Architecture. The highest number of respondents came from the discipline of Construction Management (47.70%) while Property Studies accounted for only 8.80% and Architecture only 14.90%.

**Table 1.** Sample Demographic Statistics

<b>Year of Study</b>	<b>Frequency</b>	<b>Percentage</b>
1	185	34.10
2	126	23.20
3	107	19.70
4	125	23.00
<b>Total</b>	<b>543</b>	<b>100</b>
<b>Gender</b>	<b>Frequency</b>	<b>Percentage</b>
Male	324	59.80
Female	219	40.20
<b>Total</b>	<b>543</b>	<b>100</b>
<b>Programme of Study</b>	<b>Frequency</b>	<b>Percentage</b>
Construction Management	259	47.70
Quantity Surveying	155	28.60
Property Studies	48	8.80
Architecture	81	14.90
<b>Total</b>	<b>543</b>	<b>100</b>

The research questionnaire with its associated descriptive statistics are shown in Table 2. The scales in the questionnaire were developed by the authors based on the operational definition of the research constructs.

Table 2: Measurement Model

Research Constructs		Mean	Std. Dev	Skewness	Kurtosis	
<b>Cognitive Loading</b>						
<b>COGLD</b>						
1	I was expected to remember too many things from each lecture	COGLD1	3.497	1.056	-0.233	-0.649
2	I was overwhelmed with the amount of information I was expected to remember	COGLD2	3.461	1.037	-0.294	-0.443
3	I was given too much information during the lectures	COGLD3	3.298	1.020	-0.065	-0.533
4	The information I was given during lectures was confusing	COGLD4	2.789	1.087	0.121	-0.528
5	The information I was given in class was complicated and difficult to understand	COGLD5	2.785	1.085	0.154	-0.538
<b>Complex Questions</b>						
<b>COMPQ</b>						
1	I was given assignments and tests which were difficult to understand and solve	COMPQ1	2.829	1.076	0.130	-0.431
2	I was given problems which did not have enough information for me to solve them	COMPQ2	2.693	1.119	0.304	-0.501
3	I was required to solve questions which were not clear as to what I was expected to do	COMPQ3	2.837	1.119	0.151	-0.640
4	I was given questions which could be interpreted in more than one way	COMPQ4	3.108	1.063	-0.042	-0.515
5	I was given problems which were not easy to understand clearly	COMPQ5	2.875	1.098	0.091	-0.566
6	I was given questions which were not expressed clearly	COMPQ6	2.772	1.163	0.137	-0.725
<b>Schema Construction</b>						
<b>SCMCON</b>						
1	My lecturers concentrated on making me understand the basic concepts and principles (points) of a module/subject	SCMCON1	3.779	0.950	-0.640	0.297
2	My lecturers concentrated on making me connect new concepts and principles (points) with what I already knew	SCMCON2	3.733	0.9114	-0.488	-0.091
3	I connected points that I already knew with what I was being taught in class	SCMCON3	3.791	0.877	-0.438	-0.032
4	I organised, categorised or connected anything new that I learnt with what I already knew	SCMCON4	3.695	0.916	-0.428	0.010
5	My lecturers clearly highlighted the main concepts and principles	SCMCON5	3.944	0.936	-0.666	0.000

Cognitive loading was operationalized mainly as the extent to which students are overwhelmed by the amount of assigned work and the extent to which they were expected to remember too much information which was complex, difficult and confusing to understand. This conception is shared

by others (Hadie & Yusoff, 2016) and is also supported by the findings which show that high levels of cognitive loading lead to students being overwhelmed (Scheiter, Gerjets, Vollmann, & Catrambone, 2009).

The concept of complex questions was operationalized by extent to which students were given assessment problems which were difficult to understand, had no defined solution and required combining information from different subject areas and sources in tandem with the conception of complex questions by (Chali et al., 2015).

Schema construction was operationalised based on the definition of a schema from schema theory. The instrument was anchored on a 5-point Likert scale with 5=almost never; 4=often; 3=sometimes; 2=seldom; and 1=almost never. The questionnaire, along with the entire study, were reviewed by the university research ethics committee and approved. The resulting questionnaire and its associated descriptive statistics are shown in Table 2. The results exhibited mild skewness and kurtosis.

### 3. FINDINGS

The results were analysed, firstly, with Structural Equation Modeling (SEM) using IBM SPSS AMOS v25 and, secondly, with the PROCESS macro v3 in IBM SPSS by Andrew F. Hayes. SEM was used to assess model fitness also to assess reliability and validity from the resulting factor loading and mediation was assessed using the PROCESS macro.

#### 3.1 Structural Equation Modeling

Structural Equation Modelling (SEM) was used to assess the goodness of fit of the theoretical mediation model to the empirical data using Maximum Likelihood Estimation (ML) with 500 bootstrap samples. Absolute and incremental fit indices were used to assess model fitness. The fit indices are shown in Table 3 and the SEM model is shown in Figure 2.

Table 3: Model Fit Indices

Model Fit Index	Acceptable Threshold	Study Threshold	Met/Not Met
<b><u>Absolute Fit Indices</u></b>			
Chi-Square Significance		P=0.000	Not Met
Relative Normed Chi-Square value ( $\lambda^2/df$ )	<3	2.575	Met
Random Measures of Sample Error Approximation (RMSEA) (RMR)	<0.080	0.055	Met
Goodness of Fit Index (GFI)	>0.0	0.053	Met
	>0.900	0.946	
<b><u>Incremental Fit Indices</u></b>			
Incremental Fit Index (IFI)	>0.900	0.964	Met
Comparative Fit Index (CFI)	>0.900	0.963	Met
Tucker Lewis Index (TLI)	>0.900	0.952	Met

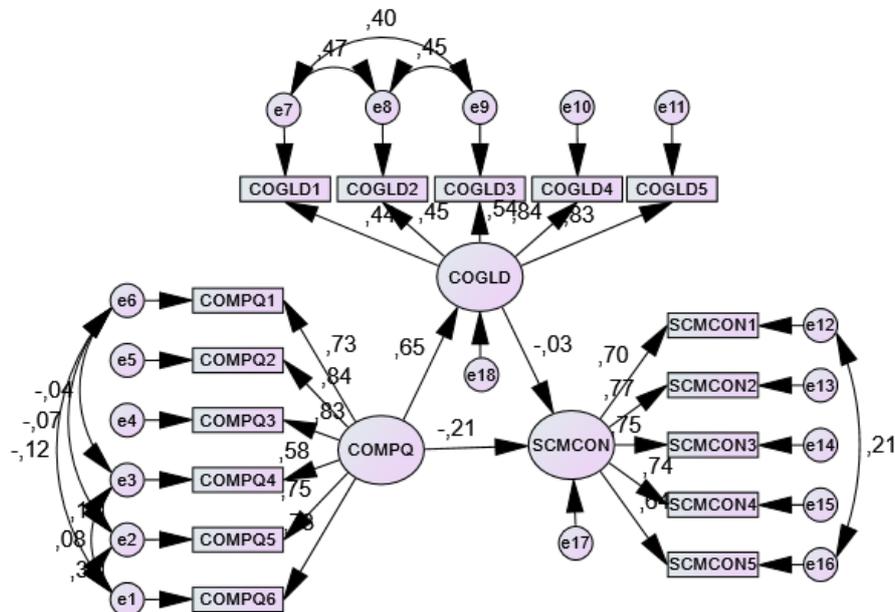


Figure 2: Structural Equation Model with Standardised Coefficients

The fit indices in Table 3 show that the overall mediation model exhibits a good fit with the empirical data based on recommended model fitness index thresholds (Anderson & Gerbing, 1988; Fornell & Larcker, 1981; Hu & Bentler, 1999; Hulland, 1999; Tabachnick & Fidell, 2013). The theoretical model displays a good fit to the empirical data and so inferences made from the conceptual model are both theoretically and empirically valid.

The test statistics were then assessed for reliability and validity. Table 4 shows the results of the reliability and validity statistics. Reliability was assessed using Cronbach's alpha and Composite Reliability (CR) while validity was assessed using Average Variance Extracted (AVE). Cronbach's alpha for all constructs ranged between 0.735 and 0.841. Therefore, all the constructs exceeded the recommendation of 0.70 by Byrne (2006). Hulland (1999) recommended a threshold of 0.70 for CR and all the constructs exceeded this threshold. Therefore, based on the Cronbach's alpha and the CR, the research constructs exhibit good reliability. For validity, Fornell and Larcker (1981) recommended AVE values to be greater than 0.50 and all the constructs exceeded this threshold. Therefore, the measurement instrument is both reliable and valid.

The structural relationships from the SEM analysis in Figure 2 are tabulated in Table 5 and show that COMPQ is significantly negatively associated with SCMCON ( $R^2=-0.207$ ,  $p=0.005$ ). COMPQ is also significantly positively associated with COGLD ( $R^2=0.651$ ,  $p=0.0001$ ). While COGLD shows a negative association with SCMCON, the relationship is not statistically significant ( $p=0.714$ ).

**Table 4:** Reliability and Validity Statistics

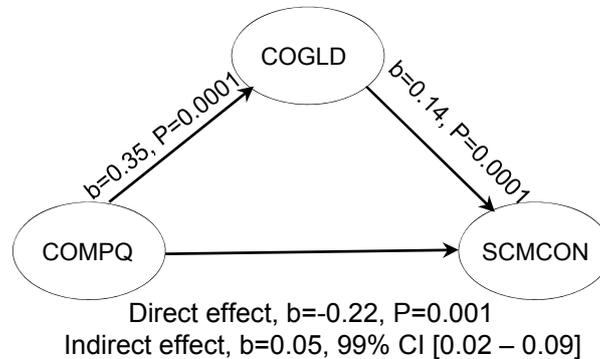
Research Constructs	Cronbach's Test		C.R.	AVE	Item Loadings	
	Item-total	$\alpha$ Value				
Cognitive Loading	COGLD1	0.585	0.822	0.734	0.558	0.441
	COGLD2	0.605				0.446
	COGLD3	0.659				0.545
	COGLD4	0.617				0.844
	COGLD5	0.608				0.834
Complex Questions	COMPQ1	0.638	0.885	0.841	0.651	0.731
	COMPQ2	0.756				0.837
	COMPQ3	0.767				0.827
	COMPQ4	0.579				0.583
	COMPQ5	0.744				0.745
	COMPQ6	0.704				0.729
Schema Construction	SCMCON1	0.665	0.848	0.817	0.626	0.704
	SCMCON2	0.701				0.771
	SCMCON3	0.650				0.745
	SCMCON4	0.658				0.745
	SCMCON5	0.611				0.635

**Table 5:** Structural Relationships

	Proposed Hypothesis		R <sup>2</sup> Estimate	P Level
1	SCMCON <--- COMPQ	H <sub>1</sub>	-0.207	0.005
2	COGLD <--- COMPQ	H <sub>2</sub>	0.651	0.000
3	SCMCON <--- COGLD	H <sub>3</sub>	-0.027	0.714

### 3.2 Mediation Analysis

The Preacher and Hayes (2004) bootstrapping procedure is a very good procedure for analysing mediation among latent variables (Field, 2018). Therefore, the mediating role of cognitive loading on the relationship between complex questions and schema construction was assessed using the IBM SPSS PROCESS macro. Additionally, the procedure by Preacher and Hayes, unlike other alternatives, does not rely on the assumption of normality of the indirect effects whilst at the same time being suitable for smaller sample sizes (Preacher, 2008). The confidence interval (CI) for the indirect effect is a bias corrected accelerated (BCa) bootstrapped CI based on 5000 samples. The results of the analysis are shown in Figure 3.



**Figure 2:** Model of Complex Questions as a Predictor of Schema Construction Mediated by Cognitive Loading

The indirect effect of COMPQ on SCMCON through COGLD was significant (indirect effect = 0.05, 99% CI = 0.02 to 0.09). This shows that cognitive loading mediates the relationship between complex questions and schema construction.

#### 4. DISCUSSION OF FINDINGS AND CONCLUSION

Studies have shown that administering complex questions induces significant amounts of cognitive loading in students and that high levels of cognitive loading impede learning (Huang, Shadiev, & Hwang, 2016; Leppink, 2017; Sweller & Paas, 2017). Using a different methodology from established studies, the aim of this study was to assess the extent of cognitive loading which can be attributed to complex questions using mediation analysis. The study also assessed the extent to which complex questions achieve learning. Mediation was assessed using the PROCESS macro by Andrew F. Hayes in IBM SPSS. A supplementary structural equation model was used to assess the model fitness of the theoretical mediation model. The structural relationships in the model assessed the extent to which complex questions achieve learning.

Consistent with other studies, the structural relationships from structural equation modelling show that administering complex questions significantly impedes the development of schemata in students. Therefore, complex questions do not help to achieve learning but in fact work against learning. Also, consistent with other studies, complex questions induce quite large amounts of cognitive loading. However, the results suggest that cognitive loading in itself does not necessarily hinder learning. This is because, while it has a negative relationship with schema construction, the relationship is not statistically significant.

On one hand, the results are in tandem with other findings showing that complex questions lead to increased levels of cognitive loading. The results also agree with other studies which show that complex questions impede rather than aid learning. However, it is unclear about the effect of cognitive loading alone on schema construction. It was expected, based on other studies, that cognitive loading would be significantly negatively associated with schema construction.

However, the mediation analysis, on the other hand, shows that complex questions would impede schema construction less if cognitive loading was not induced in the students. This, therefore, shows that cognitive loading affects schema construction indirectly through mediation. This is demonstrated in the mediation model when the relationship between complex questions and schema construction reverses from negative to positive when cognitive loading is a mediator. That is, when complex questions are administered to students and the resulting levels of cognitive loading are high, the students will not be able to construct any schema. Conversely, if complex questions are administered and cognitive loading is not high, students will be able to construct some schemata. This significant improvement in schema construction when complex questions are used and cognitive loading reduced explains why cognitive loading is found to be lower in more knowledgeable learners. More knowledgeable learners already have some schemata on the subject matter and so are able to deal with complex questions with much lower levels of cognitive loading. Prior subject knowledge places less demand on working memory when dealing with complex questions and so induces lower levels of cognitive loading.

These findings add to the fairly new body of knowledge on cognitive loading. The findings also have practical implications for educational practice. When questions which are perceived by students as being complex are administered in assessments, appropriate measures should be put in place to help the students deal with the consequent levels of cognitive loading. Otherwise, the high levels of cognitive loading will impede learning. Cognitive loading can be reduced by appropriate scaffolding. Scaffolding could include, but not limited to, supplementary lectures and seminars to provide students with the appropriate level of knowledge to deal with the perceived complexity.

## **6. LIMITATIONS**

While this study makes contributions to the body of knowledge and to educational practice, it has some limitations. Firstly, the data were purposively collected using instruments which have not been extensively tested. Therefore, future studies may validate the instruments used in this study or use other established instruments for the constructs under study to test the validity of the results and conclusions arrived at by this study.

Future studies could also test to establish whether in fact cognitive loading has moderating rather than mediating effect on the relationship between complex questions and schema construction. This model is a plausible representation of the empirical data given that cognitive loading did not exhibit a significant relationship with schema construction in the structural model.

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# **An Evaluation of Early Career Competency of the Project Manager in the Construction Industry**

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## **ABSTRACT AND KEYWORDS**

### **Purpose:**

This paper aims to identify and evaluate the technical knowledge and determine competencies that should be assumed by junior and intermediate project managers within the construction industry.

### **Design/Methodology/Approach:**

To arrive at the main objective of this study, the literature review was used to assess the requisite skillset and identify whether the current education curriculum prepares the professional for the working environment. The competencies were categorized in the 10 knowledge areas derived from the PMBoK and were incorporated into the design of the research tool. A questionnaire was distributed to 17 participants whom are senior management in either their consulting firms and building contractors.

### **Research Limitation/Implications:**

The research was conducted in Durban, KwaZulu-Natal.

### **Findings based on Empirical Research:**

The junior professionals are not well prepared with the essential practical skillset of project management. The adoption of a practical oriented curriculum in universities should address the competence inadequacy of recently graduated construction project managers. This research proposes

the Inquiry Based Learning as an effective system to traditional universities in South Africa. This would improve the junior professional's knowledge absorption and task-performance.

**Response to Conference Theme:**

Education and training are key approaches addressing illiteracy and the shortage of skill development.

**Value of paper:**

This research paper identified tertiary training methods and exposure required for professionals to elevate their practical knowledge and performance improvement in project management.

**Keywords:**

Project Management, Competency, Task-Performance, Knowledge, Tertiary Training.

## **1. INTRODUCTION**

### **1.1 Background of the study**

The South African construction industry is constantly undergoing development. This is due to the phenomena of globalisation, where many South African construction companies have the opportunity to expand their scope into Africa as well as into the world as a whole. Thus, despite being a third world country in terms of economic status ranking, South Africa has thrived to be one of the fastest growing economies in Africa (African Economic Outlook Organisation, 2017). In 2010, the South African government joined the BRIC (Brazil, Russia, India, and China) developing countries, changing the acronym to BRICS (Brazil, Russia, India, China and South Africa). The intention of this merger was to expand economic participation, development, integration and industrialisation within developing countries (Esposito, 2016). The BRICS countries, have a share of global output that has increased significantly in the years since their birth. Esposito (2016) mentions that BRICS economies have shown a mixed performance in terms of social development. However, the World Economic Forum declared the BRICS's improvement in global competitiveness, as shown in figure 1.1 below.

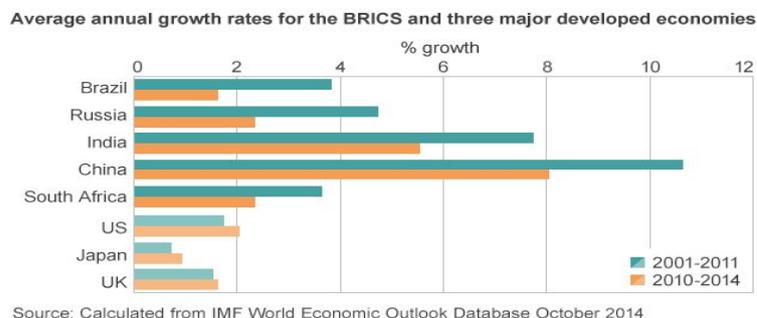


Figure 1.1 Growth Rates for BRICS Economies

This could be an advantage for many industries, including the construction industry. This is because according to Udo and Koppensteiner, (2004) many projects are cancelled during economic recessions and downturns, therefore resulting in the laying off of many professionals, including project managers. However, project managers are also laid off due to developers not recognising the importance of these professionals in the successful implementation of a project. In order to acknowledge the important role played by a project manager in a project, it is vital for an organisation to base their selection criteria on the competency of the position rather than the project manager's professional fit into the organisation (Udo and Koppensteiner, 2004). Gerek and Efeoglu, (2015) state that construction projects are regarded prospectively effective when they are under the leadership of a building and engineering professional; mainly in the project management discipline. According to Dziekonski, (2016) the knowledge competency of the project manager should be a collective skillset related to the changing construction industry. Rui, Ismail and Hussaini, (2015) mention that the skills competitiveness ignited by the rapid economic transformation can be noted globally. This clearly indicates the importance given to skills development and training in policy discourse as a means of improving productivity across all sectors of the economy (Rui, Ismail and Hussaini, 2015). The paper is intended to assess the core requisite skills for the future project manager and to identify effective training and development programs at the early stage of their career.

## 1.2 The Construction Project Manager

### 1.2.1 The Professional

A project manager is the professional that is responsible for the overall success of delivering the owner's physical development within the constraints of cost, schedule, quality and safety requirements (Edum-Fotwe and McCaffer, 2000). Project managers today are faced with a critical shift in focus in terms of their fundamental roles and functions they should perform. The dynamic industry leaves them with no option other than to rely on knowledge and skills acquired through training

and experience (Edum-Fotwe and McCaffer, 2000). The project manager's professional importance, relevance and existence depends on their maintained competency (Kalinova, 2008). The project management triangle serves as the project manager's guide to successful project outcomes (Atkinson, 1999), as described in figure 1.2 below:



Figure 1.2: The three constraints in a Project management triangle (Source: Atkinson, 1999)

- 1) **Time:** Time is a crucial factor which is uncontrollable. On the other hand, failure to meet deadlines in a project can create adverse effects. Most often the main reason for organisations to fail in terms of time is due to lack of resources.
- 2) **Cost:** It is imperative for both the project manager and organisation to have an estimated cost when undertaking a project. Budgets will ensure that the project is developed and implemented below a certain cost. Sometimes project managers have to allocate additional resources in order to meet the deadlines with a penalty of additional project costs.
- 3) **Scope:** Scope looks at the outcome of the project undertaken. This consists of a list of deliverables which need to be addressed by the project team. A successful project manager will know how to manage both the scope of the project and any change in the scope which impacts on time and cost.
  - **Quality:** Quality is not part of the project management triangle, but it is the ultimate objective of every delivery. Hence, the project management triangle implies quality.

### 1.2.2 The Profession

Attakoraa-Amaniampong, (2016) defined project management as the practical application of the technical knowledge, skills and managerial methods to project activities leading to the achievement of project objectives. According to Stevenson (2008) the key success factors of project management are a top-down management commitment, a capable project manager, enough time to plan, careful tracking, good cost control systems, and good communications. It is therefore imperative that construction projects do not suffer from poor performance in terms of time delays, cost overruns, and quality defects (Rui, Ismail and Hussaini, 2015).

### 1.2.3 The Responsibilities

According to the Association for Construction Project Managers – ACPM (2016) an experienced project manager should have the ability to: (i) prepare and evaluate the request for quotation for construction work; (ii) prepare contracts and change orders for consultants and contractors; (iii) manage project schedules and update project schedules; (iv) manage the progress and cost of the project on a monthly basis, including the review of invoices and change orders by consultants and contractors; (v) organise regular project manager meetings to review construction work progress and prepare meeting minutes; (vi) co-ordinate and participate in quality control and assurance meetings on the project site; (vii) interface and develop key relationships with clients, contractors and other stakeholders; (viii) co-ordinate cost report meetings and report to client; and (ix) report progress and issue to client/employer. Therefore, a junior construction project manager should have the ability to provide assistance to the senior professional.

## 2. COMPETENCIES OF A CONSTRUCTION PROJECT MANAGER

### 2.1 Defined Competencies

Competence is the underlying characteristic of a person in that it may well be a motive, trait, skill, aspect of one's self-image or social role or a body of knowledge which he or she uses (Young and Conboy, 2013). It is generally known that those within the construction industry are continuously faced with a variety of unknown, unexpected, frequently undesirable and often unpredictable factors (Euripides, 2008). The need to define the professional responsibilities in construction is eminent and requires core competencies outlined for the professional in Table 2.1. The competencies of a professional create parameters and guidelines as to what is expected by the industry at large. Crawford (2007) stated that there has been an increasing interest in project management competence with 'project based personnel actively seeking sound guidance on desired PM competencies as well as credentials that will enhance their credentials. Different organisational cultures require different emphasis within the three competency areas.

Table 2.1 Core Competency Areas (Adapted from: Udo and Koppensteiner, 2004)

<b>CORE COMPETENCY AREAS</b>		
<b>Knowledge:</b>		
General Management Skills	Project Management Skills	Industry Skills
Leadership	Fundamental project	Wide industry

	skills	knowledge/application
Provide direction & Vision	Project management tools & techniques	Life cycle management
Effective decision making	Organisational savvy	
Negotiation & Communication		
Conflict resolution & Team Building		
Mentor team members & sound judgment		
<b>Technical Experience:</b>		
Strategic in approach: understands & addresses inter-dependencie & real issues		
Experience managing to deliverables & milestones: on time/within budget/meeting business needs (quality)		
Ability to manage troubled teams/projects & bring them to success		
Proven experience with projects of similar size & scope		
Organised and efficient in work processes		
<b>Personality:</b>		
	<b>Characteristics</b>	<b>People management skills</b>
	Aptitude; flexibility & ability to adapt to change & cultural realities	Build & manage interpersonal relationships
	Confidence & commitment	Ability to influence & win respect
	Pro-active & can-do attitude	Know when not to manage
	Open-mindedness	Socio-Eco Politically sensitive
	Common sense	Active listening
	Trustworthy	Lead by example & with fairness
	Creativity	

## 2.2 PM Knowledge Areas

The project management environment is characterised by change, responsibilities, and hence required knowledge and skills will continue transforming (Udo and Koppensteiner, 2004). According to PMI (2008) the PMBOK identifies ten (10) construction project management knowledge areas namely; intergration management, scope management, time management, cost management, quality management, human resources management, communication management, risk management, procurement management and stakeholders management. Zulch (2012) stated that the construction project management has additional knowledge areas namely; safety, environment, finances and claims management. The knowledge areas

are performance based competency standards specifically designed for assessment and recognition of current competence, they also encourage self-check, reflection and personal development in order to provide evidence of competence against the specified performance criteria (Young and Conboy, 2013).

### **2.3 Training and Continuous Professional Development**

The growing need for curriculum development is apparent around the world due to new technology and the overall dynamic construction domain (Paslawski, et al., 2016). Knowledge-intensity and sustainable training systems are imperative for the production of efficient professionals (Rui, Ismail and Hussaini, 2015). Conventional engineering education and organisational training courses tend to follow a positivistic mindset and approach to problem solving rather than fostering a constructivist mindset trained to deal with wicked problems (Raisanan, Josephsson and Luvo, 2015). Calls for reform in university education have prompted a movement from teacher-to-student centred course design, and included developments such as peer-teaching, problem and inquiry-based learning (Gormally, et al., 2009). In emphasis Raisanan, Josephsson and Luvo, (2015) stated that learning needs to be action-driven and include reflection loops, allowing for both individual reflection and, more importantly, collective reflection. Interpersonal and problem-solving skills are acquired more effectively by training that takes place off the job (Rui, Ismail and Hussaini, 2015). Project managers in construction undertake various modules to compensate the areas lacking from their academic development (Edum-Fotwe and McCaffer, 2000). The scope coverage for a project manager to attain professional status may range from 11 to 50 small, medium and large scale projects (Edum-Fotwe and McCaffer, 2000), from the SACPCMP (South African council for the project and construction management profession) and ACPM (Association for construction project managers). The SACPCMP acts as the body that accredits construction courses from universities and universities of technology, namely; National Diploma Building Science, Bachelor of Science in Construction Management. Therefore, upon attainment of the professional status qualification, the construction project manager may be considered formally competent.

### **3. THE RESEARCH APPROACH**

The research used a questionnaire completed by 17 participants mainly consulting project management professionals, engineers, architects and quantity surveyors from various firms located in Durban, KwaZulu-Natal. The questionnaire instrument was structured to elicit the general and technical background of these practising project managers. This comprised of the academic and experiential training of the professional development. The questionnaire also elicited the importance of the

knowledge and skillset that can improve professional competency of construction project managers. The survey was conducted in a structured interview setting resulting in a 100% response rate and questions were based on a 5 point likert scale type of responses.

#### 4. DATA ANALYSIS AND RESULTS

The results of the survey were analysed by descriptive statistics, and findings presented graphically.

##### 4.1 General Information

Section one of the questionnaire sought general information of the respondents, as depicted in Table 4.1. The respondents' highest in years of experience were 56 years and an average of 11 years. Only 4 firms practice project management and the 13 includes PM and other services such as engineering, property development, quantity surveying. Six respondents were registered for the project management professional status.

Table 4.1: Section One of the Questionnaire

No. of years in Construction	Type of Organisation or Sector	PM services in Organisation	Professionally Registered in Organisation
Average	Contractor	PM only	Pr CPM
11	9	4	6
Highest	Consultant	PM & other	Other
56	8	13	11

Table 4.2: Section Two of the Questionnaire

Strongly Agree: <input type="checkbox"/> Agree: <input type="checkbox"/> Unsure: <input type="checkbox"/> Disagree: <input type="checkbox"/> Strongly Disagree: <input type="checkbox"/>		i	ii	iii	iv	v
1	Construction project management profession is a combination of engineering, science and management.	9	7	1	-	-
2	University education & training gives basic knowledge of construction to professionals, then to practically expose students and co-ordinate on how to implement theoretical knowledge.	2	4	4	6	1
3	A recently graduated professional can perform the minimum required functions/skills of a construction project manager.	-	-	2	10	5
4	A construction student immediately possesses multi-disciplinary abilities and skills at final year & after graduation	-	-	4	10	3
5	Junior construction professionals show in-depth understanding and satisfactory knowledge to independently carry out project tasks without supervision.	1	1	2	8	5
6	Construction Project Management Competency can only be achieved through formal education at a tertiary institution.	-	2	2	7	6
7	Recently graduated professionals show high willingness and eagerness to learn in the workplace to achieve required competency	4	5	4	4	-
8	Generally, graduates show readiness and are highly motivated to	1	5	5	3	3

	getting involved in the working environment of the construction industry.					
9	The current education system is appropriately equipping students with work-related knowledge and skills	2	2	<u>9</u>	3	1
10	The South African universities educates & trains students to be adaptive, responsible and critical thinkers known as constructivist education (Inquiry Based Learning)	2	3	5	<u>6</u>	-

#### 4.2 Technical Information and Knowledge Acquired by Junior PM's

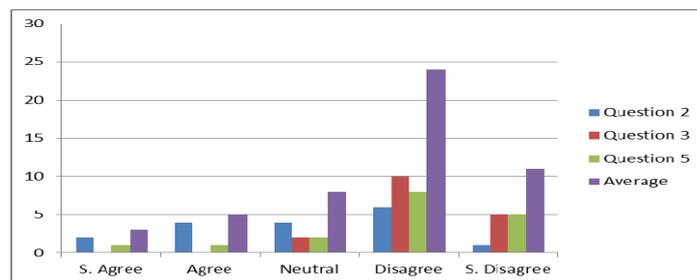


Figure 4.2: Technical Information & knowledge Acquired

Project management knowledge and project management performance are considered by prior studies as hard or technical skills that are thresholds for being a competent project manager, (Zhang, et al., 2013). Figure 4.2 addressed question 2, 3, and 5 about the intensity in which junior project managers can perform fundamental minimum skills required. Figure 4.2 presents that a larger segment of the respondents disagree and the average shows similar depiction. These results show that the technical knowledge acquired by graduates at tertiary is not enough and is incomplete for the level of expectancy from the industry and what employers require from junior project managers. The respondents indeed disagreed that junior project managers after graduation would have the ability to run projects or assume responsibilities of a project manager without supervision.

### 4.3 Professional Competency and Performance

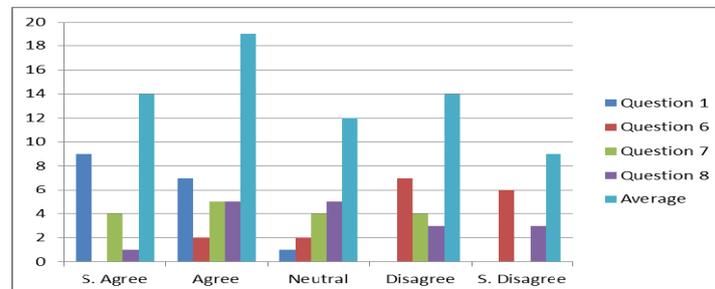


Figure 4.3: Professional Competency & Performance Measurement

As shown on figure 4.3, the results indicate(s) that almost half the total number of respondents on average agreed with questions 6, 7 and 8. In question 1 about nine respondents strongly agree that project management is a profession that incorporates science, engineering and management knowledge into one deliverable required for a project manager to be versed at. Figure 4.3 shows question 6 that respondents disagreed that recently graduated and junior project managers competency can only be obtained through education, whilst question 8 agrees largely that graduates are eager and willing to learn and join the construction industry.

### 4.4 Education Training and Practical Exposure

Technology use is an important aspect for a built environment professional, however educational training is equally essential (Gerek and Efeoglu, 2015). The significance of technical training from the institutions of education is that it prepares the built environment professional to apply what is known theoretically to practical experience.

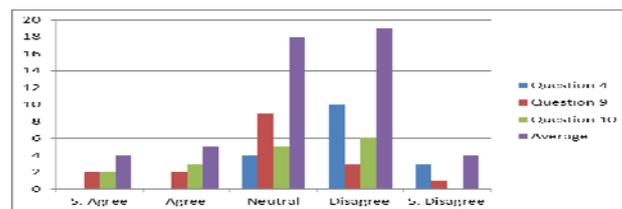


Figure 4.4: Educational Training & Practical Experience

Figure 4.4 indicated above represents questions 4,9 and 10. In question 9 the findings show that many respondents do not know the details whether the current tertiary curriculum prepares construction graduates adequately for the working world. The respondents in question 10 disagreed that south African universities train junior project managers to be critical thinkers at the immediate point of exit at university and whilst they are still at their junior level. On average they disagreed that the

current university training would address the purpose and intention of the constructivist education which trains students to be independent and more practical, however the primary question would remain to be “would a junior project manager that has undergone an inquiry based learning or constructivist education system be adequately prepared for PM duties required by the construction industry?”. Figure 4.2 and figure 4.3 dispute the readiness of a junior PM having to assume responsibilities of a project manager without relevant experience.

## 5. CONCLUSION

The study presented the readiness degree of construction project management graduates upon entrance to the working industry. In detail, this research study identified technical, competency and educational training contributions towards a competent and astute construction professional. Therefore, performance evaluation is one of the most important attributes of project management competency and identifying key performance indicators pronounces successful project management. The findings simply show that recently graduated project managers need more training in the working environment and obtain the relevant practical experience in order to be adequately ready for the duties of a project manager and be as competent as expected by employers. This research can also pave the way for further studies, certainly increase the number of respondents to deepen the analysis of what level of competency is required from junior project managers and how they may be trained properly at a university point of view.

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## **Construction project managers' services in South Africa: Key stakeholder perceptions of performance**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

Numerous factors influence the execution of projects in the construction industry. Whilst each construction project is unique in terms of how it is managed, projects are one of the major delivery vehicles for products and services in the global economy. Construction Project Managers (CPMs) aim to perform the crucial role of ensuring the successful delivery of project objectives and project deliverables i.e. timely completion of the project, within allowable budgetary and quality expectations. In SA, there are growing reports of unsatisfactory delivery of project objectives. A number of studies have explored factors responsible for poor project execution and delivery in the SA construction industry. Some of these factors point to poor management of construction projects such as poor choice of contracting and procurement strategies, poor project execution and close out and a limited pool of experienced project managers suitable for management and execution. The standard services of CPMs in SA in a typical project were established and defined under Act 48 – Project and Construction Management Professions Act, 2000. As such, this study aimed to contribute

to the body of knowledge by identifying how CPMs' performance measure against these standard services.

#### **Design/methodology/approach**

This study is descriptive and exploratory and it is designed to obtain views from stakeholders in the South African construction industry regarding the performance of CPMs. The research methodology used was a non-experimental and quantitative.

#### **Findings**

Competencies such as technical competencies were highly rated for effective project management with understanding of construction processes, the understanding of design processes, construction science, finance and costing and industry experience. However, in terms of critical measures, understanding the general construction process was at the top of the list followed by financial and cost factors and then design processes. Personal competencies however such as leadership, communication, decision-making, honesty and integrity have been indicated as areas of improvement when evaluating CPMs' performance in South Africa.

#### **What is original/value of the paper**

This research is important for enhancing future project and organisational performance which will have a positive impact on infrastructure development in South Africa.

**Keywords:** Construction Project Managers, Performance, Stakeholders.

## **1. INTRODUCTION**

The inability to complete projects on time and within budget continues to be epidemic globally and this trend is worsening but more severe in developing countries (Apolot, Alinaitwe and Tindwesi, 2013:33). Price Waterhouse Coopers (PWC, 2013), while reviewing trends in the construction industry, found top risk factors constraining the performance in the South African Construction industry as: pressure on margins and competition; market instability and its effect on order books; liquidity/cash flow risks; lack of legislation and regulations; influence on socio-economic factors; insufficient transformation; inadequate ability in effectively managing and retaining talent; volatility in labour force and trade union issues; health, unsustainable safety and environmental practices; tender risks; scarcity of resources and poor cost management; which contributed to poor project execution and outcomes. Mbachhu and Nkado (2007) report that the extent of employer dissatisfaction in the South African building industry is due to poor execution of project objectives by the project teams. Baloyi and Bekker (2011) found that a number of the ten stadia for the 2010 South African FIFA World Cup projects experienced substantial delays and cost overruns. In the South

African construction industry, cost and time overruns are common prevalence in the execution and delivery of capital outlay projects hence these reports point to significant performance issues on the part of the CPMs; given their crucial responsibility for ensuring satisfactory delivery of the project objectives.

## 2. LITERATURE SURVEY

The complicated nature of construction projects from design to construction and the uncertain site environment requires CPMs to organize, manage the advancement of the project and safety of the project as well as to ensure that the project team stays motivated (Ritz quoted in Mei-yung et al., 2011). Not only do CPMs have to deal with challenging time pressures, restricted site resources, inherent unknowns, and the constantly changing societal structures that are typical of construction projects, but every choice they make has an immediate effect on cost, quality, time and the safety of a project (CIOB quoted in Mei-yung et al., 2011). According to Nur Liyana and Jaafar (2013:278), the selection of project managers is dependent on their suitable competencies. Therefore, a good project manager must have knowledge of and experience in numerous disciplines which includes all aspects of the occupation from technical knowledge to marketing. The "Construction Project Manager is the individual responsible for the successful completion of a construction project" (Mincks, 2016:23). The CPMs' performance is said to be the single most critical factor affecting successful project outcome according to Powl and Skitmore (2005:3). According to Ashworth and Hogg, in Burger (2013:127), the responsibilities of a CPM, being one of the contracting parties, include assisting the client with the preparation of the project brief, providing the client with guidance on matters related to the budget and funding, procurement of the site, organizing a report on the feasibility of the project, establishing and preparing a project strategy and consultants' briefs, formulating a project handbook, developing the project programme, choosing project team members, creating the management structure and facilitating the design processes. These duties also include employing consultants, organizing insurance and warranties, deciding on a procurement system or strategy, organizing tender documentation, arranging contractor pre-qualification requirements, adjudicating tenders, contributing to contractor selection and appointment, arranging the control system and overseeing progress, planning meetings and approving payments. The standard services of CPMs for typical construction projects are detailed under Section 4 of the SACPCMP- ID OF WORK CPM (1996) and are categorised into six Project Work Stages.

Every construction project is different, from the site to the stakeholders involved. In comparison with other industries, the construction industry is more unpredictable and more complicated, which can lead to inefficiencies at almost every level of the project (Ribeiro et al., 2013). As such, effective performance of the CPM services is critical as they ultimately determine project outcomes. Project success means different things for different

stakeholders and it is not fixed, nor does it have a definite definition. Therefore, this implies that different stakeholders have differing views of CPMs' performance required. Since the project manager's role is to ensure that the overall project objectives are achieved (Du Plessis, 2014:16), this suggests that the project manager's performance is the most critical impact which has an effect on project success (Hartman, Bandow and Summer quoted in Powl and Skitmore, 2005). Therefore, effective project management is seemingly dependent on the project manager's competency and authority (Jaselskis and Ashley quoted in Dainty et al., 2003). Since project success is determined by the people involved rather than the processes and systems they apply, project management competence can be regarded as one of most critical criteria upon which project success is dependent (Cooke-Davies, quoted in Dainty et al., 2003).

To make this research relevant to the South African context, the research was undertaken during 2016 and is limited to the nine Project Management knowledge areas as described in the SACPCMP's guidelines for registration criteria and excludes the Project Management Body of Knowledge's 10th knowledge area namely Project Stakeholder Management. (PMBOK 2013).

## **2.1 Research problem**

There are growing reports of unsatisfactory delivery of project objectives in the South African construction industry with evidence of schedule and budget overruns, inferior quality of service and outputs, poor health and safety performance and overall client dissatisfaction of project outputs.

## **2.2 Research objectives and research questions**

By researching the performance in the services of the CPMs with a view to identifying critical poor performance and areas for improvement in the services of CPMs in South Africa, from the viewpoints of the key stakeholders, this research endeavours to contribute to the body of knowledge of project management success. The research questions are: 1. On the basis of the importance-performance ratings, how are project performance criteria (project success) positioned on an Importance-Performance matrix map? 2. What are the various areas of the CPMs' services in the project delivery process, and what level of importance do stakeholders attach to each of these service areas? 3. How do stakeholders rate CPM's performance of the identified service areas? 4. In general, how do stakeholders perceive the performance of CPMs? 5. What improvements are needed in the CPMs' services to enhance their performance in the project delivery process?

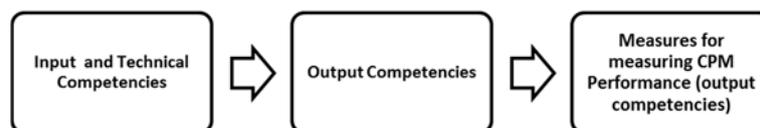
## 2.3 Conceptual Method

The conceptual frameworks in Figures 1 and 2 below were developed, based on extensive literature reviews undertaken to investigate and determine key stakeholder's perceptions of the CPMs' performance of their required services in South Africa. These were founded on a model for evaluating project performance provided by Crawford (2005:9). Here it can be argued that there are only two recognisable aspects of competence for which there are standards for applying project management which are Knowledge and Demonstrable Performance. These were measured against the relevant standards. One can further argue that output competencies rely on noticeable performance, or processes in the work environment determined or in line with competency levels specific to particular occupations, professions or organisations. In the South African construction project management context, this professional or organizational competency standard is provided for under Section 4 of the SACPCMP- ID OF WORK CPM (1996) which details the standard services of CPMs and deliverables per work stage. The widely accepted, PMI's project management guidelines and the Guide to the Project Management Body of Knowledge (PMBOK), provide the knowledge inputs required for developing CPMs. Together these two standards provide the basis for developing the conceptual framework, one for knowledge (PMBOK) and another for performance based competency or use of construction project management processes in the work environment (SACPCMP- ID OF WORK CPM (1996)). In addition, Burger's Construction Project Management Knowledge Model (Burger, 2013) was integrated into the development of this conceptual framework. This integrated framework enabled the measurement of the performance against these standards which were rated by the various key stakeholders. The overview and integrated (detailed) frameworks are illustrated in Figures 1 and 2 respectively. These frameworks were developed against the backdrop of Crawford's integrated model of competence, classifying aspects of the general concept which classified overall competence as input competencies (knowledge and one's abilities in performing work tasks); personal competencies (the intrinsic character traits underlying a person's ability to perform work) and output competencies (relate to the person's capability in performing work related tasks as expected in the particular line of work or occupation). These competencies then form the basis for achieving competence or competent performance i.e. when combined, the attribute and performance based inference of competence or input, personal and output competencies, form the several features of competence. The frameworks in Figures 1 and 2 demonstrate the knowledge competencies required for effective construction project management adopted from the PMBOK, SACPCMP- ID OF WORK CPM (1996) and Burger's Construction Project Management Knowledge Model. These are essentially the input and technical competencies. The output competencies were developed from the deliverables of each stage (i.e. from project initiation through Project Close Out) of the standard services of CPMs as detailed under Section 4 of the SACPCMP-ID OF WORK CPM (1996). The measures for evaluating CPM

performance were developed from a combination of Dainty et al.'s (2003:210-214) measures for the evaluation of CPM's performance and the leadership competencies identified by Dulewicz and Higgs (in Müller and Turner, 2010:438) which are:

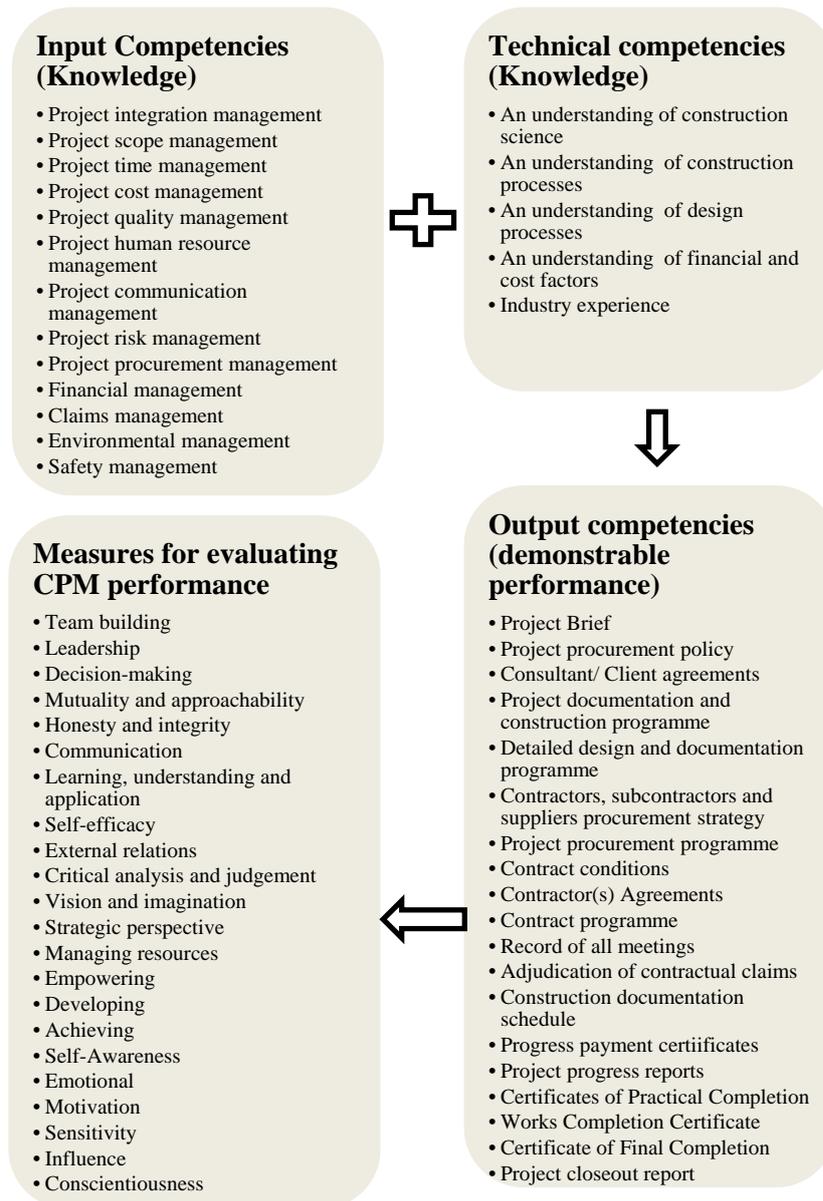
- Team building
- Leadership
- Decision-making
- Mutuality and approachability
- Honesty and integrity
- Communication
- Learning, understanding and application
- Self-efficacy
- External relations
- Having the ability to
  - critically analyse and judge,
  - be visionary and imaginative,
  - focus on strategy,
  - communicate effectively,
  - manage resources,
  - empower others,
  - develop others and
  - achieve goals
- Being
  - aware of oneself,
  - balanced emotionally,
  - self-motivated,
  - sensitive,
  - influential,
  - intuitive and
  - conscientious.

As per Figure 1 below, the “input” and “technical” competencies are the two main drivers leading to the “output” competencies which can then measure the “performance” of the construction project manager or the measures that are required for measuring the “output” competencies:



**Figure 1:** Overview of conceptual framework for evaluating CPM's performance

The following figure 2, expands on the previous explanation whereby the combination of the “input competencies” and “technical competencies” will lead to the “output competencies” which then will lead to measures for evaluating the construction project manager’s performance:



**Figure 2:** Detailed framework for evaluating CPMs’ performance of their required services

### 3. RESEARCH METHODOLOGY

An empirical research design method was used whereby an extensive literature review was conducted followed by data collection, through a questionnaire and analysis thereof, which was used to explain the observed themes. As such, this research study used a deductive approach since theory was applied and tested.

#### 3.1 Research strategy

The research methodology chosen is described as follows:

- Literature Review;
- Formulation of conceptual framework;
- Data collection through a specially designed questionnaire;
- Data analysis: Statistical analysis was employed to evaluate and analyse responses from the questionnaire survey.

Data was collected through findings of the extensive literature review and a survey questionnaire. The literature survey reviewed CPM's services, CPM's competencies, and CPMs' performance of required services and identified the key stakeholders in the construction industry. A structured questionnaire was then designed on the basis of the literature survey conducted. The sampling framework used in this study consisted of registered members of the six statutory councils regulated by the Council for the Built Environment (CBE) namely: SACAP, SACLAP, SACPCMP, SACPVP, and SACQSP, (SAICE, 2014). Primary data was collected by administering the questionnaire to the target population via the secretariats of the respective trade and/or professional organisations and was hosted online on the SurveyMonkey website with the aim of eliciting a higher number of participants. The questionnaire survey was chosen as it is one of the most cost effective ways to collect and analyse responses in order to achieve better statistical analysis of the data. The survey strategy allows for the collection of quantitative data which could be analysed quantitatively using descriptive and inferential statistics. In its basic elements a survey involves the researcher posing a series of questions to willing participants, summarises their responses with percentages, frequency counts or statistical indexes and then inferences can be drawn about a particular population from the responses of the sample (Leedy and Ormrod, 2010: 184).

### 3.2 Data analysis

Results of the study were analysed quantitatively and qualitatively. A thematic analysis approach was used to analyse qualitative data from the open ended questions. This was to ensure that only principal concepts or themes were developed to formulate key ideas. Techniques such as graphs, charts and statistics were used to process the raw quantitative data collected from the questionnaire survey to allow the researcher to explore, present, describe and examine relationships and trends within the data collected (Saunders, M.N., 2011: 414). A descriptive statistical analysis was employed during the data analysis. Descriptive statistics is used to describe gathered data by providing means, spread and associations of the data collected. Descriptive statistics involves the presentation of the description and the summary of the data collected from the survey (Welman et al., 2005). SPSS software was used to analyse group mean ratings of the attributes.

## 4. RESULTS

Based on the framework defined in the conceptual method and the research design and methodology, a survey questionnaire was designed and was hosted online on the SurveyMonkey website for users to easily enter data. A total of 55 questionnaires were successfully completed. Respondents of the study were profiled in terms of sector, role and experience in the construction industry as indicated in Table 1 below.

**Table 1:** Distribution of respondents

Role	Percentage	Count	Sector	Percentage	Count	Experience	Percentage	Count
Contractor	16%	9	Building	18%	10	5 years or less	29%	16
Employer and/or Project sponsor	9%	5	Civil Engineering	18%	10	between 5 and 10 years	18%	10
Project Manager	25%	14	Engineering	45%	25	10 years or more	53%	29
Quantity Surveyor	15%	8	Manufacturing	9%	5			
Subcontractor	2%	1	Other	9%	5			
Other	33%	18						

The majority of respondents, 45% were in engineering, 18% from building and civil engineering respectively, 9% from manufacturing and another 9% indicated they were in other sectors such as oil and gas or all above sectors. Based on the 53% study respondents' years of experience being 10 and more, it can be argued that the respondents were well experienced in their roles giving this study an advantage of rich and in-depth responses based on practical experiences and learning from various projects.

## 4.1 Descriptive statistics

### 4.1.1 Project Success

Respondents were asked to indicate the outcome of projects they have worked on in terms of the given performance criteria and to rate the level of importance they attach to each of these project performance criteria. The mean score performance ratings of project success vs. the importance placed on each attribute were used to generate the Importance-Performance matrix map which is illustrated in Figure 3. The key for reading the Importance-Performance matrix map is illustrated in Table 2 below:

Table 2: Matrix key

<b>Q1</b> Low importance, high performance	<b>Q2</b> High importance, high performance
<b>Q3</b> Low importance, low performance	<b>Q4</b> High importance, low performance

The matrix below indicates that projects have performed poorly in terms of cost, time, risk management, stakeholder satisfaction and claims management. Projects have performed well in terms of health and safety.

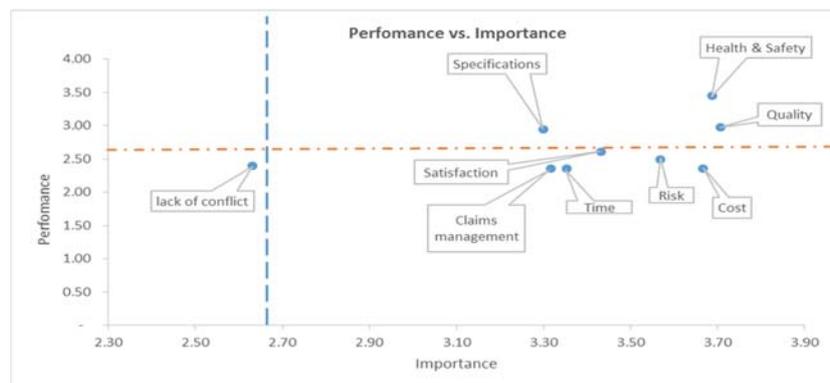


Figure 3: Importance-Performance matrix map

### 4.1.2 CPM Competence

Respondents were provided with the input and technical competences (services performed by CPMs) and were asked to identify the level of importance they attach to each of these services. Their responses are indicated in Figures 4 and 5 respectively.

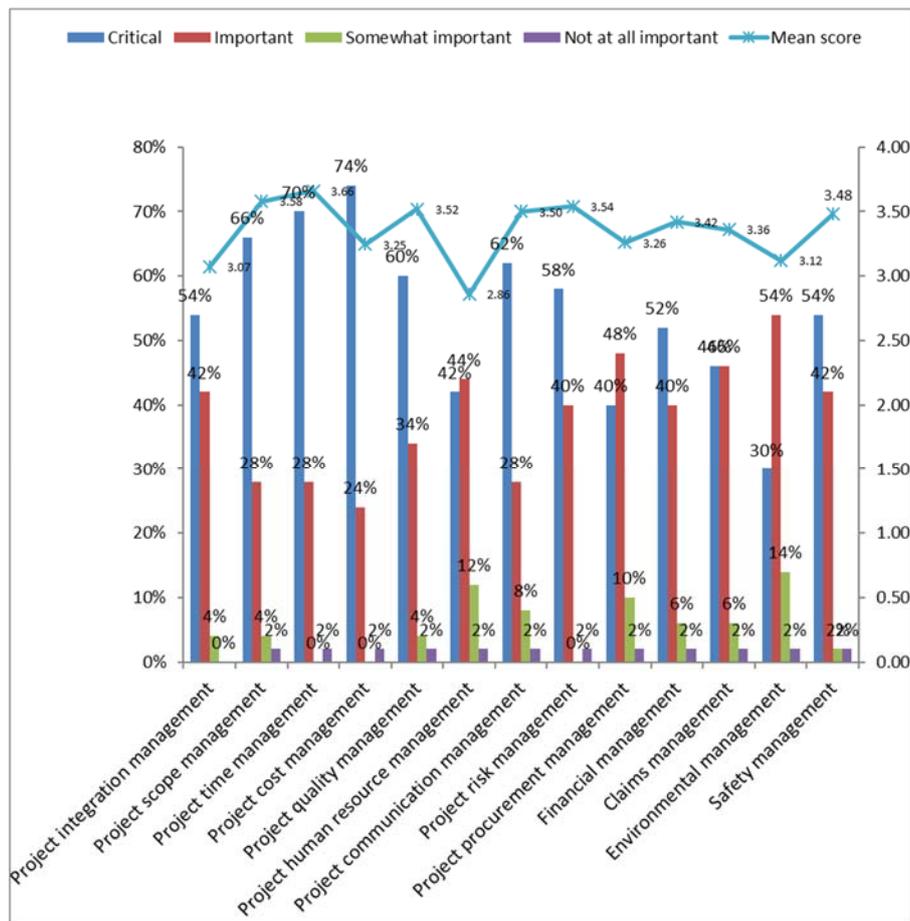


Figure 4: Input competencies respondents consider important

From the list of project knowledge areas presented to them, respondents indicated that human resource management was the least important. As discussed earlier, the list excludes the PMBOK's 10th knowledge area, Project Stakeholder Management. Risk and cost management were the highest in importance with 3.54 and 3.62 means

scores respectively. Project integration management was deemed critical or very important by 96% of respondents. Six percent (6%) of respondents viewed project scope management as not very important. Time, cost and quality management in projects was very important to 98%, 98% and 94% of respondents respectively. Ninety percent (90%) stated that project communication management was important. Procurement and financial management were considered important or critical by 98% and 92% respectively. Safety management was considered important for effective project management by 96% of respondents. Project stakeholders in this study, viewed the top 3 most critical input competencies of CPMs as cost, time and scope management.

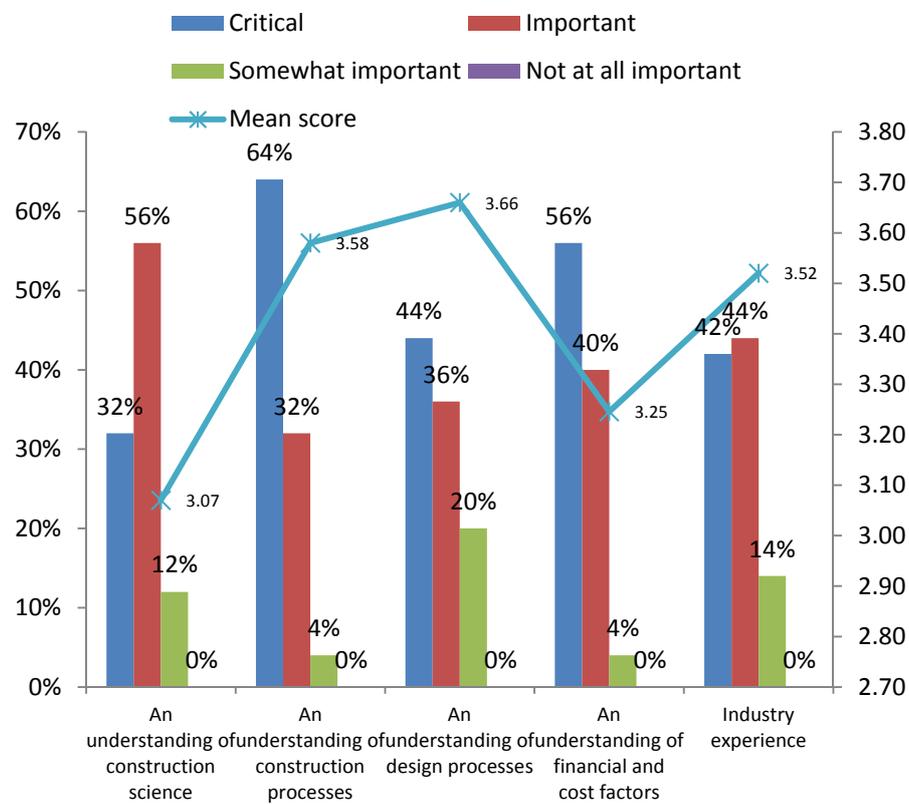


Figure 5: Technical competencies respondents consider important

All technical competencies were highly rated for effective project management with understanding of construction processes (96%), understanding of design processes (80%), construction science (88%), finance and costing (96%) and industry experience (86%). However, in terms of critical measures, understanding the general construction process was at the top of the list followed by financial and cost factors and then design processes.

#### 4.1.3 CPM Performance

Respondents were asked to rate the relative levels of importance of the CPMs' service areas (output competencies) and their perceptions of performance levels of CPMs in those areas. The mean scores for project deliverables were compared (importance of output competencies vs performance of output competencies) and the results of the comparison presented in Figure 6 below.

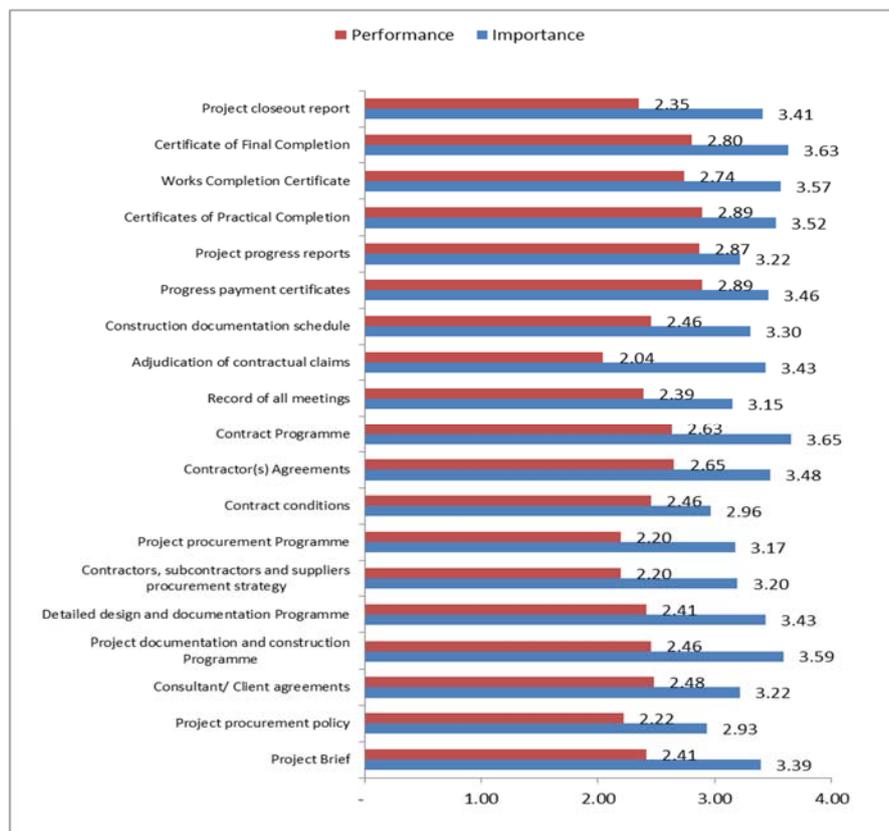
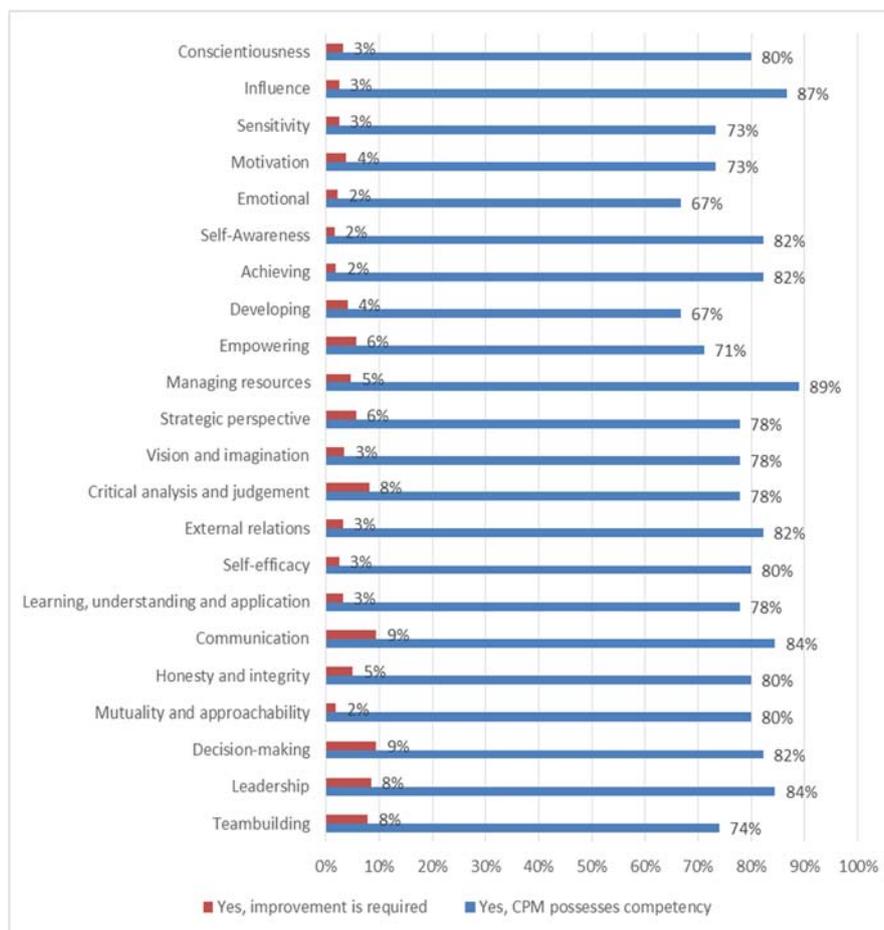


Figure 6: How CPMs perform in delivering listed output competencies

It is important to note that when the mean scores for project deliverables were compared, respondents in the study indicated that all attributes were performing below standard. In addition, respondents were presented with a list of personal competencies for efficient and successful project management and were requested to indicate personal competencies possessed by CPMs and areas of improvement (results in Figure 7).



**Figure 7:** Possession and improvement of listed personal competencies

Leadership was a skill found in about 84% of CPMs, decision-making (82%), mutuality and approachability (80%), honesty and integrity (80%), ability to communicate was found in 84% of CPMs, learning, understanding and

application (78%). Self-efficacy was possessed by 80% of CPMs, external relations (82%), critical analysis and judgement (78%), vision and imagination (78%), strategic perspective (78%), managing resources was highest at 89%, empowering (71%), developing (67%), achieving (82%), self-awareness (82%), emotional (67%). Motivation was prevalent in 73% of CPMs, sensitivity (73%), influence (87%) and conscientiousness (80%).

Improvements were flagged for all attributes but in less than 10% of all the cases. The highest proportion of respondents (9%) indicated that there was a need to improve decision making skills and communication among CPMs. Eight percent (8%) mentioned leadership and teambuilding as well as critical analysis.

## **5. CONCLUSIONS AND RECOMMENDATIONS**

The key stakeholders in this study indicated that achieving project time, cost, quality, meeting customer expectations and adhering to health and safety regulations are critical or important indicators of project success.

Almost all input competencies were deemed to be important for effective project management. Cost, time and scope management were viewed as the top three most critical input competencies. The respondents in the study indicated that CPMs were performing below standard on all project deliverables such as adjudication of contractual claims, project procurement programme and the project's procurement strategy.

In the South African context, literature indicates that construction industry indicators in South Africa have been especially poor in terms of performance related to quality, client satisfaction, payment to contractors and profitability (Emuze & Smallwood quoted in Smallwood, 2012: 2). As such improvements in the performance of CPMs in the South African construction industry of project deliveries is required. Hence, personal competencies such as leadership, communication, decision-making, honesty and integrity have to be improved which are the measures for evaluating CPM performance. This in turn supports findings found in literature that construction project managers require project communication skills that entail elements such as trust and respect, objectivity, collaboration, leading by example and motivation which can be applied in decision-making, problem-solving conflict management, team-building and negotiation (Zulch, 2016).

## **6. FUTURE RESEARCH AND RECOMMENDATIONS**

As it was established that CPM's performance affects project performance, the findings from this study provide useful information to organizations involved in executing construction projects in South Africa. This information

can be used for making management decisions, identifying areas for training and development, and matching the right CPMs to the projects based on their skills and competence. Further, it is recommended that organisations employ the measures introduced in this study for evaluating CPM performance and ensuring that there's continuous development and training in order to enhance project and organisational performance. A failure to improve the performance of CPMs in the South African construction industry could have a negative impact on infrastructure development in the country.

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ASOCSA2018-049

## **Cost Overruns and Their Impact in The Business of Construction**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The main objective of the study was to identify core issues that need to be addressed in order to minimise and mitigate the effects of cost overruns on construction projects.

#### **Design/methodology/approach**

The empirical study was conducted using a quantitative statistical approach by distributing research questionnaires to members falling within the sample population.

#### **Findings**

The salient findings suggest that cost overruns on construction projects contribute to the following: construction project delays; inadequate standards and quality of the final product, and increased project costs due to increases in project duration. Furthermore, delays in project handover and ineffective Scope Management result in additional project costs.

#### **Research limitations/implications**

The sample population was limited to Built Environment Professionals registered with the South African Council for Project and Construction Management Professions (SACPCMP) and the Association of South African Quantity Surveyors (ASAQS) as well as members of the Master Builders Association (MBA) within South Africa.

**Practical implications**

The research study investigated the critical problem of cost overruns as well as the resultant effects on the South African Construction Industry as a whole.

**What is original/value of paper?**

This study will assist project stakeholders with measures to identify and mitigate the effects of cost overruns on construction projects.

**Response to the Conference Theme**

Construction and Project Management

**Keywords:** Construction; Cost Overruns; Estimating; South Africa; The Built Environment

**1. INTRODUCTION**

According to Rathi and Khandve (2016:334) the construction industry has become an important player in the economy of many countries and it contributes to the Gross Domestic Product (GDP) and employment rate of many nations and for this reason it is considered vital for the economic development of any nation. Consequently, Rathi and Khandve (2016:334) explain that cost overruns reduce competitiveness of the economy. Flyvbjerg (2008 cited by Brunes and Lind 2014:74) stated that costs are underestimated in the case of 90% of projects, and on average final construction costs are 28% higher than initial estimated costs. Cost overruns in construction projects lead to an increase in the capital-output-ratio for the entire economy as few projects are delivered in time and on budget.

Cost overruns occur for a number of reasons on construction projects which has resulted in a debate on how to minimise construction projects cost overruns. However, Memon, Rahman, Asmi, and Azis, (2010) states that in order to mitigate cost overruns, the first step to take is to identify and understand the factors responsible for the overruns. Therefore, the objective of this paper is to investigate the factors that cause cost overruns and the resultant effects of cost overruns on construction projects.

**2. CAUSES OF COST OVERRUNS ON CONSTRUCTION PROJECTS.**

Rathi and Khandve (2016:335) explained that the success of any construction project can be determined by meeting the set goals and objectives defined in the planning stage. A project may not be regarded as a successful endeavour until it satisfies the cost, time, and quality standards applied to it (Arcila 2012:486).

## **2.1 Variation orders**

According to (Arcila 2012:486) cost overruns can be defined as excess of actual cost over estimated budget cost. There are a number of factors that attribute to cost overruns. Variation orders are a major problem in the construction industry. Arian and Peng (2005b:181) defined a variation order as any modification or change to the contractual agreement provided to the contractor by the client. Enshassi et al. (2009:143) stated that a construction contract is a business agreement between parties and is subjected to variability. Construction projects are complex and they involve operations which cannot be accurately determined in advance and this leads to the occurrence of variation orders.

According to PMBOK (2013:47), Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. Scope management is primarily concerned with defining and controlling what is and is not included in the project. Variation orders involve change to scope, alteration, addition, omission, and substitution in terms of quality, quantity and schedule of work.

## **2.2 Accelerated increase in the cost of material on Construction Projects**

Material cost increase entails the increase in the actual cost of materials, taxes and shipping charges. When calculating the total cost of materials, it is essential to include the above variables. It is often difficult to estimate construction material costs accurately and price fluctuations in material costs may result in cost overruns if not allowed for. Price fluctuation can be attributed to variations in the prices of materials specifically in developing countries, South Africa included (Amoa-Abban and Allotey (2014:54).

Eshofonie (2008:19) added that material prices are subject to supply and demand and are also affected by other variables, including quality, quantity, time, location, buyer and seller. For example, the construction of the FIFA 2010 world cup stadiums had immense cost overruns. Even though the stadiums were completed and ready for the games, nearly all projects experienced cost overruns. Baloyi and Bekker (2011:7) attributed increases in materials cost as the leading factor to the cost overruns.

## **2.3 Inaccurate cost estimate on construction projects.**

According to Oyedele (2015:1), a construction cost estimate is the amount forecasted to finish a construction project. It is the possible amount that is calculated to complete a construction project. He further stated that it is also the predicted amount of a project based on the available data at the time of prediction. Oyedele (2015) argued that inaccurate cost estimate errors result in cost overruns. He further identified the following as the main types of

estimating errors: omissions; erroneous assumptions; price changes and inadequate estimates. Omissions include items that are accidentally left out of the estimate. Omissions may be attributable to items omitted from the plans and specifications and not included in the estimate or unavailable at the time tender. Furthermore, material costs or labour costs may rise giving way to price changes between the estimated cost and the final cost of the project.

## **2.4 Delays on Construction Projects**

According to PMBOK (2013:59), Project Time Management includes the processes required to manage the timely completion of the project. Delay in construction projects means the non-completion of a construction project within the time specified on the contract (Theodore (2009:37)). According to Theodore (2009:37) delays are classified into two categories. There are delays caused by the contractor and there are delays caused by the client. Furthermore, Theodore (2009:37) added that delays caused by contractors can be attributed to poor managerial skills, a lack of planning and a poor understanding of accounting and financial principles. In contrast, he added that delays caused by the client include the following factors: late submission of drawings and specifications, frequent change orders, and incorrect site information. Delays lead to cost overruns and the loss of the clients funding and in numerous instances the abandonment of the project.

## **2.5 Effect of Cost overruns on Construction Projects.**

Construction cost overruns affect the construction of the building and all stakeholders involved, from the client to the industry as a whole. Construction cost overruns affect the client's budget and results in addition costs higher than the costs initially agreed and this results in less returns on the client's investment. This results in higher rental and lease costs to the end user of the building due to the higher final project costs (Amoa-Abban & Allotey (2014:54)).

Mbachu and Nkado (2004) cited in Amoa-Abban & Allotey (2014:54) added that construction cost overruns affect the professionals and the contractor involved in the construction projects.

Construction cost overruns entail a loss of profit for non-completion and also defamation that could affect the contractor's chances of winning future contracts. Similarly, construction cost overruns imply that a professional has the inability to deliver projects on time and on budget and this could tarnish their reputation and client relationship.

Furthermore, Amoa-Abban & Allotey (2014:54) added that one of the most common effects of construction cost overruns is delays in completion of construction projects and that cost overruns prolong the duration of construction projects, which will result in more resources being allocated.

Cost overruns tarnish the relationship between the contractual parties and ultimately result in the inability to secure funding for future projects.

### **2.6 Proactive measures in the Construction Industry to reduce cost overruns.**

There are several measures which can be employed in the construction industry to minimise construction project overruns. These include: adequacy of funding; adequacy of plans and specifications; constructability; project manager commitment; risk identification and management and owner's feedback and involvement. Olawale and Sun (2010:24) cited in Mukuka (2014:12) identified the following four categories of measures that can be used to minimise cost overruns on construction projects: Preventive measures; predictive measures; organisational measures and corrective measures. He further added that preventive measures are precautionary measures that are put in place during the planning stage of a project as a defence to the causal factors. He further explained that using 3D modelling to test how the plan will work out is a predictive measure that could be used for the mitigation of complexity of works. Olawale and Sun (2010:25) added that corrective measures are reactive measures that only act after the event and they are utilised to mitigate the effect of the project control inhibiting factors by acting as a remedy. Lastly, organisational measures are measures generally encompassing practices that go wider than the actual control process but have an effect on project control.

## **3. RESEARCH METHODOLOGY**

For the purposes of this study questionnaires were distributed to Built Environment professionals who are members of the Master Builders Association and registered with the SACPCMP and ASAQS. The participants were selected randomly and consisted of construction managers, site agents, architects, project managers and quantity surveyors. The researcher also made use of the snowball method of sampling, thus all respondents had an equal share of being selected for the study. A questionnaire consisting of two sections was used for the study. Section A sought respondents' biographical data namely, sex, name, age, academic and professional qualification and Section B comprised of 10 questions.

Respondents were required to indicate the extent to which they agreed with a particular statement on a 5-point Likert scale. 32 responses were eligible for inclusion in the analysis of the data.

Thirteen Construction managers and Two Project Managers registered with the SACPCMP and CIDB, and seventeen members of the ASAQS responded to the survey. Therefore, the combined response rate was 53.0%.

#### 4. DISCUSSION OF RESULTS

The results pertaining to the frequency of the cost overruns revealed that 94% of the respondents experienced projects costs exceeding their estimated amount. Have your project costs exceeded the estimated amount?

Table 1: Frequency at which project costs exceed the estimated amount according to respondents

Unsure	Never.....Always					MS
	Never	Rarely	Sometimes	Often	Always	
3.13	0.00	25	56.25	15.63	0	3.94

In Table 1, majority of the respondents stated that sometimes their projects experienced cost overruns. A Mean Score ranging between  $> 3.40$  to  $\leq 4.20$  indicates that respondents can be deemed to experiences project costs exceeding the estimated amount between sometimes too often.

Table 2: Extent to which certain factors contribute to projects costs exceeding the budgeted amount on construction projects.

Factor	Response (%)						MS	Rank
	Unsure	Minor.....Major						
		1	2	3	4	5		
Delays in project handover	0.00	0.00	3.13	18.75	9.34	36.70	4.44	1
Inadequate planning	0.00	3.33	10.00	20.00	36.70	30.00	4.22	2
Poor project management	0.00	6.25	9.38	6.25	28.13	50.00	4.06	3
Design errors	0.00	3.13	12.50	12.50	37.50	31.25	3.89	4
Changes to scope	0.00	3.13	12.50	18.75	25.00	40.63	3.88	5
Complexity of designs	0.00	6.25	28.13	12.50	21.88	31.25	3.44	6
Material price increases	0.00	9.38	18.75	12.50	37.5	21.88	3.43	7
Inaccurate cost estimating	12.50	15.63	31.25	31.25	6.25	3.13	2.53	8
Unforeseen site conditions	6.25	15.63	31.25	28.13	9.38	9.38	2.30	9
Late delivery of materials	0.00	100	0.00	0.00	0.00	0.00	1.00	10

Table 2 indicates the extent to which factors contribute to project costs exceeding the estimated amount in terms of percentage responses to a range of 1 (minor) to 5 (major), and a MS with a minimum value of 1.00 and a maximum value of 5.00. 7 out of the 10 factors have MSs  $> 3.00$ , which indicates that the respondents collectively can be deemed to perceive the factors contribute to project costs exceeding the estimated amount to a major opposed to a minor extent, as in the case of MSs  $\leq 3.00$ . The top five factors which contributed to cost overruns were delays in project handover, inadequate planning, poor project management, design errors, changes to scope respectively.

The respondents perceived that first ranked delays in project handover have a major extent with regards to project costs exceeding the estimated amount. Inaccurate estimating by project team ranked eighth. Changes to scope ranked fifth among the factors that contributed to cost overruns. Material price increases ranked seventh. It can therefore be concluded that the hypotheses are supported by the research findings.

Table 3: Extent to which cost overruns contribute to the following factors on construction projects

Factor	Response (%)						MS	Rank
	Unsure	Minor.....Major						
		1	2	3	4	5		
Construction project delays	0.00	0.00	0.00	6.25	46.88	46.88	4.41	1
No standard and quality on final project	0.00	0.00	3.13	3.13	46.88	46.88	4.31	2
Increased project cost due to duration	0.00	3.13	3.13	15.63	31.25	46.88	4.16	3
Constraint of client's capital	0.00	0.00	0.00	31.25	40.63	28.13	3.97	4
Abandonment of projects	0.00	6.25	6.25	15.63	31.25	40.63	3.94	5
Contractor insolvency	0.00	0.00	12.50	15.63	40.63	31.25	3.91	6
Under-utilisation of plant and equipment	0.00	6.25	12.50	31.25	31.25	18.75	3.47	7
Under-utilisation of manpower	0.00	6.25	15.63	31.25	31.25	15.63	3.34	8

Table 3 indicates the extent to which certain factors affect construction projects in terms of percentage responses to a range of 1 (minor) to 5 (major), and a MS with a minimum value of 1.00 and a maximum value of 5.00.

All of the 8 factors listed in Table 4.3 have MSs > 3.00, which indicates that the respondents collectively can be deemed to perceive that the effects of cost overruns on construction projects have a major extent. The top five ranked factors were construction project delays, no standard and quality on final project, increased project cost due to duration, constraint of client's capital, abandonment of projects respectively.

Table 4: Extent to which the following interventions help minimise cost overruns on construction projects.

Factor	Response (%)						MS	Rank
	Unsure	Minor.....Major						
		1	2	3	4	5		
Proper project management	0.00	3.13	3.13	0.00	46.88	46.88	4.28	1
Adequate planning	0.00	0.00	0.00	15.63	46.88	37.5	4.22	2
Allocation of adequate project duration	0.00	3.13	3.13	18.75	28.13	46.88	4.13	3
Sound pre-contract estimates	0.00	0.00	0.00	21.88	46.88	31.25	4.09	=4
Accurate initial cost estimates	0.00	3.13	3.13	15.63	37.50	40.63	4.09	=4

Proper pre-contact planning	0.00	3.13	3.13	15.63	46.88	31.25	4.00	=6
Adequate designs	0.00	0.00	9.38	12.50	46.88	31.25	4.00	=6
Decrease amount of variation orders	0.00	3.13	9.38	9.38	46.88	31.25	3.94	=8
Proper pre-tender estimates	0.00	0.00	15.63	6.25	46.88	31.25	3.94	=8
Appointment of experienced contractor	0.00	9.38	12.50	9.38	21.88	46.88	3.84	10
Adequate structural designs	0.00	3.13	6.25	31.25	31.25	28.13	3.75	11
Employment of experienced site workers	0.00	3.13	3.13	31.25	46.88	15.63	3.69	12
Use of appropriate materials	0.00	15.63	6.25	40.63	15.63	21.88	3.22	13
Comprehensive client brief development	3.13	6.25	31.25	40.63	12.50	6.25	2.88	14
Proper procurement method	0.00	18.75	28.13	46.88	3.13	3.13	2.44	15
Sound workmanship	0.00	53.13	15.63	21.88	6.25	3.13	1.91	16

Table 4 indicates the extent to which the following interventions help minimise cost overruns on construction projects. in terms of percentage responses to a range of 1 (minor) to 5 (major), and a MS with a minimum value of 1.00 and a maximum value of 5.00. 13 out of the 16 factors listed in Table 4 have MSs > 3.00, which indicates that the respondents collectively can be deemed to perceive that the stated mitigating factors have a major extent on construction projects. 3 out of the 16 factors listed in Table 4 have MSs < 3.00.

## 5. CONCLUSION AND FURTHER RESEARCH

Construction cost overruns occur frequently in the construction industry and greatly affect the success of most projects in developing and developed countries with South Africa included. The current study revealed that delays, ineffective scope management and late procurement of materials are major causes of cost overruns. Research also showed that construction cost overruns typically occur during the construction phase of construction projects.

In an attempt to reduce the problem of cost overruns, all construction industry stakeholders should have the relevant education and be made aware of the importance of cost control in a project and the construction

industry as a whole. In this context, the contractors employed by the client are experienced and have a good track record and construction managers should use modern management systems and up to date technology such as Building Information Modelling (BIM) to help mitigate cost overruns. Further research should be conducted on the effectiveness of procurement systems in construction.

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## **Aligning educational strategies & learning styles with teaching construction management students**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

Construction management students in general are confused as to how to approach the material of this challenging course. This article reports the findings of a study done to determine the study methods used by undergraduate construction management students.

#### **Design/methodology/approach**

A literature review was done to develop a quantitative questionnaire to determine which part of the brain was predominantly used by third year construction students. Contributing factors included the influence of teaching styles on learning styles, the effect of learning style preference on academic achievement, and the correlation between brain dominance and learning styles. A total of 22 third year construction management students participated. A weighted average is critically discussed to provide an overview of the brain quadrant dominance of students.

#### **Findings**

The results showed that construction management students have a

distributed learning style preference, and also that most of these students make use of more than one quadrant of the brain when learning.

#### **Research limitations/implications**

A limitation of this study was that it only included students from the Department of Construction Economics at the University of Pretoria.

#### **What is original/value of the paper**

Construction management students are not fully logical, methodical, visual or kinaesthetic; however they make use of a variety of learning styles. Teaching techniques from informative lecturers should present study material accordingly.

**Keywords:** Brain dominance, Construction management students, Learning styles, University of Pretoria.

## **1. INTRODUCTION**

There are many terms and definitions used to describe learning styles which are used interchangeably between different scholars. Some of the learning terms that are used are: learning approaches or approaches to learning, learning conceptions and learning profiles (Rogowsky, Calhoun & Tallal, 2015). According to Entwistle and Ramsden (1983) learning styles is defined as the different ways or means in which a student learns. According to López, Almerich Cerveró, Suárez Rodríguez, García Félix and Garfella Esteban (2012) "Approaches to learning are understood to be learning processes which learners establish in order to deal with an academic task, and they originate from the learners' perceptions of the task and from their attributes". Seven main learning style methods were reviewed with the objective to gain a basic understanding of their characteristics. These are: deep approach, surface approach, visual approach, auditory approach, kinaesthetic approach, logical approach and methodical approach.

## **2. LEARNING STYLE METHODS**

### **2.1 The deep and surface learning approaches**

A paradigm that had and continues to have a large impact across various studies worldwide is known as the deep and surface approaches to learning. Some students try to understand the meaning of the text while others take the text literally and reproduce what was given in the text (Loyens, Gijbels, Coertjens, & Côté, 2013: 24). When adopting a surface

approach, students tend to be preoccupied with memorising and rote learning material (Prosser & Trigwell, 1998: 250).

### **2.1.1 Deep approach to learning**

According to Svensson (1977: 233-243) when adopting a deep approach, students tend to analyse and reinterpret the study material in order to understand its broader meaning and to be able to use the knowledge in other contexts. Their focus is on the main themes and principles of the information in which they try to gain an understanding of it. Schmeck and Geisler-Brenstein (1989: 9) put forward that those students with a deep approach “dig for the deeper meaning behind the words”. They also make use of global and analytic information processing in alternation or synthesis. Schmeck and Geisler-Brenstein (1989: 11-12) also explain that students using this approach are analytic, linguistic and have better control of their cognitive resources and thus do not rely heavily on external cues. According to Loyens *et al.* (2013: 24) many researchers have found that the deep approach demonstrates a higher quality of learning and thus students demonstrate greater academic achievement than students using a surface approach.

### **2.1.2 Surface approach to learning**

A contradictory approach to the deep approach to learning is the surface approach to learning. A distinctive feature of students who take a surface approach to learning is that they tend to take the information just as it is found, literally (Schmeck & Geisler-Brenstein, 1989: 9). They are preoccupied with memorising the text which, Loyens *et al.* (2013: 24) refer to as rote learning. A student using surface approach to learning reproduces the content of the syllabus which becomes habitual. In other words, one tries to memorise this information as much as the literal memory permits without creating links between the different pieces of information (Loyens *et al.* 2013: 24).

They can accumulate more facts than students using a deep approach, but they fail to gain a greater understanding of the text (Schmeck & Geisler-Brenstein, 1989: 10). Students with a surface approach to learning take things literally because they feel it is inappropriate to challenge the work that has been done by someone else who is assumed to have a superior intellect. This leads to reproducing the facts as stated in the text without understanding the deeper meaning and avoid developing their own conclusions. Schmeck and Geisler-Brenstein (1989: 11) defines this as “avoidance of deep processing”. By avoiding deep processing, one fails to integrate global and analytic skills, thus leading to the avoidance of

integration when processing information (Schmeck & Geisler-Brenstein, 1989: 11).

## **2.2 Visual approach**

Students with a visual approach have active imaginations in which they create mental images of the text in order to remember its content. A visual student's metacognitive characteristic is setting goals and objective goals. Activities of this approach include: extensive reading, written instructions, using outlines, flash cards or summaries, TV, videos and the internet (Psaltou-Joycey & Kantaridou, 2011: 110).

According to Bothma, De Boer and Du Toit (2001: 13), visual students facilitate internal learning. This is described as "an insight, visualisation, the synthesis of data or through the understanding of concepts holistically or intuitively".

## **2.3 Auditory approach**

According to Psaltou-Joycey and Kantaridou (2011: 110), auditory approach encompasses a representation of sound in a person's memory. The cognitive aspect of this approach is note-taking from auditory input such as listening to lectures. A student with a strong auditory memory is inclined towards using songs and music as part of their learning technique (Psaltou-Joycey & Kantaridou, 2011: 110).

## **2.4 Kinaesthetic approach**

Kinaesthetic approach includes mimes and gestures. It involves using a physical response to the tasks given. A student using a kinaesthetic approach can easily cooperate and collaborate with others. They enjoy making posters, collages, activities that allow students to move around and change groups frequently. It also consists of role playing and activities that make authentic use of language (Psaltou-Joycey & Kantaridou, 2010:110).

## **2.5 Logical approach**

Logical students can also be described as students who use a deep approach to learning. Loyens *et al.* (2012: 24) describes students using a deep approach to learning as follows: "A deep approach to learning has typically been measured as a student's intention to understand content together with the processes of relating and structuring ideas, looking for underlying principles, weighing relevant evidence, and critically evaluating knowledge".

As discussed earlier by Schmeck (1983: 233-279), analytical learners who are referred to as operation learners process information in a very structured and sequential manner. Their focal point of processing information is on the finer details. This is achieved by analysing the facts in detail by going through them step-by-step. Schmeck (1983: 233-279) describes them as people who “sees the trees but misses the forest”.

## **2.6 Methodical approach**

According to Bothma *et al.* (2001: 18) methodical students use an organised and consistent approach to studying. They facilitate learning by outlining, summarising, making checklists and enjoy following procedures when studying (De Boer, Bothma & Du Toit, 2001). Methodical students place emphasis on staying on track and on time with their studying (Bothma *et al.*, 2001:18). They prefer exercises and problem solving that require particular steps to be followed (De Boer, Bothma & Du Toit, 2001).

## **3. LEARNING STYLES AND TEACHING STYLES**

As suggested by Corina, Ioan, Cristina and Mihaela, 2011: 257), compatibility between teaching styles and learning style is helpful to students who prefer to have more autonomy and less personal interaction. Due to the fact that students have various learning style preferences, lecturers should adopt a flexible teaching approach (Corina *et al.*, 2011: 257).

A significant view suggested by Corina *et al.* (2011: 257) is that students in higher education are often exposed to a variety of teaching styles by different lecturers; hence they should have the capacity to adjust their learning styles accordingly. They must become better by “investing extra effort in their underdeveloped or unused cognitive styles”. Corina *et al.* (2011: 257), suggests that students must learn to adapt to the lecturers teaching style by means of training or practice. By doing so, a student will develop learning skills that are necessary to cope with situations that require various learning requirements.

## **4. BRAIN DOMINANCE**

According to Bothma *et al.* (2001: 12), the left and the right hemisphere represent cerebral processes and the two halves of the limbic system represent the more visceral processes. It is explained by Bothma *et al.* (2001: 12), that each quarter has specific clusters of cognitive functions. According to Herrmann (cited: Bothma *et al.*, 2001: 12), if a person is dominant in A-quadrant, then the person is inclined to activities that involve logical, analytical and fact-based information. If a person uses B-quadrant

then the person prefers organised, planned and sequential information. A preference for C-quadrant means that a person favours information that is interpersonal, feeling-based and involves one's emotions. If a person prefers D-quadrant then the person uses a holistic and conceptual approach to thinking. It is suggested by Bothma *et al.* (2001: 12), that even though a person may favour the usage of a particular quadrant, "both hemispheres contribute to everything, but contribute differently".

## 5. METHODOLOGY

The study used a quantitative research approach as the research involves numbers and measurement (data to be collected) and thus emphasising frequencies and statistics (expressed in numbers) (Struwig & Stead, 2001:7; Leedy & Ormrod, 2005: 179). Because the study is focused on information seeking behaviour around the current learning styles that undergraduate construction management students make use of, a survey research method was deemed the most appropriate for this study (Courtright, 2007: 273).

Williams (2007: 67) classify a survey as a standard quantitative research method. Survey research involves acquiring information about one or more groups of people, perhaps about their opinions, characteristics, attitudes, or previous experiences, by asking questions and tabulating the answers. The ultimate goal is to learn about a population by surveying a sample of it (Leedy & Ormrod, 2005: 183). Survey instruments can be broadly classified into two categories, namely questionnaires and interviews (Boubala, 2010: 55). This study used structured questionnaires to collect and analyse data gained from undergraduate construction management students.

### 5.1 Data collection

The department of Information Science assisted in formulating the questionnaire. The questionnaire formed part of a left brain right brain assessment test that was previously approved through an ethics committee. The comprehensive questionnaire consisted of 24 short questions on various learning style preferences and was based on information reviewed from the seven main learning style methods including: deep approach, surface approach, visual approach, auditory approach, kinaesthetic approach, logical approach and methodical approach.

The questionnaire was used as a survey tool to collect data from undergraduate construction management students to identify their preferred learning style approach. For the purpose of this study, the data that was collected and reflected in parallel with the literature review. The questionnaires were handed out to the students during one of their weekly

classes. All data gathered from or with this questionnaire is strictly handled with utmost confidentiality. Students were not required to put their names on to the questionnaires so as to maintain privacy of information. The researcher was present when all the questionnaires were handed out and filled in by the students. The researcher was available to answer any questions and uncertainties by the students regarding the questionnaire. A total of three lecturers, who are currently working in the department of construction economics, accompanied the researcher.

## **5.2 Sampling**

Data was gathered from one independent population on the same day. The population comprised of 40 construction management students who are also in their third year of studies at the University of Pretoria. Students were selected based on their time availability and was conducted on a voluntary basis.

## **5.3 Response rate**

A positive response of 22 out of 40 questionnaires were successfully completed and collected, which means a response rate of 55 % was achieved for this questionnaire.

## **5.4 Data analysis**

A 5-point Likert scale was used to obtain the opinions of the respondents and to analyse the results. Likert-type or frequency scales use fixed choice response formats and are designed to measure attitudes or opinions (Bowling, 1997; Burns, & Grove, 1997). These ordinal scales measure levels of agreement/disagreement. For the purpose of analysis and interpretation, the following scale measurement was used where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. All 4 brain quadrants were represented by 6 questions that were randomly numbered in the questionnaire to ensure reliability and validity. Weighted averages for each of the questions were also used to provide a more in depth analysis of the data that was collected. The results of the analysis were used to determine brain dominance per quadrant. Furthermore the results were directly associated with the preferred learning styles of these construction management students.

## 6. RESULTS AND FINDINGS

The results discussed below represent the strongest single quadrant preference gathered from the construction management participants. The survey indicated that 35% of the construction management respondents prefer a logical approach to learning. They are inclined towards analytical, fact-based and quantitative manner of learning. A weighted average of 3.00 indicates that these respondents are neutral towards collecting and analysing facts, ideas and theories. They do however, prefer when the lecturer explain the subject matter clearly and they seem to learn more when they are presented with informative lectures. This reflected weighted averages of 4.55 and 4.27 respectively.

When respondents were asked whether they preferred clear, brief and to the point information coupled with expert sources, they rated the question as follows: 0 % strongly disagree, 0 % disagree, 9 % are neutral, 59 % agree and 32 % strongly agree. This rating suggests that the respondents have a strong response to information that is conveyed to them in a concise and accurate manner. The overall analysis of quadrant A revealed a high quadrant weighted average of 3,86.

It was found that only 24% of construction management respondents are in favour of a methodical approach to learning.

The research findings suggest that construction management students have a strong preference for content that is organised into lists, outlines and categories. This showed a weighted average of 4.36. When construction management students were asked whether they get frustrated with open-ended activities and discussions, their response to the question was as follows: 9% strongly disagreed, 23% of the respondents disagreed, 50% were neutral, 18% agreed and 0% strongly agreed. This resulted in a weighted average of 2.77 which lead to the conclusion that construction management students are neutral to having open-ended activities or discussions and are neutral to the exploration of ideas.

The overall analysis of information gathered, reflected a quadrant weighted average of 3.67 for quadrant B.

The survey highlighted that 22 % of the respondents have a preference to quadrant C. Respondents who are dominant in this quadrant make use of a kinaesthetic approach to learning. They are also attributed to being interpersonal, feeling-based and emotional.

The survey further indicated that these respondents enjoy hands-on, active instructions which allow them to move around. This revealed a weighted average of 3,95. They are inclined towards getting to know other students as well as discussing ideas with them. This scored a high weighted average of 3,68 by the respondents.

A calculated weighted average of 3,77 indicates that construction management respondents enjoy class discussions through which they may express their ideas with others as well as be exposure to other ideas. This response is significantly higher than the weighted average of quantity

surveying respondents who only scored an average of 2,92 for this question.

Respondents were asked whether they preferred to receive personal attention, care and acceptance from the lecturer with smiles and good eye-contact. They rated the question as follows: 0 % strongly disagrees, 36 % disagree, 32 % are neutral, 18 % agree and 14 % strongly agree. This resulted in a weighted average of 3,09.

The survey also demonstrated that these respondents appreciate hearing personal stories from the lecturer that connect to the topic that they are being taught about. A high weighted average of 4,09 was found. Respondents dominant in quadrant C reflected a weighted average of 2,86 when they were asked if they disliked competition amongst classmates and whether they needed to feel comfortable with everyone in the class in order for them to learn.

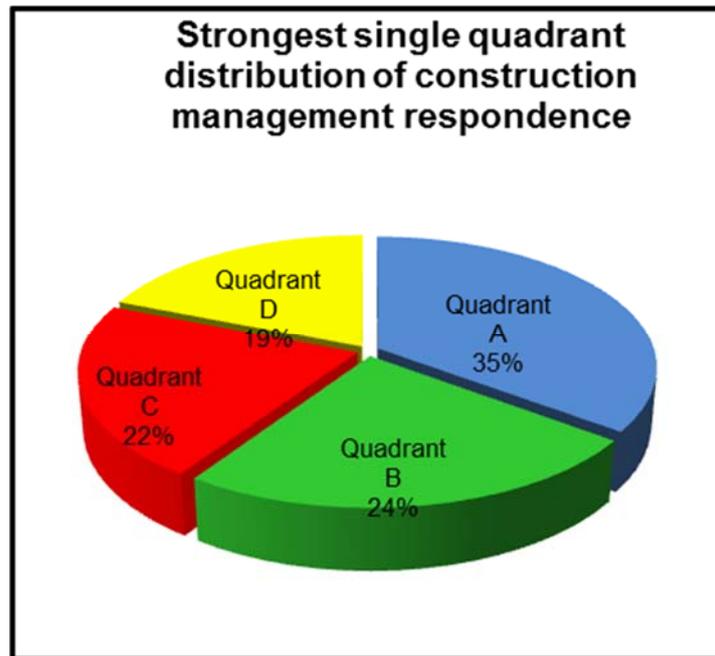
A quadrant weighted average of 3,58 was found which reflects the lowest average when compared to the other quadrant averages for the construction management respondents.

Quadrant D showed that 19% of the construction management respondents adopted a visual learning approach. The survey revealed that respondents who are dominant in quadrant D strongly prefer to have lectures that make use of visuals that illustrate patterns, relationships and connections. This is represented by a weighted average of 4,09.

The survey highlighted that it is crucial for these respondents to see the big picture whenever a new unit of work commences. A weighted average of 4,36 was calculated.

A weighted average of 3,50 showed that is important for construction management respondents to choose how things should be done and they prefer having numerous options available to them. These respondents welcome opportunities when lecturers give them freedom to explore ideas, to make discoveries and to solve problems independently. This is shown by a weighted average of 3,64. The survey illustrated that they are inclined to variety and change in the classroom by a weighted average of 3,73.

When respondents were asked as to whether they become frustrated with structured lectures especially if it contains many lists and outlines, they rated the question as follows: 23 % strongly disagree, 23 % disagree, 50 % remain neutral, 5 % agree and 0 % strongly agree. This means that the majority of respondents like it when lectures are well structured and when they contain lists and outlines. The overall analysis of quadrant D revealed a quadrant weighted average of 3,61 by the respondents.



**Figure 6.1 Distribution of brain dominance in construction management students**

Figure 6.1 above illustrates the distribution of construction management respondents with regard to their brain dominance. It can be concluded that 59 % of the population make use of the left side of their brain (Quadrant A and B) more than the right side (Quadrant C and D).

This indicates that lecturers need to explore teaching methods that touch on all four quadrants, i.e. slides, bullets, class discussions etc.

## 7. CONCLUSIONS

This study was conducted with the aim of determining the learning style preferences of construction management students as well as whether or not a difference in learning style preferences exists among construction management students. Relevant literature was studied by looking at seven main learning style methods to try and gain a basic understanding of their characteristics. These learning style methods are: deep approach, surface approach, visual approach, auditory approach, kinaesthetic approach, logical approach and methodical approach. The literature was reviewed as a background setting of learning styles used by students in order to

compare the data that was collected from the construction management students at the University of Pretoria.

The core purpose of this questionnaire was to determine the preferred learning style approach of undergraduate construction management students. It was found that construction management students have a distributed learning style preference. It has become clear that most of the construction management students make use of more than one quadrant of the brain when learning.

The sub-question aims at identifying the preferred learning style method(s) used by construction management students.

Even though findings of the study show that construction management students have a distributed learning style preference, it also revealed that students have a strong preference towards a methodical and visual approach to learning. A small percentage of the construction management students prefer to use a kinaesthetic approach to learning.

Analysis results indicate that construction management students are not fully logical, methodical, visual or kinaesthetic, but they make use of a variety of learning styles. Lecturers therefore need to incorporate a variety of teaching styles. A greater focus should be aimed at a logical learning approach. This involves teaching techniques that require students to critically analyse information as well as solving problems. Lectures must be informative as this contributes to effective learning. Lecturers should also demonstrate authority and explain the subject matter in a clear manner. Lecturers should focus on conducting individual assignments rather than group assignments.

Construction management students strongly prefer to use a logical approach when learning and therefore make use of visual mechanisms such as diagrams, flow charts and pictures that facilitate their learning style. This is the third most preferred learning style and needs to be implemented.

The study found that a kinaesthetic approach to learning is the least preferred manner of learning amongst construction management students and hence this seems to be an opportunity to conduct further research to try and gain further insight regarding this low preference.

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# **Barriers preventing the implementation of environmental sustainability in social infrastructure projects – Exploratory study of health infrastructure projects in Cape Town, Western Cape, South Africa**

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## **ABSTRACT AND KEYWORDS**

### **Purpose of this paper**

This study investigated barriers preventing effective implementation of environmental sustainability in health infrastructure projects and the effectiveness of current measures put in place towards the achieving environmental sustainability on construction sites.

### **Research Methodology**

The research approach adopted included a study targeting purposively selected construction firms that are involved or have been involved in health infrastructure projects around Cape Town, Western Cape Province. An exploratory study was carried out to gain more insight into the concept of environmental sustainability and barriers affecting its implementation.

Specifically, data was collected by means of semi-structured interviews with relevant parties directly involved in project operations. The study obtained data from four construction firms via interviews which are involved in construction of health facilities and had agreed to be interviewed.

### **Finding**

Two construction managers and two health and safety managers working on four construction sites were interviewed. The findings revealed that cost, time, climate change, process control, leadership and communications are the barriers to implementation of environmental sustainability in health infrastructure projects. Moreover, the findings revealed that there is no standard plan put in place or policies that ensure the implementation of environmental sustainability; thus, construction firms have their own ways which are efficient and cost effective in ensuring sustainability. The research concludes by recommending that a more detailed analysis is required and that attention should be focused on the concept of environmental sustainability, because, if one of the pillars of sustainability is weak then the system as a whole is unsustainable.

### **Research Limitations**

This study was limited to construction firms that are involved in health infrastructure projects around the Western Cape Province.

### **Value of the paper**

This study will be of great importance to all stakeholders including; contractors, consultants (Architects, Builders, Quantity Surveyors, Engineers, and Project Managers) and clients operating in the construction industry in ensuring that a detailed analysis is carried out and that attention should be focused on the concept of environmental sustainability, because, if one of the pillars of sustainability is weak then the system as a whole is unsustainable.

### **Keywords**

***Construction Industry, Environmental Sustainability, Health Infrastructure, Social Infrastructure***

## **1. INTRODUCTION**

The concept of sustainability has been growing in importance over the past two decades, and it currently forms a cornerstone of most developments and socio-economic activities in the construction industry [World Commission on Environment and Development (WCED), 1987]. Sustainability is one of the most vital concepts that the world is looking at, especially in developing countries as the population increases and this raises the need for a lot of social infrastructures to be implemented. With

technology evolving, all these infrastructures must be developed as effectively as possible but without compromising the resources for the use of future generations. Environmentally friendly developments must be considered and ways of implementing it effectively should be looked at (Resnick, 1994). South Africa is a developing country and the need for social infrastructure projects is increasing because of the surge in population. An infrastructure project is a kind of public good in which government policy has an important role to influence the effects of the project on economic development and social needs and are intended for delivery of those basic needs and services such as provision of housing, sports facilities, roads and transport, schools and welfare infrastructures (World Bank 1994; Shen, Wu & Zhang, 2011). The more the projects, the greater one has to look into the concept of sustainability especially during the construction and operation phase of these infrastructures to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs (Kates, Parris and Leiserowitz, 2005). Infrastructure projects play major roles in economic, social, and environmental activities, particularly in developing countries including South Africa. Hence the sustainability performance of infrastructure projects should be properly assessed when considering implementation (Shen *et al.*, 2011). The three pillars of sustainability include Economy, Social and Environment, however, the environmental aspects of sustainability in social infrastructure projects are not effectively assessed (World Bank, 2006), and this implies that if one of the pillars is weak then the system is unsustainable. For that reason, the focus of this paper is on one factor of the pillars, which is environmental sustainability, particularly in a case of health infrastructure project as one of the basic needs in communities. Hence, the study aims to identify the factors that affect environmental sustainability in health infrastructure projects, and the lack of adherence to policies that informs its implementation.

## **2 ENVIRONMENTAL SUSTAINABILITY IN HEALTH INFRASTRUCTURE PROJECTS**

### **2.1 Importance of health infrastructure projects**

Infrastructure is the foundation for planning, delivering, evaluating, and improving public health. Research has shown that for all the health services to operate efficiently, it depends on the presence of basic infrastructure. Health infrastructures play a major role in our society and therefore are part of our everyday lives and it is important that they are constructed in an area that is accessible to the nearby communities (Fokazi, 2012). According to Turnock (2001) and Baker and Koplan (2002), health infrastructure provides communities, states, and the nation the capacity to prevent disease, promote health, and prepare for and respond to both emergency

and ongoing challenges to health. Health departments are also considered primary players because strong infrastructures depend solely on them. Federal agencies rely on the presence of solid health infrastructure to support the implementation of their health programs, policies and to respond to health threats, even others from different countries.

## **2.2 Concept of environmental sustainability in health infrastructure projects**

The built environment accounts for 45% of total South African carbon emissions (27% from domestic buildings and 18% from non-domestic), 72% of domestic emissions arise from space heating and the provision of hot water, 32% of landfill waste comes from the construction and demolition of buildings and 13% of products delivered to construction sites are sent directly to landfill without being used (Construction excellence, 2008). Similarly, construction, operation, and deconstruction activities in health care facilities like hospitals consume large amounts of energy, raw materials, and water which is about 20% of the energy consumed and carbon dioxide emitted (Zhang, Yang, Zhu & Wu, 2005). The adverse environmental effects from construction activities have been thoroughly dealt with (Shen *et al.*, 2007; Tse, 2001; Tam & Le, 2007), including usage of energy, dust and gas emission, noise pollution, waste, misuse of water resources and consumption of non-renewable natural resources (Shen *et al.*, 2005; Chen *et al.*, 2000). For this reason, Zhang *et al.* (2005) opine that energy conservation, prevention of pollution, efficiency of resources are very important factors for environmental sustainable construction. These factors include an initial phase: a construction project consumes various environmental resources including soil, minerals, water, plants and animals in all their biological and genetic diversity. Hence, in every construction project, the environment must be considered. If the methods adapted use a huge amount of non-renewable resources or generates a lot of waste, then the environment will be degraded. Environmental preservation must be valued, and it is crucial that the construction methods we use promote that or come up with ways that covers up for the loss that is being made.

Health infrastructure play a major role in our society and therefore are part of our everyday lives. It is important that they are constructed in an area that is accessible to the nearby communities, therefore making environmental sustainability a vital issue to look at especially during the construction of those infrastructures (Zimmermann, 2005). The surrounding and everything that affect an organism during its lifetime is mainly known as its environment (Zimmermann, 2005). This means that environment is the total sum of water, air and land all together and the relationship they have with human being, other living organisms and properties. It includes all the physical and biological surrounding and their interactions. According to Morelli (2011), environmental sustainability is a state in which the demands placed on the environment can be met without compromising its ability to

allow all people to live well, meeting both the now and future needs. This is the maintenance of natural capital connected to both social sustainability and economic sustainability (Morelli, 2011). Foy (1990) explained that from an environmental standpoint, sustainability requires that current environmental activities do not disproportionately burden future generations. Whether one considers sustainability to consist of the environment, the economy, and society, or as a relationship between human beings and the ecosystem, there should always be an agreement that ensuring the provision of clean air, clean water, and clean and productive land is foundational to a responsible socioeconomic system especially in as far as construction activities are concerned. It is visible that, without a sustainably productive environment, it would be difficult or impossible to expect a sustainable society (Foy, 1990).

### **2.3 Barriers to implementation of environmental sustainability in health infrastructure projects**

The main challenge for the industry is to reduce the impacts of its activities on the environment and local communities. To have a sound and more sustainable construction industry, contract parties must take the leadership role in such transformation (Zhang, 2005). One of the major barriers to environmental sustainability is cost. Regardless of personal commitment to sustainable environment, and often the client's intention to choose a sustainable environment approach, the costs involved in opting for and implementing such a solution are usually an overriding barrier. In most cases you discover that there is no enough funding for public health care centre projects (Yami and Price, 2006).

## **3. METHODOLOGY**

There has been limited research undertaken in South Africa with regard to environmental sustainability in social infrastructure projects such as health facilities. As a result, an exploratory research approach was adopted to investigate the factors that affect environmental sustainability in health infrastructure projects, and the lack of adherence to policies that informs its implementation. The survey was conducted among construction firms who are registered with the Construction Industry Development Board (CIDB) because they are the ones acquainted with daily construction works and will be able to give in detail the factors or rather shortcomings that they encounter in adopting environmentally sustainable measures during construction. Purposive sampling method was adopted to select four construction projects based in Cape Town. These projects were selected on pragmatic consideration, that is their availability. Purposive sampling consists of handpicking purportedly typical or interesting cases. It is a useful sampling method consisting of receiving information from a sample of the

population that one thinks knows most with regard to the subject matter. According to Yin (2009), there is no ideal number of cases that should be undertaken. The primary data was obtained via semi-structured interviews administered to relevant parties involved in site operations including two construction management team and two health and safety officers. A framework of questions for the interview was designed to gather information with regard to the barriers preventing the implementation of environmental sustainability and measures in place towards the implementation of environmental sustainability in health infrastructure projects. Respondents were first informed of the focus of the interview prior to meeting. The verbal arrangement was thereafter confirmed in writing with a cell phone text message to highlight the purpose of the interview. The semi-structured questionnaire was sent as an attachment with the cell phone text message and this approach aided the interviewees to prepare adequately for the interview in advance. Three face-to-face interviews were phone-recorded and subsequently transcribed, the telephonic interview was recorded through notes. Both the transcribed and written data was analysed using content analysis.

## 4 FINDINGS AND DISCUSSIONS

### 4.1 Profile of respondents

Table 1 depicts the occupations of the respondents; it is evident that four respondents were interviewed. These were the only respondents on the sites who had relevant information regarding the content of the study and were thoroughly acquainted with the details of the projects including its nature and all project construction activities. Two of them were construction managers, while the remaining two were health and safety officers. The respondents were asked to indicate the number of years they have worked in the construction industry. It is evident that the experience for the interviewees in the construction industry ranged from 2 to 5 years. With respect to gender, it is evident from table 3 that 75% (3) of respondents were males and 25 (1) was a female, and this suggests both gender participated in the study but not equally represented. It is important to note that all respondents had tertiary learning qualifications, including National diploma (2) BTech / Bachelor degrees (1), and BSc (Hons) (1).

**Table 1:** Profiles of respondents

Project	Position	Gender	Qualification	Experience	Duration	Location	Means for recording
A	Construction manager	Male	BTech	4 years	30min	Remote	Telephone interview
B	Construction manager	Male	B(Hons)	3 years	30min	Site office	Phone-recording

							and notes
C	Health and safety officer	Female	ND	5 years	30min	Officer's Office	Phone-recording and notes
D	Health and safety officer	Male	ND	2 years	45min	Officer's office	Phone recording and notes

## 4.2 Analysis of the discussions

### 4.2.1 Barriers preventing the implementation of environmental sustainability in projects

Interviewees were asked to indicate barriers preventing the implementation of environmental sustainability in their project. According to the project manager in Project A, one of the factors that have been a major cause of environmental sustainability not to be effectively implemented is cost. The respondent indicated that *“as a company, if we are to adopt a more sustainable design and construction, we will incur a lots of costs which is however a valuable benefit to the market value. Hence, making a comparison between the capital costs of sustainable building techniques mainly with those of traditional buildings and prove their worth, will motivate stakeholders to consider and use methods of sustainable construction”*. The respondent further indicated that *“...nowadays, the costs associated with sustainable practices in the short-term are perceived to be excessively high and therefore cannot justify our application in this highly competitive market. This now becomes a barrier for us to implement environmental sustainable practices on our construction sites”*.

The respondent in Project B indicated that lack of knowledge, lack of experience and economic stability and considerations play a major role in hindering the implementation of environmental sustainability. With reference to the barriers, the interviewee cited an example by stating that *‘South Africa is a developing country and construction is also growing. Environmental sustainability is one of those concepts that if it is not taught you can never implement the concept during construction of a project. So as emerging companies, we are all after providing what the client wants, and we never consider other issues such as environmental sustainability. We do not have experience and certainly do not have sufficient capital to implement measures that ensure environmentally sustainable construction’*.

In project C, the health and safety officer stated that the barriers preventing effective implementation of environmental sustainability in their project is time constraint. *“All these new ways of construction that seems to be environmentally sustainable need a lot of time to plan and this may lead to delays and additional costs”*.

In project D, the health and safety officer’s response to the question regarding the barriers preventing effective implementation of environmental

sustainability in their project was “... *poor project planning, where if there is poor project planning, that means there is poor project management, hence the measures to regulate and control environmental threats are minimal*”. The interviewee further added that barriers are “*Executing work outside boundaries of regulations where we are not employing proper construction guidelines*”.

#### **4.2.2 Measures in place for effective implementation of environmental sustainability**

Regarding measures in place for effective implementation of environmental sustainability, the respondent in Project A indicated that they have in place an environmental assessment plan. “*The environmental assessment plan helps us to identify and obtain any relevant information in relation to the impact that the construction project may cause on the environment. These include identifying sensitive environmental areas (that are regarded as “no go areas) or uses that may be affected by construction activities, whether residents adjacent to the site could be affected by excessive noise and pollution from construction activities or suffer reduced amenity*”. The respondent further highlighted the aims of the environmental assessment plan and how it is carried out. “*This assessment also aims to monitor baseline air, water quality and noise levels close to the construction site. We assess expected noise levels from construction activities which may affect the adjoining community. We also undertake a desk study to ascertain potentially contaminated sites in and around the construction area and conduct a soil investigation to ascertain soils that are suspected of being contaminated before construction activities begins.*” Regarding risks that could impose on the environment due to the health infrastructure project that they are working on, the respondent identified land degradation to be the highest risk. “*In projects of this magnitude, our work most of the times entail extensive land disturbance involving the removal of topsoil such as vegetation and reshaping the topographical nature of the site. These activities make the soil susceptible to erosion and soil removed by erosion may result in dust problem or be carried by water into natural waterways, thereby polluting them*”.

The construction manager stated that during construction, a lot of materials are being used, and all sorts of possible air pollutants arises, the respondent was asked in what ways do they mitigate air pollution risks. The respondent opined that they make use of water because it has low cost implications and gives excellent results. He further said that they apply water on the site at least two days or more, depending on the atmospheric conditions while managing the quantity of water applied to prevent excess water that can cause erosion problems. The respondent indicated that “*A water tanker is driven on site spraying water over the affected areas, to prevent dust*”. The respondent indicated that the earthwork trade such as bulk excavations are potential source of dust on their site, therefore they

ensure that works associated with this trade are tactically executed to minimise dust disturbance as much as possible. *“For instance, during dry weather conditions, all dusty activities are damped down. We minimise dust disturbance by temporarily covering earthworks if possible and minimise drop heights to control the fall of materials”*. In cases where cutting and grinding requires to be done on site, they follow a technique to reduce dust emissions. *“If materials, such as bricks or concrete slabs, are cut with a power tool without suppression or extraction, a second worker pours water from a plastic bottle over the material as it is being cut. This greatly reduces the amount of dust generated”*. When dealing with waste disposal, the respondent indicated that they have good practices they follow on site and which is mainly to do with buying and storing the materials on site. To reduce the amount of waste, the respondent stipulated that they ensure that they order the amount of materials needed as accurately as possible and arrange for 'just in time' deliveries to reduce storage and material losses. The respondent further elaborated that they ensure that storage areas are safe, secure and weatherproof (where required).

The respondent further indicated that *“We also store liquids away from drains, burns and in banded areas to prevent pollution and keep the site tidy to reduce material losses and waste”*. Concerning the issue of noise pollution, the respondent indicated that they use what he referred to as “sequencing and scheduling” of construction operations. *“Noise pollution falls under one of the biggest problems we are facing in this project especially that it is next to residential properties. In mitigating the noise levels on site, we schedule several noisy operations concurrently to take advantage of the fact that the combined noise levels produced may not be significantly greater than the level produced if the operations were performed separately.”*

The respondent in Project B was asked about measures put in place to ensure that during construction, the well-being of the environment is not compromised. The respondent indicated that *“... we carry out a feasibility study before the commencement of the project, we do quality control regarding dust and noise pollution and we do management of natural resources including soil material and plantation”*. Another question that the respondent was asked is to identify risks that could damage the environment due to construction and his response was as follows: *“Just like any other construction, pollution is one of the risks that we know may occur. Our site is situated in a space where there was a forest before, so when we were clearing the site, the risk of cutting down indigenous plants was high hence we had to get specialists to look at the site to identify those. Our project takes up such a large space, so another thing that we feared was over exploitation of natural resources including soil”*. In relation to how they deal with air pollution on site, the respondent indicated that they have dust control measures which include watering the entire site's access roads as well as maintenance of temporary roads. The respondent added that *“According to our observations, unpaved temporarily access roads can*

*account for a significant proportion of dust emissions, particularly during dry or windy conditions, when the generation of dust through the movement of vehicles is exacerbated. We damp down unpaved temporarily access roads both within and outside the site”.*

When dealing with waste disposal on site, the respondent specified that they have provided skips where all waste materials will be deposited. *“We ensure that we have skips on site to dispose waste. Another important thing is that we use excavated material to close off all holes and excavated areas”.* To reduce noise levels, the respondent stated that *“It is very important to maintain site plants. The more they are used, the more they get old and have tendencies of making sounds”.* The interviewee further added that they also provide access roads which are far from people and houses, provide good and quality plant and educate local communities, including their employees with regard to how to prevent noise pollution which may include noise reducing agencies. The respondent also highlighted the importance of mitigating noise levels on site especially for the sake of the health of employees. *“We provide and ensure usage of ear plugs during construction”.*

The health and safety officer in Project C indicated that they have an environmental management plan in place to ensure that the environmental well-being is not compromised during construction. *“The plan includes spillage, waste, resources, management and how to address different types of levels and exposure in relation to environmental management”.* The health and safety officer further elaborated on the plan that helps to reduce the adverse impact of construction activities on the environment. The respondent indicated that the plan is regularly updated to meet new risks or where inspections, monitoring or audit reveal that measures are ineffective as well as to achieve ongoing improvement. The risks endangering the environment due to the health infrastructure project is accidents that may occur on site. *“The risks that we may encounter is environmental accidents resulting from major spillages, tempering with ecological areas such as wet lands, noise, dust and other pollutants which are difficult to rehabilitate.”*

To reduce air pollution, the health and safety office stipulated that they conduct a survey relating to the scope of work. *“For example, because we are generating a lot of dust, we have a dust monitoring survey which is put in place and it helps as a control measure which could be suppressing the dust with water application”.* Another interview question was how the site deals with waste disposal. The respondent indicated that *“When it comes to waste, firstly we ensure that we differentiate between types of waste, which is hazardous and general waste. The waste must be stored in different marked skips and it must be disposed at an approved and certified waste disposal company”.* To mitigate noise levels, the respondent indicated that they use alternative ways of construction which differs from the traditional one. *“For example, alternative to driving piles, we use vibration or hydraulic insertion techniques. Even drilling holes for casting in*

*place piles is another alternative that produces noise levels significantly lower than the traditional driving method as well as using compressors".* The respondent further added that compressors are significantly quieter, hence they opted diesel or gasoline engine powered compressors.

To ensure that the environmental well-being is not compromised, the health and safety officer in Project D indicated that *"having an execution plan is important. Where we have well defined our scope of work and then identified potential environmental threats that are existing, we must also identify mitigation actions to be put in place to ensure that the environment is not compromised"*. According to the respondent, the risks that could impact the environment due to this project are air and noise pollution coupled with interference with the environment where the natural habitat is threatened by manmade actions. *"The first thing before any project commences on site is that, the scope of work must be clearly defined, and then indicate the extent of pollution that will be generated in the course of executing the work"*. To deal with waste management on site, the respondent clearly stated that *"there is a formal waste disposal plan put in place and after disposing, we obtain a waste disposal certificate. For example, if during construction there was maybe oil involved, and must be disposed, there are specific areas we must dispose it as we can't just expose it anywhere. It is a legitimate area where after disposing we get certificate indicating the amount of oil disposed and even if authorities come on site to check they will find that you did dispose certain amount of waste."*

When asked how noise is controlled on site, the respondent indicated that *"One of the effective noise mitigation technique is to state clearly what the nature of your job is and you must stay within your boundaries, another way to mitigate noise is by using equipment which allows for minimal noise"*.

## **5. CONCLUSIONS AND RECOMMENDATIONS**

The respondents have expressed their experience with regard to the different ways in which their firms deal with issues pertaining to environmental sustainability in health infrastructure projects. Even though the respondents had different views, the following conclusions can be drawn based on the findings. With regard to barriers affecting the implementation of environmental sustainability, all the respondents mentioned cost as a major barrier. Others included poor project planning, lack of knowledge, lack of experience and economic stability and considerations. The risks associated with construction activities that may have a negative impact on the environment include extensive land disturbance involving the removal of vegetation and reshaping of topography, air, noise and land pollution. Others include environmental accidents resulting from major spillages, tempering with ecological areas

such as wet lands and the risk of cutting down indigenous plants and exploitation of natural resources.

Environmentally sustainable measures put in place before construction commences include the environmental assessment plan which helps to identify and obtain information concerning any relevant environmental impact that the construction project may cause, a feasibility study of the site and the surrounding, a proper execution plan, and environmental assessment plan. With regard to air pollution reduction measures, one way is conducting a survey relating to the scope of work, getting information on the measure and amount of dust that will be generated and coming up with ways to mitigate or reduce it. The dust control measures identified by respondents included watering all the access roads on site, as well as maintenance of temporary roads.

Waste disposal management techniques included waste plan and making sure that waste must be stored in different marked skips and be disposed at an approved and certified waste disposal company. In relation to noise pollution control, use of equipment which allows for minimal noise level, use of alternative ways of construction from the traditional one, for example, alternative to driving piles, constructing shields around stationary noise generating equipment and sequencing and scheduling of construction operations are also measures that the respondents use on site to mitigate noise levels.

Based on the findings, it is recommended that precise policies with regard to environmental sustainability should be put in place and be adhered to by construction firms during construction. This is because if one of the pillars of sustainability is weak then the system as a whole is unsustainable.

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## **Inadequate time management in the KZN Education Department Infrastructure Projects**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The aim of the paper is to investigate time management or the lack thereof in the KwaZulu-Natal Department of Education infrastructure projects.

#### **Design/methodology/approach**

This was a quantitative desktop study that involved an in-depth analysis of the data from the infrastructure reporting model (IRM). New schools and upgrades and additions to school projects completed in 2016 and 2017, was utilised to determine the effectiveness of time management techniques. This resulted in the analysis of 20 projects with an estimated project value of R12.3 billion.

#### **Findings**

The results of this desktop analysis are indicative of inadequate time management systems in planning and execution of projects. This is substantiated by the findings that ninety five percent of the projects completed later than the estimated completion date and 50% started later than the estimated construction start date. There are no projects that started or completed earlier than scheduled. On average the projects are completing 14 months behind schedule.

**Research limitations/implications**

This study is limited to the KwaZulu-Natal Department of Education infrastructure projects. The projects were further limited to new schools and upgrades and additions projects between 2016 and 2017.

**What is original/value of paper?**

It is important to investigate the effectiveness of time management tools and the possible lack thereof because the construction of schools is social infrastructure and the South African Government has invested substantial financial resources in order to provide quality education facilities.

**Response to the Conference Theme**

Infrastructure Design and Delivery challenges

**Keywords:** infrastructure projects, time management, project management, cost, delays.

**1. INTRODUCTION**

Social infrastructure has the ability to increase the economic growth and social development of a nation's citizens and ensures that the basic infrastructure is better utilised (Economic and Social Commission for Asia and the Pacific (ESCAP), 2006:5). Economic growth and social development in turn plays an important role in addressing the long term growth challenges in South Africa, including unemployment (Simo–Kengne, 2016).

Government invests in infrastructure, such as healthcare facilities, schools, housing and roads, in order to provide citizens with access to services and to promote social wellbeing (National Treasury Republic of South Africa (NTRSA), 2017).

In line with the medium-term strategic framework and the National Development Plan, the South African government has prioritised spending on social and economic infrastructure such as schools, health facilities, roads and transport, energy, and water and sanitation (Simo–Kengne, 2016). It also continues to fund programmes and policies to improve the quality of infrastructure spending and the capacity of government to plan and implement capital projects (NTRSA, 2017:147).

It is therefore imperative to research ways in which existing social infrastructure can be developed without wasting financial resources because substantial financial investment has gone into the development of social infrastructure. Therefore the objective of this study is to investigate the time management aspect or the lack thereof in the KwaZulu-Natal Department of Education infrastructure projects.

## 2.1 KwaZulu-Natal Department of Education Infrastructure

The KwaZulu-Natal Department of Education (KZN-DoE) carries a large property portfolio (DBSA, 2012). The KZN-DoE has 5,923 public educational institutions (5,850 ordinary and 73 special schools) (NTRSA, 2017). The public ordinary schools accommodate approximately 2.84 million learners (DBSA, 2012). Apart from the teaching and learning spaces and ancillary facilities dedicated to school based education service delivery, the department has non-school administrative offices which complement the aforementioned portfolio base. All these institutions are staffed by about 109,000 employees ( $\pm 90,000$  educators and  $\pm 19,000$  non-educators) (DBSA, 2012).

The KZN DoE public school infrastructure portfolio is characterised by extremes. There are schools that can be compared with the best schools in the world whilst many schools can be considered to be minimalistic. This imbalance and inequality is what the Government is trying to address (NTRSA, 2017).

Over the past 20 years, the KZN DoE has focused on the poorer schools by applying appropriate interventions through various programmes. The regulations relating to the Minimum Norms and Standards for Public School Infrastructure, published in November 2013, has provided focused impetus to the abovementioned programmes (NTRSA, 2017). Critical to these regulations are the minimum space norms and standards (educational, administrative and support) and sports fields that are required at schools and the timeframes for the provision thereof (*ibid*).

The challenge of space deficiencies is compounded by the poor physical condition of many of the schools (DBSA, 2012). Hence, a database or reporting tool called the Infrastructure Reporting Model (IRM) was created by National Treasury in order to keep a record of where and how the provincial departments are spending their infrastructure budgets.

### 2.1.1 Infrastructure Reporting Model (IRM)

The IRM is a project level monitoring and reporting tool and is a web based system. The model is used by provincial departments to report expenditure and performance progress on infrastructure projects (NTRSA, 2017).

Each provincial department has the responsibility to report progress on infrastructure projects to its relevant Provincial Treasury and the relevant National Sector Department. Both the Provincial Treasury and the National Sector Departments monitor progress on reported projects and verify data quality (NTRSA, 2017). Poor data quality may result in the withholding of infrastructure funds due to the provincial department (DBSA, 2012).

The provincial department's responsibility regarding the IRM is to record all ongoing projects and capture all new infrastructure projects at

the beginning of each financial year to create a planning IRM with projected expenditure for the financial year (NTRSA, 2017). The data that is reported on the IRM is also used to conduct infrastructure site visits.

In the construction industry, the aim of project control is to guarantee that projects finish on time, within budget and achieve other project goals. It is a complex task undertaken by project managers in practice, which involves constantly measuring progress, evaluating plans, and taking corrective actions when required (Burger, 2013). This is in line with what the IRM aims to achieve.

But, South Africa's infrastructure challenges are not primarily the result of a lack of funding but are caused by institutional failures and a lack of appropriate capacity within departments (Simo-Kengne, 2016). This study therefore specifically looks at time management in the KwaZulu-Natal Department of Education infrastructure projects utilising the IRM.

## 2.2 Significance of Time Management

*"Time management is the act or process of planning and exercising conscious control over the amount of time spent on specific activities, especially to increase effectiveness, efficiency or productivity"* (Nepal, 2014:1). Time management in projects involves processes required to accomplish timely completion of projects (PMI, 2008) such as activity definition, activity sequencing, duration estimating, schedule development and schedule control (Burke, 2014; PMI 2008).

Although it is common knowledge in the construction industry that time and cost are two major concerns globally in any construction project (Landman, 2014), literature indicates that there are numerous claims and disputes which arise specifically as a result from time delays (Baloyi & Bekker, 2011). Time delays occur quite frequently, and more time is used to resolve the matters arising from delays (Yates & Epstein, 2006).

Effective time management for a construction project is important in managing the risk of delays, extension of time claims and time overruns on the project (Burger, 2013). Time management is one of the critical factors to consider when looking at the success of a project (Burke, 2014).

Hence, time in construction projects needs to be controlled from the beginning of the construction process until the project is totally completed (Memon, *et. al.*, 2014). Cost impacts usually accompany delays, therefore it is not only important that analysis is done, but also that it is accurate in order to minimise risks and maximise the potential for project success (Landman, 2014). By analysing the time aspect of the project it is possible to better plan for costs regarding the total project and to some extent avoid some of those costs stemming from delays (Yates & Epstein, 2006). Time management is therefore critical when it comes to delivery of infrastructure projects because of the high demand, low resources and short and medium terms that government operates under.

### **3. RESEARCH METHOD**

A quantitative analysis of the multi-case data was conducted. The IRM was used as the source of data and systematic data sampling was done in order to identify and categorise the data. Written consent was obtained from the KZN Department of Education and the Provincial Treasury to use the project information contained in the IRM. This information was collected through different sources, namely: data from the electronic system, official reports and archival records. Both Departments were willing to share the information but there was a concern about confidentiality, therefore, the project names and other sensitive information are not disclosed.

New schools and upgrades and additions to school projects completed in 2016 and 2017 was utilised to determine the effectiveness of time management techniques. Upgrades and additions projects are those where an additional classroom, learning space, lavatory or administration block/s are added to an existing school.

Only projects with a status of final completion and practical completion were considered and the data was further limited to projects categorised as upgrades and additions as well as new school projects. 219 projects had to be excluded from the study because they did not have project end dates captured on the IRM. This systematic sampling resulted in 19 projects at practical completion and 1 project at final completion.

### **4. ANALYSIS**

A systematic analysis of the data was undertaken for this study. Projects completed in the years 2016 and 2017, which means projects that have a project status of final completion or practical completion in the said years, were analysed. The projects which are the focus of the study are those which are upgrades, additions and new school projects. Projects with no completion dates were not considered in the sample. The data was categorised by district municipality, number of projects and project cost as depicted in Table 1.

Table 1: Total number of projects by District Municipality

District Municipality	Number of Projects	Projects Cost per district
Amajuba	98	566 526 349
Ethekwini	166	1 694 719 497
Harry Gwala	147	1 437 970 378
Ilembe	162	486 781 641
King Cetshwayo	162	1 304 338 129
Ugu	127	668 383 659
uMgungundlovu	183	1 379 098 773
Umkhanyakude	190	1 020 250 107
Umzinyathi	249	855 871 746
Uthukela	179	800 916 378
Province Wide	41	778 631 000
Zululand	366	1 332 530 129
<b>Total</b>	<b>2070</b>	<b>12 326 017 786</b>

There are 10 districts in KwaZulu-Natal and the eThekweni Metro. There were 366 projects within the Zululand District at a total cost of R 1.33 billion and it is closely followed by the Umzinyathi district with 249 projects at a total project cost of R 856 million. EThekweni has 166 projects at a total project cost of R 1.69 billion. On the lower end of the scale there are 41 projects that are distributed province wide at a total project cost of R 779 million. Amajuba district has 98 projects at a total project cost of R 566 million. Table 1 shows that there is a high demand for school infrastructure in the province as there is no district without projects and the district with the lowest number of projects is 98 projects.

When one focuses on the upgrades and additions, see Figure 1, the total number of projects is 2016 of which the bulk is located in the Zululand district with 363 projects. Umzinyathi district has 247 projects and Umkhanyakude district has 185 projects. On the lower end of the scale, the district with the smallest number of projects is Amajuba with 97 projects.

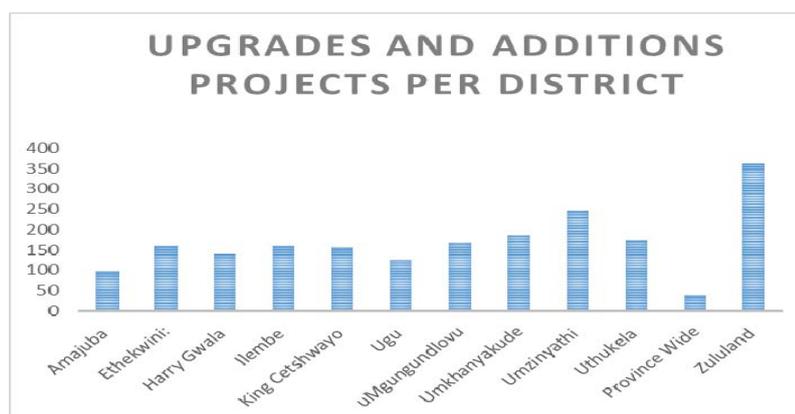


Figure 1: Upgrades and Additions projects per district

There were a total of 54 new school projects in the province as indicated in Figure 2, the bulk of which is located in uMgungundlovu district with 13 projects. Harry Gwala district has 7 projects and King Cetshwayo district has 6 projects. On the lower end of the scale, the districts with the smallest number of projects are Ilembe and Amajuba districts with 1 project each.

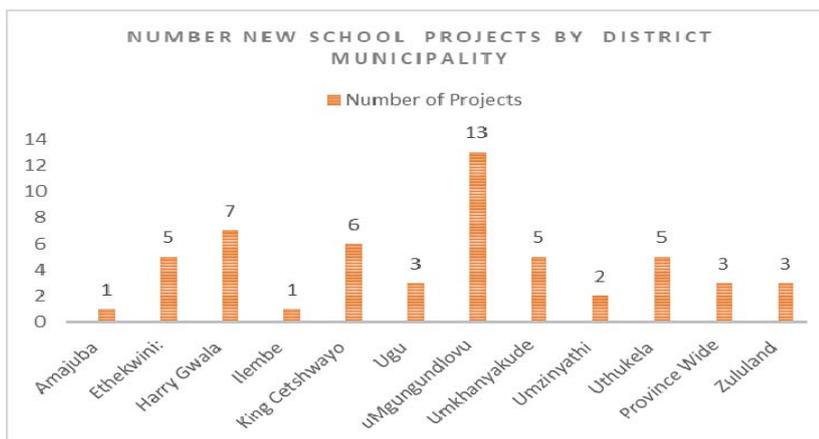


Figure 2: Number of New Projects by district municipality

Table 2 lists the number of projects according to the status of the project. This study and the detailed analysis that will follow, focuses on the 259 projects at practical completion with an estimated total cost of R 2.76 billion and 1 project at final completion with an estimated cost of R 13 million.

Table 2: Projects by status

Project Status	No. Projects
Project Initiation	173
Pre - Feasibility	4
Feasibility	130
Design	206
Tender	765
Site Handed - Over to Contractor	5
Construction 1% - 25%	157
Construction 26% - 50%	70
Construction 51% - 75%	67
Construction 76% - 99%	187
Practical Completion (100%)	259
Final Completion	1
On Hold	0
Terminated	5
Other - Compensation of Employees	0
Other - Packaged Ongoing Project	41
<b>TOTAL</b>	<b>2070</b>

#### 4.1. Multiple Case Study data analysis

The purpose of the case study is to analyse the consistencies and discrepancies between the project duration time estimates prepared at the beginning of the project and the actual project duration at the end of the project. However, only 1 project has a status of final completion out of the sample of 2070 projects. Therefore projects at practical completion were also considered and the number of projects increased to 260 projects. There are 219 projects with no project end date captured on the IRM, therefore these projects had to be excluded as part of the study. The detailed analysis will be restricted to projects that reached practical completions in the year 2016 and 2017 and this criteria yielded 20 projects for analysis.

#### 4.2 Data Analysis and Interpretation

The data analysis is done in order to answer the research question of how effective are the time management tools and techniques implemented by the KwaZulu-Natal Department of Education in reducing time overruns? Effectiveness of the time management tools and techniques is measured by the adherence to project time frames. The data analysis focuses firstly on the variance between the actual and estimated project completion. Secondly, the variance between estimated construction start dates and actual construction start dates and finally the variance between estimated construction end dates and actual construction end dates.

Table 3: Variance between the actual and estimated project completion

	Project Start Date	Actual Project Completion Date	Estimated Project completion Date	Variance between Estimate and Actual Project Completion
Project 1	10 March 2011	26 November 2017	19 February 2017	9 months late
Project 2	15 February 2012	18 November 2017	23 August 2017	3 months late
Project 3	08 February 2013	31 August 2017	31 August 2017	0
Project 4	03 January 2011	26 November 2017	03 September 2017	2 months late
Project 5	10 April 2012	31 August 2017	31 August 2016	12 months late
Project 6	06 May 2014	20 December 2017	16 November 2015	13 months late
Project 7	09 November 2012	20 December 2017	28 November 2014	37 months late
Project 8	06 June 2016	10 October 2017	13 June 2016	16 months late
Project 9	06 June 2016	10 October 2017	16 June 2016	16 months late
Project 10	06 November 2012	30 November 2017	31 August 2016	15 months late
Project 11	22 February 2013	10 November 2017	10 August 2017	3 months late
Project 12	10 April 2012	29 December 2017	31 August 2016	16 months late
Project 13	20 March 2011	30 November 2017	01 September 2017	2 months late

Project 14	11 October 2010	11 December 2017	12 November 2014	37 months late
Project 15	12 February 2014	14 November 2017	30 May 2014	42 months late
Project 16	08 February 2011	09 November 2017	02 September 2017	2 months late
Project 17	01 February 2012	20 November 2017	01 September 2017	2 months late
Project 18	06 June 2016	10 October 2017	17 June 2016	16 months late
Project 19	06 June 2016	10 October 2017	13 June 2016	16 months late
Project 20	17 February 2012	30 November 2019	31 August 2017	26 months late

Table 3 reflects a variance between actual project completion dates and estimated project completion. Ninety five percent of the projects were completed later than the estimated completion time, with only 5% of the projects being completed on time in line with the estimates. There are no projects that completed earlier than scheduled. On average the projects are completed 14 months behind schedule.

Table 4: Variance between the actual and estimated construction start dates

	Estimated Construction Start Date	Actual Construction Start Date	Variance Between Construction Start Dates
Project 1	18 May 2011	19 June 2011	1 month late
Project 2	08 March 2012	18 June 2012	3 months late
Project 3	10 February 2013	28 February 2013	0
Project 4	18 January 2011	09 May 2011	4 months late
Project 5	10 April 2013	10 April 2013	0
Project 6	05 June 2014	01 August 2015	13 months late
Project 7	04 November 2013	04 November 2013	0
Project 8	08 June 2016	10 June 2016	0
Project 9	10 June 2016	13 June 2016	0
Project 10	06 October 2013	30 November 2013	1 month late
Project 11	15 March 2013	18 May 2013	2 months late
Project 12	10 April 2013	10 April 2013	0
Project 13	14 March 2012	14 March 2012	0
Project 14	12 November 2012	11 December 2013	13 months late
Project 15	12 March 2014	12 May 2014	2 months late
Project 16	19 March 2011	10 September 2011	6 months late
Project 17	01 February 2015	01 March 2016	13 months late
Project 18	10 June 2016	13 June 2016	0
Project 19	08 June 2016	10 June 2016	0
Project 20	11 February 2013	11 February 2013	0

Table 4 reflects a variance between actual construction start dates and estimated construction start dates. It is evident from Table 4 that 50% of

the projects started construction later than the estimated construction start time. There are no projects that started earlier than scheduled. There are three projects that have a construction start date that was delayed by 13 months.

Table 5 reflects a variance between actual construction end dates and estimated construction end dates. It is evident in Table 5 that 65% of the projects in the table completed construction later than the estimated construction end time. Only 35% of the projects completed construction on time in line with the estimates. There are no projects that ended construction earlier than scheduled.

Table 5: Variance between actual and estimated construction end dates

	Estimated Construction End Date	Actual Construction End date	Variance between Construction End Dates
Project 1	15 August 2017	26 November 2017	3 months late
Project 2	23 October 2017	18 November 2017	1 month late
Project 3	17 August 2016	31 August 2017	0
Project 4	03 September 2017	26 November 2017	2 months late
Project 5	29 October 2015	31 August 2017	22 months late
Project 6	12 October 2017	20 December 2017	2 months late
Project 7	28 November 2016	20 December 2017	13 months late
Project 8	05 October 2017	10 October 2017	0
Project 9	05 October 2017	10 October 2017	0
Project 10	10 September 2017	30 October 2017	1 month late
Project 11	12 October 2017	10 November 2017	1 month late
Project 12	29 December 2015	29 December 2017	24 months late
Project 13	01 September 2017	30 November 2017	2 months late
Project 14	11 December 2016	11 December 2017	12 months late
Project 15	24 October 2017	14 November 2017	1 month late
Project 16	08 November 2017	09 December 2017	1 month late
Project 17	01 November 2017	20 December 2017	0
Project 18	05 October 2017	10 October 2017	0
Project 19	05 October 2017	10 October 2017	0
Project 20	31 August 2019	30 November 2019	3 months late

## 5. CONCLUSION AND RECOMMENDATIONS

The results of this desktop analysis are indicative of inadequate time management in planning and execution of projects. This is substantiated by the findings that ninety five percent of the projects completed later than the estimated completion date and 50% started later than the estimated

construction start date. There are no projects that started or completed earlier than scheduled. On average the projects are completing 14 months behind schedule.

The undertaking of this study in time management is significant in order to determine how time is managed in infrastructure projects, so that the project team can get a clear understanding of time management and the lack thereof so that they can try to prevent project delays. It is important to investigate the effectiveness of time management tools and techniques in the construction of schools because schools are social infrastructure and the South African Government has invested substantial financial resources in order to provide quality social infrastructure facilities to the citizens (Wood, 2013). Government invests in infrastructure, such as healthcare facilities, schools, housing and roads, in order to provide citizens with access to services and to promote social wellbeing (National Treasury Republic of South Africa (NTRSA), 2017:198).

It is therefore recommended that the programme managers and project managers make realistic estimates of the project duration through computer simulation using efficient techniques such as programme evaluation and review technique (PERT) and the critical path method (CPM).

This study highlights the reflects the lack of monitoring tools for projects when they move from planning and design stage to construction stage, as half the projects started late. Therefore it is recommended that computer software should be bought and implemented for project activity monitoring such as the earned value technique.

Due to the number of projects, the quality of the information on the IRM is poorly maintained. It is recommended that specialist data capturers be allocated the function of updating project progress reporting systems and data bases such as the IRM. This will also assist with providing reasons for delays and ensuring that all information on the system is up to date.

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## **Retrofitting existing structures with green roofs to combat the Urban Heat Island effect**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

This paper aims to raise awareness about the benefits of retrofitting existing structures in South Africa with green roofs.

#### **Design/methodology/approach**

This study investigates the benefits of green roofs from literature, reports on a lifecycle cost-benefit analysis for a typical office building and practically tests several different plant species to find the most suitable South African plants for lightweight green roofs.

#### **Findings**

Green roofs are shown to have significant environmental benefits and can effectively combat the Urban Heat Island effect. The **Spekboom** is found to be the best local plant for use in green roofs.

The initial costs of retrofitting green roofs remain a challenge. Including an incentive from the City or State would however make such retrofitting economically feasible for building owners.

#### **Research limitations/implications (if applicable)**

The cost-benefit analysis was based on a building within the Johannesburg CBD, South Africa. The practical plant test was however conducted in Stellenbosch, South Africa and evaluated plant species from within the greater Cape biome.

It is recommended that additional tests be done for plants in other parts of South Africa. A pilot study which investigates the economic impact (and not only the social or environmental impacts) of retrofitting green roofs, is needed.

**Practical implications (if applicable)**

South African officials and property owners need to seriously consider the benefits of retrofitting green roofs towards improving the environment. New buildings should be required to have green roofs by law, as the cost of building new vs. green is negligible.

**What is original/value of paper?**

The civil engineering industry often forgets about the environment and only focuses on project costs. This paper raises awareness about the inner city environment and how it may be improved for healthier and sustainable living.

**KEYWORDS**

**Green, Engineering, Retrofitting, Structure, Sustainability**

**1. INTRODUCTION****1.1 Background**

This paper investigates the advantages and disadvantages of retrofitting green roofs onto existing city structures to specifically combat the Urban Heat Island (UHI) effect.

It is hoped that the findings of this investigation will convince more architects, civil engineers, developers and building stakeholders to include green roofs into their designs.

**1.2 Problem statement**

As the global population increases, there is a growing need to find sustainable solutions to reduce the negative impact of humans on the natural environment. Global climate change, melting polar ice caps, the destruction of natural habitats and the extinction of species are but a few consequences of humans' impact on the environment (Goudie, 1990).

The Urban Heat Island (UHI) effect is considered to be the most obvious alteration of the atmosphere as a result of urbanisation (Oke and Maxwell, 1975). It is calculated as the difference between the higher ambient urban temperature and the lower, surrounding rural ambient temperature (Li et al., 2014).

The types of materials often found in urban environments (e.g. concrete and asphalt) absorb and retain the Sun's energy, raising the ambient air temperature (Berardi, 2016). Cities also generate artificial heat from vehicles, air conditioners and machines. Air pollution further worsens the

UHI effect by trapping radiation under a "pollution dome" (Oke and Maxwell, 1975). This is similar to the greenhouse effect. Green roofs in urban areas have been proposed as a mitigation strategy for the UHI effect (Li et al., 2014). Green roofs also increase the levels of shading and absorption of heat by plant thermal mass (Lewis, 2004). The retrofitting of green roofs onto skyscrapers and inner-city buildings therefore warrants further investigation.

### 1.3 Aim and Objectives

This paper aims to evaluate the effectiveness of retrofitting green roofs in a city to reduce the UHI effect. This is done by comparing various roof cover alternatives in terms of their cooling effect, advantages and disadvantages. The objectives of this paper are to:

1. Investigate the advantages and disadvantages of retrofitting green roofs onto existing buildings in a city.
2. Report on the findings of a lifecycle cost-benefit analysis for retrofitting a green roof onto a typical office building in SA.
3. Evaluate the effectiveness of five different green roof covers for implementation in the Western Cape.

### 1.4 Methodology

A literature review is conducted to investigate the advantages and disadvantages of retrofitted green roofs.

The result of a lifecycle cost-benefit analysis for the retrofitting of a green roof to a typical office building in South Africa is reported upon. This analysis was done by a parallel study within this Research Chair at Stellenbosch University.

A physical experiment is undertaken to measure the cooling ability, as well as the water and maintenance requirements of five different roof plant species.

A mathematical model is then developed to evaluate the effectiveness of the plant alternatives for application in the Western Cape. This model may also be applied to other locations and climates in future.

Finally, the mathematical model and test results are discussed in further detail before conclusions are drawn.

### 1.5 Scope & Limitations

This paper investigates how retrofitted green roofs may be used to mitigate the UHI effect in cities. As such, the ambient temperature on the surface of several plant species was measured as part of an experiment. Other

aspects (such as water requirement) are also taken into account during the evaluation process.

Only plant species from the Cape biome are investigated; the test would have to be repeated for other climates and/or plant alternatives.

This study focuses on extensive green roofs with an applied loading between 0.5 - 1.5kN/m<sup>2</sup>. Such green roofs could theoretically be retrofitted to existing buildings without significant structural alterations.

## **2. GREEN ROOFS**

This paper investigates the retrofitting of extensive green roofs (maximum 150mm soil thickness) as they do not usually require significant structural alterations. Extensive green roofs are therefore most often used to combat environmental problems in cities (Saadatian et al., 2013).

Extensive roofs do however limit the selection of plants that may be used as roof covers. Plant species that are ground-covering and weather resistant, as well as require little water and/or maintenance are preferred. Local, indigenous plants usually meet these requirements best.

### **2.1 Advantages of Green Roofs**

From literature (Li et al., 2014; Lewis, 2004; Saadatian et al., 2013; Van der Walt, 2018) it is found that the benefits of green roofs include:

1. Mitigation of the UHI effect
2. Insulation of the building which saves energy for heating and cooling
3. Producing more oxygen and absorbing more carbon dioxide
4. Reduced health-associated costs due to reduced air pollution
5. Decreasing storm water runoff peaks
6. Improving water runoff quality
7. Providing a habitat for natural eco-systems and promoting inner-city biodiversity
8. Opportunity for food production in urban environments
9. Lessening noise pollution
10. Creating a recreational space
11. Improving the aesthetics of a city

As per the title, this investigation focuses on the advantage of green roofs in decreasing the ambient temperature in cities. Green roofs mitigate the UHI effect by reflecting up to 27% of solar radiation, absorbing up to 60% through photosynthesis and transmitting the remainder to the substrate (Wong, 2003). A Canadian study further proved that green roofs reduced the inner-city air temperature increase by 70-90% in summer and by 10–30% in winter (MacIvor et al., 2016).

## 2.2 Disadvantages of Green Roofs

According to existing literature (Saadatian et al., 2013; Van der Walt, 2018; Maclvor et al., 2016), green roofs may however suffer from the following disadvantages:

1. High initial cost
2. Added load to a structure
3. Rechecking the structural design for safety
4. Additional maintenance, trimming and gardening
5. Increased water requirements
6. Damage to the building by roots and/or blocked drainage systems

Points 2-5 may be effectively mitigated through correct plant choices and proper planning/design of the green roof system. Extensive green roofs add little additional permanent load onto a structure (often less than the previously imposed load), resulting in no structural strengthening being needed (Van der Walt, 2018). Choosing the correct plant types for local climatic conditions ensures low water and maintenance requirements. Specifically designed root barriers and drainage trays may further be used to prevent damage and/or blockage to the existing water proofing.

The high initial cost of retrofitting a green roof onto an existing structure therefore remains the single largest challenge. This is discussed in the following chapter.

As the retrofitting of green roofs onto existing buildings will positively impact both the individual buildings and inner-city environment, it is recommended that additional research should be conducted into suitable local plant types and innovative funding mechanisms to support them.

## 3. COST-BENEFIT ANALYSIS FOR A TYPICAL OFFICE BUILDING

### 3.1 Typical office building: Johannesburg CBD, South Africa

Van der Walt (2018) determined the characteristics of a typical building within the Johannesburg CBD as:

- 7 storeys high
- 685m<sup>2</sup> floor area
- 548m<sup>2</sup> roof area (80% of floor area, 20% for mechanical services)
- 4797m<sup>2</sup> gross lettable area (floor area x number of floor)

The above values were calculated by choosing six city blocks spread across the Johannesburg CBD and counting the number of buildings and their storeys in each block. The floor area of each building was then measured using Google Maps. 34 buildings were thus analysed (Van der Walt, 2018).

### **3.2 Cost-benefit analysis of retrofitting a green roof to an existing office building in South Africa**

It was determined that the retrofitting of a green roof to a typical office building would return a payback period of 7 years to the building owner if the city or state (Van der Walt, 2018):

- Provides at least 80% subsidy for the initial costs, and
- Reduces the annual property tax by at least 2%

The above may seem like an unusually large subsidy, but the city or state would recuperate their costs within 15 years due to the money saved on (primarily) health-related expenses (Van der Walt, 2018).

Spin-off benefits for the city (not included in the analysis above) may include improved tourism, healthier/happier inhabitants, better property prices and higher income tax returns. The city's storm water infrastructure would also be more efficiently utilized. This would reduce the payback period to less than 15 years.

## **4. PLANT TEMPERATURE TEST METHODOLOGY**

A physical experiment was done to measure the temperature effects of the plant species used in a green roof, whilst also comparing the practical aspects and maintenance requirements of the different alternatives.

The test consisted of six 800x800x300mm plywood boxes which were filled with a 50mm drainage layer (9mm crushed stone) and 100-150mm potting soil layer. The plants were then rooted into the potting soil. The individual layers were separated using a sheet of woven geotextile as a root guard.

The test boxes were set up on the roof of the Civil Engineering Building of Stellenbosch University as it is flat, fully exposed to the Sun and easily accessible. The boxes were placed so that they received full sun and were exposed to typical Western Cape weather conditions, as seen in Figure 4.1.

The tests were conducted during September - October 2016. The surface temperatures were recorded daily at 13h00 (local time) using a handheld thermometer with an accuracy of  $\pm 0.1$  degrees Celsius ( $^{\circ}\text{C}$ ).

The measured data points collected were:

- Outside temperature ( $T_o$ ) on the roof 1m above the surface
- Temperature ( $T_i$ ) on the surface of each plant alternative in the centre of the box



**Figure 4.1** Test setup on the roof of Stellenbosch University's Department of Civil Engineering

The following plant species were investigated:

1. Painted (light grey) concrete roof - Do Nothing case
2. Artificial grass (i.e. plastic grass)
3. Spekboom
4. Kikuyu grass (i.e. normal/garden grass)
5. Baby Spinach and Swiss Chard
6. Cape Floral succulents

Box 1 tested the existing waterproofed and painted concrete roof and thus represented the Do Nothing (DN) alternative. The temperature, practicality and performance of the other alternatives were then compared to the DN alternative and to each other.

## 5. SPEKBOOM

*Portulacaria afra* is a small perennial plant more commonly referred to as the Spekboom (Palgrave, 1983). It is indigenous to South Africa and a recommended garden plant for the Cape, but may be lesser known than the other alternatives and is therefore briefly introduced here. A close-up photo of the Spekboom and its fleshy leaves may be seen in figure 5.1.



**Figure 5.1** The Spekboom (*Portulacaria afra*)

The Spekboom was primarily chosen to be part of this investigation because of its excellent carbon sequestration properties, i.e. sucking CO<sub>2</sub> out of the air. Of all the indigenous plants in South Africa, it has largest capacity for carbon sequestration (Mills et al., 2005). This means that it has great potential to combat the effects of global warming.

The Spekboom is known to have good weather and/or drought resilience, is readily available, easy to plant and has low water consumption. The leaves of the plant are edible with a pleasantly acidic flavour (Palgrave, 1983) and can also be used as animal fodder (economic benefit). The Green Roof Pilot Project in Durban also found that the Spekboom attracted several moth species and beneficial insects during its flowering (Van Niekerk, 2011).

The benefits listed above, makes the Spekboom an ideal plant for use in green roof applications and it was therefore included in the physical experiment.

## 6. PLANT SPECIES EVALUATION MODEL

The performance score of each plant alternative was calculated using equation 6.1 as follows:

$$Score = \beta_T T + \beta_W W + \beta_M M + \beta_R R + \beta_E E + \beta_C C + \beta_N N \quad (6.1)$$

The individual weighting factors were chosen as  $\beta_i = 1$  for the initial ranking of the results. Future studies may adapt these factors for individual applications. A sensitivity analysis was performed on the test results to confirm the validity/robustness of the findings. This is discussed in the following section.

The measured data points in equation 6.1 are:

- T : Temperature difference (%) ( $-3 < T < 3$ )
- W : Water requirements ( $0 < W < 3$ )
- M : Maintenance needed ( $0 < M < 3$ )
- R : Weather resistance ( $0 < R < 3$ )
- E : Ecological score ( $0 < E < 3$ )
- C : Carbon sequestration ( $0 < C < 3$ )
- N : Nutritional value ( $0 < N < 2$ )
- $\beta_i$  : individual weighting factor ( $\beta_i = 1$ )

Fuzzy-logic matrices were used to convert each of the physical measurements from low-medium-high impacts to point values of 1-2-3. The percentage temperature change could however be accurately measured and its matrix thus differed in that its point scale ranged from -3 to +3 (as seen in table 6.1 below). The overall score counted towards a maximum of 20 points.

**Table 6.1** Percentage temperature difference

Temperature difference	Points Score (T)
-15% to -20%	3
-10% to -15%	2
0% to -10%	1
0%	0
0% to +10%	-1
+10% to +15%	-2
+15% to +20%	-3

## 7. DISCUSSION OF RESULTS

Figure 7.1 plots the actual temperature measurements taken over the course of the experiment in degrees Celsius (°C).

With the exception of the artificial lawn, all of the alternatives were found to be cooler than the existing light grey roof - proving that green roofs make a positive difference to the Urban Heat Island (UHI) effect.

The artificial lawn was found to be significantly hotter than the existing roof and should therefore not be used in any outside applications.

Kikuyu grass, Spinach and Spekboom were the three best plants in terms of their cooling ability.

The Spekboom achieved the highest overall score (16 out of 20) and would therefore be the most suitable alternative to be implemented on roofs in the Cape Town area. The Spinach plant came in second place (11 out of 20). The Kikuyu grass did however not perform well overall (9 out of 20).

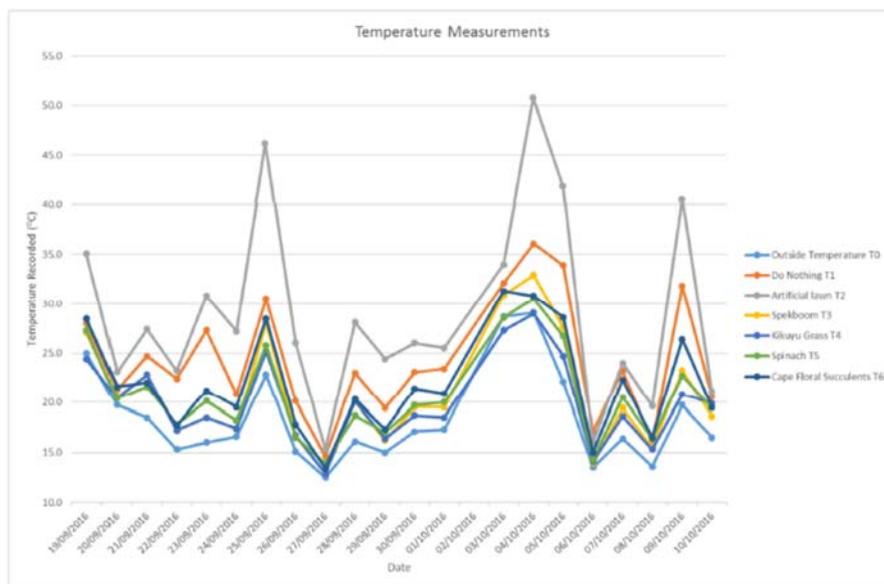


Figure 7.1 Measured temperatures from the physical experiment (°C)

A sensitivity analysis was also conducted by varying the temperature weighting factor ( $0 < \beta_T < 3$ ) to determine the robustness of the findings.

Table 7.1 shows that the Spekboom and Spinach plants remain in the top 2 places, regardless of the temperature weighting. This validates the robustness of the findings.

Table 7.1 Sensitivity analysis of the Temperature weighting factor ( $0 < \beta_T < 3$ )

#	$\beta_T = 0$	$\beta_T = 1$	$\beta_T = 2$	$\beta_T = 3$
1	Spekboom	Spekboom	Spekboom	Spekboom
2	Spinach	Spinach	Spinach	Spinach
3	Succulents	Succulents	Kikuyu grass	Kikuyu grass
4	Do nothing	Kikuyu grass	Succulents	Succulents
5	Artificial grass	Do nothing	Do nothing	Do nothing
6	Kikuyu grass	Artificial grass	Artificial grass	Artificial grass

## **8. CONCLUSIONS**

Based on the findings of this study, the following conclusions are drawn:

### **8.1 Green roofs reduce the UHI effect**

The experiment and mathematical model proved that the surface temperatures of green roofs were significantly lower than a light grey, painted concrete roof. Green roofs could therefore be used to reduce the Urban Heat Island effect in major cities.

Furthermore, an extensive green roof adds little additional load to an existing structure and should therefore not require significant structural alterations.

### **8.2 The Spekboom (*Potulacaria afra*) is the preferred plant type for extensive green roofs in Cape Town, South Africa.**

This indigenous plant has good cooling ability, is easy to grow, requires little water and is low maintenance. It has very high carbon sequestration and may also be used as food or animal fodder.

### **8.3 Funding models for the retrofitting of green roofs onto existing buildings require further research.**

Although decent payback periods may be realized for both building owners and the city/state through the use of subsidies, it is seen that the high initial cost of retrofitting green roofs remain a key challenge to their widespread implementation in South Africa.

### **8.4 Kikuyu (i.e. normal/garden) grass is unsuitable for green roofing applications as it requires too much water and provides limited ecological benefits.**

### **8.5 Artificial grass enhances the UHI effect and should therefore not be used in any outdoor or green roofing applications.**

### **8.6 Test setup and mathematical model**

The physical experiment and mathematical model developed in this study were found to be simple to build and cost effective, whilst providing

accurate results. The method may be used to evaluate local plant species and/or weather conditions elsewhere in the world.

If needed, the test setup may be improved by embedding the temperature sensors into the individual alternatives to allow for continuous and/or more regular data logging. An automated (drip) irrigation system would also lessen the required manpower whilst conducting the test.

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## **Interdependent Tasks and Inseparable Risks Within the Design Phase of Green Buildings**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose**

Project stakeholders face task interdependencies which have resulted to inseparable risks. These risks cannot be transferred or allocated to an individual on a stand-alone basis, but are to be shared collaboratively. An analysis on how project stakeholders in collaborative teams deal with inseparable risks within their different design tasks is conducted.

#### **Design**

To develop a comprehensive understanding of how various stakeholders in the design of green buildings (GB), manage risks collaboratively, the research elicits the information from people involved in these buildings. Owners of GB were approached as the means to identify those involved in the design of their buildings. Those stakeholders were contacted and interviewed. In this preliminary study, 15 stakeholders in 2 projects were interviewed.

#### **Findings**

Stakeholders suggested co-location, and to overcome the traditional attitudes to design which are discipline oriented, all stakeholders should get GB accreditation training where attendees have the opportunity to discuss and become familiar with suitable practices of design and risk. Benchmarking performance on task completion ensures that stakeholders

demonstrate significant commitment, which is fundamental to a successful change system.

### **Value**

The preliminary results from this study demonstrate that the way Collaborative Risk Management occurs in the context of GB is different and this study will inform stakeholders' decisions on optimal risk sharing.

**Keywords:** Collaboration, Collaborative risk management, Design tasks, Green buildings, Risk sharing

## **1. INTRODUCTION**

Building design involves complex and comprehensive work that requires the cooperation of various specialties as collaborated stakeholders (Liu *et al.*, 2014). With the multifariousness of projects, building design becomes increasingly difficult and complex (Senthilkumar and Varghese, 2010). Thus there has been a major shift in focus towards collaborative design approaches (El-Diraby *et al.*, 2017). This study intends to distinguish how project stakeholders in collaborative teams deal with inseparable risks within their different design tasks.

Collaborative design concentrates on the process of coordination and cooperation of different stakeholders sharing their knowledge in both the design process and the design content (Kleinsmann, 2006), as a means of attaining the unified design goals in most efficient and effective ways (Liu *et al.*, 2017). But risk management has given little consideration in this emergent collaboration among the interdisciplinary and iterative process. Risk management practice continues to rely on allocating risks to specific individual entities, which is increasing problematic and non-coherence in the growing Green building sector, where the design philosophy is holistic and treats the building as a complex integrated system (El-Diraby *et al.*, 2017), that is best designed, efficiently executed and achieved expected outcome through a collaborative practice.

Chiu (2002) defines: "Collaboration as an activity that requires participation of individuals for sharing information and organizing design tasks and resources." This means that the stakeholders should provide each other with new insights that will enable each participant to fulfil his own task without compromising/ affecting the others design while meeting the common green building objectives. In collaborative designs, tasks are interdependent and iterative (Al Hattab and Hamzeh, 2015). Iteration assists progressive generation of knowledge, enabling concurrency and integrating necessary changes, but it also increases the duration and cost of a project (Wynn and Eckert, 2017). Managing iteration is thus an important issue in practice to mitigate these excess costs due to non-value adding iterations or rework, but can be a challenging issue since it relates to risk. Consequently, the need for stakeholder collaboration and risk management to provide an effective way of managing risks is, present and

unavoidable. Risks are inherent in all complex projects (Peckiene *et al.*, 2013) and they are faced by all project stakeholders involved. Thus the need for effective risk management in the design stage of projects (Lam *et al.*, 2007).

Effective design risk management focuses on integrating risk management with existing design management processes that are consistent with futuristic practices that involve all project stakeholders (Yang and Zou, 2014). Determining where design risks lie should not be an intuitive process as it commonly is currently, but a disciplined structured approach. However, with increased complexity comes increased difficulty in predicting specific risk situations, their timing and root-causes (El-Sayegh, 2008). How stakeholders deal with these risks could be mitigated or managed through the appropriate design management with properly allocated risks in a collaborative framework.

A shift towards a collaborative approach aligns the incentives and goals of the project team through shared risk and reward, early involvement of all parties, and a multiparty agreement (Kent and Becerik-Gerber, 2010). How risks are shared among stakeholders in the design phase is to a large extent governed by the dynamic evolution of management. Even risks that have been identified and allocated change in scope, this then becomes an on-going process that keeps growing with the project dynamics and require different types of responses. In order to manage such risks successfully, collaborative efforts among project stakeholders are emphasized (Gomes *et al.* 2016).

Every Collaborative Risk Management (CRM) solution is impacted by people, technology and the nature of multidisciplinary tasks in the early design stages (Sharma *et al.* 2013). This fundamentally, has become an important opportunity for improvement to the collaborative design process of green buildings because stakeholders and tasks in this design process can be hampered by different views on fundamental topics (Froese *et al.* 2007; Schöttle *et al.* 2014). In consequence, the lack of shared understanding causing unnecessary iterative loops (Valkenburg and Dorst 1998) that can be correlated to wasted design effort. But, whilst there is a continuous need to support better collaboration, the shift in practice remains uncertain.

CRM is about the dynamic management of risk (Rahman and Kumaraswamy, 2005) which plays a major role in achieving value-for-money and cost-efficiency in designing complex projects. How then are risks allocated in these complex projects? Despite the fact that CRM is arguably an effective tool, the use of CRM still seems to be uncommon because of the blurred risk allocation lines (Osipova and Eriksson, 2011b).

## 2. LITERATURE REVIEW

Green Building (GB) designs are complex undertakings that have given rise to reciprocal interdependencies between multiple and diverse stakeholders, hence the high dependence on information, followed by the

connectedness of tasks (Austin *et al.*, 2002; Ahn *et al.*, 2016). Yet, they are the most effective solutions to increase the efficiency of buildings through resource utilization and recycling, mitigating the negative impact of the construction industry on the environment (Zuo and Zhao 2014). This has been made possible by mutual collaboration, adjustments towards working collectively and responding to emergent, unforeseen problems in real-time. However project realities are such that current risk practices promote competitive attitudes between the project stakeholders involved because they tend to work for their self-interests and thus safe-guard their existence in the project life (Alsalman 2012). So, it is vital to change not only risk management (RM) practices but, mind-sets to shift towards mutual adjustments and rapid adaptation, where stakeholders will be in a give-and-take interdependence (Morris 2013).

Green-specific risks are unique with each project as they do not have enumerable set of potential solutions (Rittel and Webber, 1973) because they are unknown and cannot be determined at the outset of the project. Meaning, all stakeholders have their own knowledge on RM but CRM would require integration of all unique solutions to deal with consequential, unknown risks. The change from traditional RM to CRM is loaded with uncertainties which include risk sharing among all project stakeholders and their response to this cultural shift.

This shift towards risk sharing requires all stakeholders within complex projects to take a closer look at their risk universe. Risk sharing is a useful method for handling complex designs (Melese *et al.*, 2016). It is a collaborative way of managing risks which have an ability to take advantage of the different views from different stakeholders (Olander, 2007) and it also identifies risks that cannot just be shifted to one stakeholder but have to be collaboratively managed (Lam *et al.*, 2007). Collaborative risk management appears to be a relevant problem as it emphasizes equitable and balanced risk sharing among contracting stakeholders and wants to eliminate improper or unfavourable risk sharing outcomes which result in cost and time overrun and, undoubtedly, in legal disputes (Losemore and McCarthy, 2008).

In this vein, the traditional Critical Path Method, which is based on the descriptions of task flows using graphic symbols, will not be suitable for modelling information flow which controls the design phase (Yassine *et al.*, 1999). A Dependency Structure Matrix, or Design Structure Matrix (DSM), can be employed as a useful tool for coping with design issues of complex systems (Steward, 1981). The relationships between people assigned to tasks will be mapped to indicate the presence or absence of the direct relationship. This will show the strength, degree or type of relationships; risks, tasks and stakeholders have (Eppinger and Browning, 2012), but these complexities and interdependencies of tasks have resulted in inseparable risks. These kind of risks cannot be transferred or allocated to an individual, but would have to be shared collaboratively. How then do project stakeholders in collaborative teams deal with inseparable risks within their different design tasks?

### 3. IDENTIFYING INSEPARABLE RISKS WITHIN A DESIGN PHASE

The emphasis of effective RM in dealing with the broad spectrum of risks is moving beyond the traditional RM mechanics to examine the sources of unknown risks (Jarkas and Haupt 2015). Though the construction industry has managed to identify and analyze known risks, it has recognized that dealing with the hidden, less obvious aspects of uncertainty is complicated and resulting in inseparable risks, and this needs practitioners to be proactive (Smith and Merritt 2002). Inseparable risks are from uncertainties, ambiguities and arrays of risk factors that are intricately connected (Thamhain, 2013; Planning, 2017).

In practice, a typical approach to risks is trying to identify them as early as possible and respond to them as quickly as possible once identified (Kim, 2017). However, green projects anticipate unidentified risks, also known as unknown unknowns that have traditionally been underemphasized by risk management (Hillson, 2010; Thamhain, 2013). It is difficult to trace the causes and culprits of these unknown unknowns as they require inventive risk handling decisions on risk allocation (Jin *et al.*, 2017). Predicting and controlling such unknown risks has also developed unpractical risk preferences for some project stakeholders because they sometimes actively ignore them (Alles 2009). These risk attitudes have made the risk sharing process challenging (Walker, 2015).

The goal of identifying inseparable risks is to make the process of risk sharing more efficient through planning and coordination by mutual adjustment, so as to get a better information flow in design (Fundli and Drevland 2014). Design risks have been classified in a number of ways. Arguing that risks arise as a result of interactions between stakeholders, obsolete technology and organizational factors, Smith *et al.* (2009) suggested that they may be grouped as either involuntary or voluntary, depending on whether the incidents that create the risk are uncertain or beyond the control of the people in charge.

The increasing complexity of projects and knowledge processes, makes it imperative for stakeholders to be keenly aware of the intricate connections of risk variables among complex systems and processes (Thamain 2013), this limits the effectiveness of traditional RM methods. Stakeholders argue that no single person has all the smarts and insight for assessing multi-variable risks and their cascading effects (Hartono *et al.*, 2014). Project stakeholders realize that, while there may be good RM methods which provide a critically important toolset for risk management, it takes the collective thinking and collaboration of all the stakeholders to identify and deal with the complexity of inseparable risks in green building projects.

### 4. RESEARCH METHOD AND DATA ANALYSIS

For research choices, there are no ideal solutions, only a series of compromises (Amaratunga *et al.*, 2002) on how one collects and analyze

data. A case study strategy was adopted as case studies typically use a variety of data collection methods such as interviews, questionnaires, and observations (Eisenhardt, 1989). CRM is a relatively innovative concept in South Africa and, therefore, it is important to obtain a detailed and comprehensive view of it by investigating it in past and ongoing projects. In particular, how CRM is managed in design processes and how various stakeholders manage inseparable risks, were areas of interest. A mixed-method approach in order to seek practical solutions for creating a more complete picture of real-world problems (Creswell, 2013) was used.

Mixed methods are based on the idea that all methods have bias and weakness, and that by deliberately combining different methodological approaches and through triangulation of data, these weaknesses can be neutralized (Creswell, 2013). The rationale for this pragmatic view of fully adopting the integrated mixed methods (Saunders *et al.*, 2016) is to reveal complementarity, convergence and dissonance among the findings (Erzerberger & Prein, 1997).

The case study data to this investigation was collected through semi-structured interviews; with a mixture of open and close-ended questions (Brink, 2014), where participants were asked - stakeholder techniques on carrying out inseparable tasks, as well as their options and suggestions on CRM processes of green projects. The logic underlying the selection of such a data collection method was fourfold:

1. The interview is comprehensive, in-depth and can deduce validity of each response
2. Accurate screening. The individual being interviewed is unable to provide false information during screening questions such as experience, title, etc.
3. Keep focus. The interviewer is the one that has control over the interview and can keep the interviewee focused and on track to completion.
4. The interviewer can probe for explanations of response; body language and facial expressions are more clearly identified and understood

The sessions followed a pyramid model (Runeson *et al.*, 2012; Stickler and Hampel, 2015) which began with specific questions, and then the open questions during the course of the interview (Kvale and Brinkmann 2009). The main aspect considered at all times was the confidentiality of the interviewees.

The case studies selected differ as one is a completed 4-star green rating project and the other one is a green project in its design phase. The completed project is the No.3 Silo residential apartments in the V&A Waterfront which upon completion the building had to achieve a 4-star green rating, because of the significant impact of the project's design specifications. The project team of this case study reflects on the problems they faced. The other case study is an academic Forensic Pathology Facility in Johannesburg; this project is in its green design phase and the

project team is still engaging with their risks and experiences. In both these projects, many stakeholders with various backgrounds were involved and it thus was interesting to see how CRM could be applied. The objective for the interviews was to explore the possible challenges that had not been identified in the literature review of managing green construction projects; and identifying areas where inseparable risks were and could be managed. However interviewees were not limited to stakeholders in these case studies. Other referrals were utilized, using a non-probability; snowballing sampling technique based on that, only green building stakeholders are interviewed (Saunders *et al.*, 2016).

## 5. FINDINGS AND DISCUSSION

This research is still on going, more interviews will be conducted. For now, 17 semi-structured interviews with different experts were conducted to understand the current risk allocation practices and the way inseparable risks can be managed in collaborative circumstances.

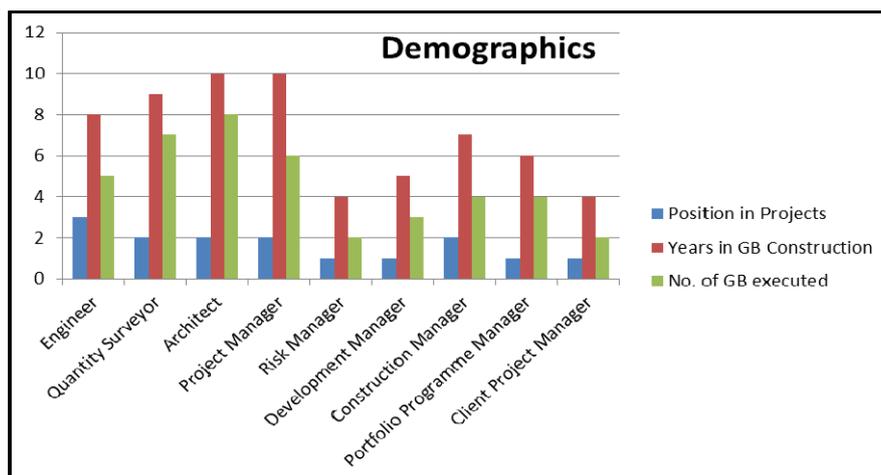


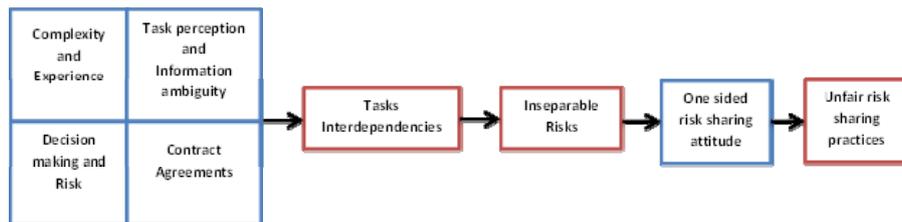
Figure 5.1: Profile of Respondents

The research was approved by the University of Witwatersrand Ethics Committee from the School of Construction Economics and Management and the interviews were conducted during January 2018 – June 2018. Based on the interviews **Figure 5.1** represents the research demographics and 65% of the projects done by the respondents were in Gauteng, 15% in the Western Cape and the other 15% was in different South African provinces, with only 5% on international projects.

Data analysis was done in two steps. First, the case analysis was done to investigate the unique patterns of each case (Eisenhardt, 1989). The analysis focused on how each project managed CRM practices. An analysis on sources of design risk, project risk management process,

collaborative activities and the design process results was achieved. Second, cross-case analysis was performed in order to examine similarities and differences in the projects. Based on the categories presented by Burns and Stalker (1961) and Geraldi (2008), comparisons on how different risk management systems were used in the two projects affected CRM.

Based on the interviews, projects are understood from the stakeholders' perspectives on how they deal with inseparable risks within their different tasks, as shown on **Figure 5.2** below.



**Figure 5.2:** Interdependent tasks and risks can lead to unfair risk sharing situations

Green building projects involve application of new technology and require new sets of skills that will allow for unfair risk sharing practices. To manage inseparable design risks, stakeholders suggested co-location where early involvement of the contractor and client will be beneficial, and the use of design management techniques. These techniques will improve coordination between disciplines and exert managerial control over the design process. Proper and timely information sharing with proportional risk sharing approaches will inspire collaborative work for better technical solutions and help in avoiding many design risks.

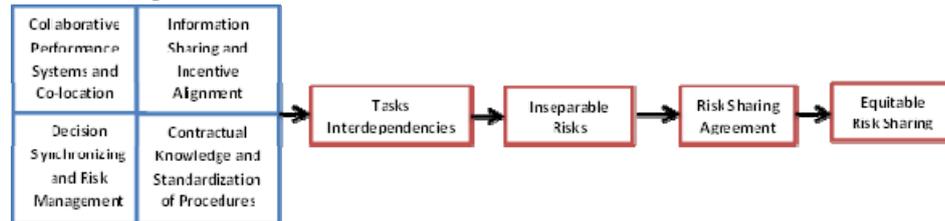
To overcome the traditional attitudes to design which is discipline oriented, all stakeholders should get GB accreditation training where attendees have the opportunity to discuss and become familiar with suitable practices of design and risk. Benchmarking performance on task completion ensures that stakeholders demonstrate significant commitment, which is fundamental to a successful change system.

Restrictive contractual clauses that impede optimal risk sharing dealings need to be edited where necessary to suit the interests of all parties in the contract and have a clear unambiguous language. In order to judge the collaborative climate and satisfaction of each stakeholder in the design team, stakeholders suggested contracts negotiation and communication as key to ensuring that all parties are able to perform their respective task adequately. CRM and Value Engineering workshops had to be on-going for Silo no.3 project and for the Forensic Lab, arrangements are being implemented.

The notion of shared insurance for specific design risks was mentioned, so to balance the risks fairly between stakeholders; in absence of bad faith; leading to a reasonable price; qualitative performance and the minimization of disputes. This will dedicate specific contingency budgets and reserve margins to each risk area. Also, there is an emergence of new

roles: the use a project risk manager, a BIM manager and a partnering or alliance facilitator to evaluate risk, identify potential cost impacts and develop contingency plans.

Views on risk sharing by different stakeholders would be through, the parties' efficient behaviour (efficiency), and the fair attitudes to share the consequences depending on the capability of the parties (fairness) as shown in **Figure 5.3**.



**Figure 5.3:** Interdependent tasks and risks can have an equitable risk sharing solution

Risk sharing allows the project to utilize the best in-class expertise and knowledge; it reduces the upfront non-recurring investment of time and cost for each partner; and, it motivates all partners to expand the market so everyone can benefit. So, decisions on sharing risks rely on stakeholders having to assign risks prudently by means of flexible contractual formats.

A fair and equitable risk sharing is essential to ensuring a successful delivery of a project design. Stakeholders must work collaboratively to seek an equitable sharing of risk based on an appropriate methodology that seeks to allocate design risks in an efficient manner and with specific considerations. In doing so, the intention will be to reduce project disputes and benefit of all parties.

## 6. CONCLUSION

Due to the dynamic, complex nature of green designs and the interplay of multi-stakeholders, RM processes used require collaboration between the stakeholders. The collaboration needed has been amplified by the interdependencies of stakeholders and their tasks, and this require integrated database to ensure the consistency and integrity of project data, enabling efficient data sharing and exchange throughout the design life cycle, and enable timely access to up-to-date project information. These information dependencies have resulted in dependable tasks which in turn result to inseparable risks, which are highly intertwined and difficult to uncouple.

Collaborative risk management is presented an approach that will aid the construction industry to improve its risk management practices; a solution that emphasizes equitable and balanced risk sharing among contracting stakeholders; and would help to eliminate improper or unfavourable risk sharing outcomes which result in cost and time overrun and, undoubtedly, in legal disputes. It can potentially improve the overall

quality of designing complex projects and be used as a tool by both researchers and practitioners to introduce a better decision support mechanism for collaborated risk management.

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## The perception of waste water reuse in South African construction

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### ABSTRACT AND KEYWORDS

#### Purpose of this paper

Many parts of South Africa have, for a long time, experienced intermittent drought or water paucity. The construction sector accords a notable contribution towards South African employment and economic progress, and it expends a considerable amount of water (approximately 3,98 million m<sup>3</sup>) annually. This study aims to determine the possibility of implementing reclaimed waste water in construction-related operations, to mitigate the effects of the industry on South African freshwater resources, and its reliance thereon.

#### Design/methodology/approach

Qualitative, semi-structured interviews were conducted with ten South African construction contractors in the province of KwaZulu-Natal. The sample was purposively selected from contractors registered with the KwaZulu-Natal Master Builders Association. The collected data was thematically analysed.

#### Findings

The analysis of the research data revealed a strong inclination toward capitalising on the potential of reusing waste water in South African construction, provided concerns regarding quality assurance, standardisation, and awareness are met by both the private and public sectors alike.

**Research limitations/implications**

The sample taken only included South African construction contractors registered with the Master Builders Association of KwaZulu-Natal.

**Practical implications/value of paper?**

This study may assist in improving the water usage of the country and its construction industry, minimising the impact of drought and water scarcity and their effects; and further enhancing sustainability in construction.

**Response to the Conference Theme**

Sustainable construction

**Keywords:** Sustainable construction, reclaimed wastewater, water scarcity

**1. INTRODUCTION**

South Africa is a semi-arid, water-stressed country (Claassen, 2010); and of recent Cape Town, one of South Africa's premier cities, has been experiencing severe water shortages due to prolonged drought in the region (Galvin, 2018). The negative impact of the water shortage has encroached upon the industrial and construction sectors, and the problem is so severe that companies in the industry are having to downsize, and delay their projects undertaken (MacNamara, 2017). At the 2017 Annual Congress of the Master Builders Association South Africa, Cape Town's deputy executive mayor, Ian Neilson, advised that treating and re-using effluent water is a sustainable direction for construction and the environment (Smith, 2017). Affirming Asano, Leverenz and Devine (1996), in their assertion, that it is no longer appropriate to see waste water as 'waste', but rather as an invaluable resource that can be used. This study aims to explore the perception of South African construction contractors on implementing reclaimed wastewater in construction-related operations, to mitigate the effects of the industry on South African freshwater resources, and its reliance thereon.

**2. LITERATURE REVIEW**

Water is an indispensable global resource on which all life forms depend. The global population relies on water not only to sustain life, but also to create and maintain the world we live in, and our standard of living. According to TheWorldCounts (2014), the planet's water is constituent of only 3% of fresh, potable water, of which on average quotidian global basis 10 billion tons is consumed; and of which approximately 4 trillion cubic

meters is expended per year. To make matters worse, approximately two-thirds of the 3% that is freshwater, is not readily available for human consumption due to it being part of glaciers or situated in an inaccessible place (*ibid*). It has been estimated that by the year 2025, two-thirds of the global community will likely experience water scarcity (World Wildlife Fund, 2018).

It has been found that about 167 litres of water per person are used in the production of items used every day such as clothing and paper; and that around 3 496 litres per person per day is used in the production of food items such person consumes (TheWorldCounts, 2014). However, in recent years, this valuable resource has been challenged by many threats which continue to grow in magnitude and effect. The impacts of these threats have adversely affected water availability and quality, resulting in evident increases in global water scarcity. The most significant of such threats are: an ever-rising global population, worldwide climate change, and pollution (Jhansi and Mishra, 2013).

Based on this analysis, it is definitive that water is a precious, limited resource which is exposed to escalating pressure, rendering its prospective state vulnerable and uncertain that it will be sustained. It is evident that a much more sustainable method of meeting growing national demands is required, as current plans are severely inadequate to reconcile future national water withdrawals with future national supply (Hedden, 2016).

## **2.1 An Overview of Water Consumption**

According to Worldometers (2018) water consumption statistics, global water consumption can be categorised as 70% consumption by agriculture, 20% by industry, and 10% to domiciliary use. It has been found that in South Africa the average water consumption per capita per day is approximately 233 litres, which is higher than the average estimated global consumption of 173 litres per capita per day (Makou, 2018). Up to 61% of South African water consumption is claimed by the agricultural sector, with domestic consumption approximating 27% (inclusive of consumption by the construction industry) and industry claiming approximately 7% (Department of Water & Sanitation, 2018). Our water resources and its management are central to the rapid socio-economic growth the country is undergoing. The total estimated yield per annum derived from surface runoff (excluding Lesotho and Swaziland) is approximately 13 227 million m<sup>3</sup>/a, and total water use requirements are approximately 12 871 million m<sup>3</sup>/a (DWAf, 2004).

## **2.2 Current alternative water sources in Africa**

Much of Africa relies on two significant, alternative water sources for its drinking water: rainwater and groundwater. Rainwater harvesting is a

common practice in Africa and has been found to be a safer drinking water source as compared to many treatments employed within decentralised systems; however, it is advised that such water be well-treated prior to consumption as it can contain bacteria such as *Salmonella* which can cause bacterial diarrhoea, and *Legionella* which can cause bacterial pneumonia. Groundwater, despite being relied upon by approximately 75% of Africans for drinking water, is becoming increasingly difficult to extract. Additionally, the quality of the water has in recent years deteriorated, particularly due to pollution, and has been found to contain increasing amounts of elements that can be detrimental to human health if consumed in large quantities, such as Fluoride (Wang, Wang, Zhang, Li, Toure, Omosa, Chiramba, Abdel-Monem and Pradhan, 2013).

### **2.2.1 Challenges associated with the implementation of reclaimed wastewater systems**

Several factors have been found to hinder the progression in respect of water treatment and waste water treatment and reclamation in African countries such as Kenya, and Nairobi (Wang *et al.*, 2013):

- a lack of financial resources and unreliable power supply systems have led to the rare adoption of conventional treatment processes such as activated sludge treatment: Treatment plants cannot efficiently operate without a sustained power supply system;
- inadequate waste treatment infrastructure. Sewer collection is often limited or there are inefficient methods of sewer collection adopted, therefore making treatment difficult. Additionally, many countries do not have the appropriate equipment to monitor water quality and composition;
- many countries cannot afford to upgrade their waste treatment facilities and monitoring equipment, and in some cases, governments are not willing to make such investments. Not many efforts or initiatives are endorsed by the communities as the locals often believe that it is the responsibility of governments and local authorities to provide waste treatment and sanitation facilities;
- existing waterworks systems and wastewater treatment plants are often badly operated and ill-maintained. Industrial wastes are often not treated appropriately as manufacturers are not knowledgeable of the relevant technologies required to eradicate pollutants in such wastes, or they are often inexperienced in respect thereto.

### **2.2.2 Reclaimed waste water**

'Reclaimed waste water' or, 'reusable' or, 'recyclable water' is water that has been used more than once prior to it returning to the natural water cycle (Jhansi and Mishra, 2013). It entails the rarefaction of wastewater to reinstate it to a required quality fit for its intended purpose (Wang *et al.*,

2013). Blackwater (namely: sewage or building waste inclusive of sewage waste), greywater (building waste exclusive of sewage waste), and rainwater or storm water run-off can be treated for reuse (*ibid*).

According to Lu and Leung (2003), in urban areas wastewater is commonly sourced from four areas, namely: industry (inclusive of food processing, metal processing, textiles, etc.), commercial (inclusive of airports, hotels, restaurants, etc.), municipal or domestic (inclusive of recreational facilities and households), and institutional (inclusive of schools, prisons, etc.). The typical reclamation process involves the separation of the wastewater in respect of its source prior to treatment; the application of primary, secondary or tertiary treatment processes depending on the required quality of the treated wastewater; and quality control in respect of odour control and de-chlorination.

Wastewater reclamation systems can be categorised into two types, namely centralised systems (or municipal-based systems) and decentralised systems (or privately controlled systems) (Wang *et al.*, 2013). These two systems supply much of Africa's drinking water, yet the water obtained via decentralised systems is often improperly treated as it is sourced and supplied by individual vendors, and there is no standardised, stringent evaluation and monitoring system thereto to enforce acceptable standards or control the water quality (*ibid*).

### 2.2.3 Local Reclamation

According to a 2011 report by the Department of Water Affairs, water reuse and reclamation is encouraged as it a much more efficient way of utilising an already limited resource. The positive benefits of reusing water are:

- protection of aquatic ecosystems by not having to extract more water from the sources, and;
- avoiding degradation of water resources by not discharging waste water.

On a domestic level, the reuse of waste water resulted in a saline waste stream. On an industrial (mining) level, the reuse of waste water resulted in a brine and sludge waste stream with some useful by-products, such as gypsum. The report concluded that these waste streams can be managed responsibly and appropriately, and the value of water reuse must not be negated but evaluated further (DWA, 2011).

Current innovations in the industrial sector have already started capitalising on this potential resource in the Olifants Water Management Areas (WMA), where the reclamation of excess mine water into potable water for local municipalities has been remarked as the future source of water to meet growing demands in the area (DWA, 2011).

The mining water reclamation projects in Olifants WMA and Emalahleni have also demonstrated further incentives through generating saleable by-products that are likely to be in short supply, such as lime and limestone, thereby reducing operational costs of treatment (DWA, 2011).

Enterprising of by-products is further encouraged by Manders, Godfrey and Hobbs (2009) stating, "When the value of treated water and by-products exceeds the cost of treatment, it is feasible to create enterprises that will provide economic benefits while dealing with the environmental problems". Although the principal beneficiaries of these treatment plants are the municipalities, the receiving aquatic environments arguably benefit the most from these initiatives (Hobbs, Oelofse and Rascher, 2008).

### **2.3 Benefits of water reclamation**

The main advantages of water reclamation according to Matthews (2015), are:

- it is less chemical- and labour-intensive than traditional treatment plants (can be fully automated);
- it is more effective in removing contaminants than traditional treatment plants;
- it conserves the available water supply, reducing the need to extract more from surface or groundwater sources;
- the reliance on dams and inter-basin transfer schemes is reduced;
- the volume of treated effluent water discharged into aquatic systems where ecological changes may be disruptive, is significantly reduced;
- the costs associated with all the above are reduced.

### **2.4 Disadvantages of water reclamation**

The main disadvantages of water reclamation are:

- while water reclamation is cheaper than using potable water for industrial purposes, it is considerably much more expensive for drinking purposes;
- environmental footprint being too varied;
- the installation of new pipelines and high-pressure pumps are expensive;
- high energy costs due to expensive treatment methods;
- it is difficult to dispose of by-products, such as high-concentration brine (Matthews, 2015).

## **3. RESEARCH METHOD**

The qualitative (exploratory) method was used for this study. This method entails gaining deeper insight into the reasoning of the research participants (Naoum, 2013). A semi-structured interview was utilised as the research instrument to collect data from ten South African construction contractors based in KwaZulu-Natal. The sample was selected from the

South African construction contractors registered with the KwaZulu-Natal Master Builders Association. The interview was designed to gauge construction contractor perspectives on the use of reclaimed waste water, and the reuse of on-site recycled water, in construction, the methods used, and the challenges associated therewith. The collected data was thematically analysed (Maguire and Delahunt, 2017).

#### 4. ANALYSIS

The data collected was categorised into three themes, namely: perception, challenges, and methods.

##### 4.1 Perception

Generally, the participants (60%) had a positive impression in terms of reusing water. Two out of ten participants felt that it has potential for use in construction with the *“correct technology and opportunities”*. In contrast, one participant felt that *“financial implications”* in terms of reclamation and transportation of the water, is a significant factor to consider; and another participant felt that *“there will be lots of hurdles to overcome, especially using greywater”*. Two participants have had previous experience with reclaimed or recycled waste water use in the industry, one of these areas being in the uMbogintwini region.

In respect of what can be done to improve the reception and acceptance of reclaimed waste water use in industry, the following were highlighted:

- reclaimed waste water reuse should be regulated via legislation, specifically for establishing standards in respect of quality and health and safety;
- there should be more enforcement from the private sector regarding waste water reuse;
- awareness should be established and promulgated through education, especially at secondary and tertiary levels;
- an *“affordability study”* or *“cost analysis”* should be executed prior to considering widescale implementation in construction, to determine the feasibility thereof;
- *“tests should be conducted on cement and clay-based products to determine whether such materials, and the products made therefrom, are adversely affected by the implementation of reclaimed waste water”*.

In response to being asked whether all activities on site require water of a potable quality, six out of ten participants said yes. Examples of activities that require potable water, that they provided, were:

- cleaning (*“it is preferred, but it is not a major issue”*);

- “any activity requiring a mixture with water” should have potable water, such as “plastering, brick-laying, concreting, tiling” and “addition to skimming compounds”;
- drinking water;
- hand-washing (hygiene);
- maintaining, cleaning and servicing machinery and vehicles (“we do not want to damage the working parts”).

One participant said that we will experience a “relapse of the building industry if no potable water is available: water of a potable quality is needed on site”. However, one interviewee felt that activities that do not require potable-quality water are ground compaction and “perhaps in concrete and mortar mixes”.

Participants were asked if they would recommend that their company utilise reclaimed waste water on site, and if so, why: 70% of the participants said yes with the main reason being to preserve water. The two most commonly mentioned activities for using reclaimed water were for use in cleaning on site, and for the operation of site ablutions such as the flushing of toilets. One participant said that, “if treated (the water) can be used for everything apart from drinking”.

Furthermore, they were what would need to happen from a company perspective in order to reuse water and the following responses were received:

- from a company perspective, the reuse of waste water should be adopted as ‘good practice’, and
- that awareness and education on site are key factors in enforcing this: “if (people) are not educated, policies would have to be used and you cannot police everything”.
- “definitely policies need to be drafted for it to be taken seriously. Most of the time it is taken as a paper exercise”.

However two participants said this decision is cost-dependent: one participant often works in rural areas where there is “very little water on site; and if you need to transport it, there are huge transportation costs”.

In response to what alternatives to waste water reclamation they would consider on behalf of their company, as an alternative water source in construction work, four out of ten participants said borehole water; with two out of ten participants stating that cost is a significant consideration in such decision. One participant said that it is dependent on “project location and duration”, to which another concurred, saying that they would not “adopt specific alternatives” as the projects they undertake are commonly for a short duration. Another participant currently uses rainwater and water sourced from a river in the region in which they frequently operate.

In respect of the sustainable management of water, participants were asked if they think water reclamation and reuse is the responsibility of companies, consumers, the, municipality or all three: 90% of the participants felt that it is the responsibility of all three. One participant felt that “it should be a joint initiative by all parties and all South Africans”; while

another stated that *“we have to work together to make something work”*. However one participant felt that the municipality must enforce or *“police”* the implementation, but it is the responsibility of property developers to *“take initiative”*.

In response to being asked if they feel using reclaimed waste water in construction poses a sustainable alternative, considering the demands of the sector and the nature of construction:

- six out of ten participants said yes:
  - *“because construction is so vast, and the work is extended to many different areas”*
  - *“we need to be able to recycle for use in industry”*
  - *“it certainly would help a dire situation at present, and looking ahead it is possibly the way to go”*;
- one participant would only use it if it was *“necessary”*: *“I won’t use it if the dams are full...”*;
- one participant said that it is dependent on several factors such as how much water can be reclaimed and what the client needs are in terms of savings on a project;
- Furthermore, they said that *“more research needs to go into finding a common ground”* and that *“saving water depends on everyone and on each company”*, meaning that it comes down to the individual’s outlook and willingness to save and adapt;
- another participant said that it will not be a viable solution as, in construction, *“we are constantly moving, and transportation of such water can be costly”*.

#### 4.2 Challenges

Regarding the adoption of reclaimed waste water in construction, participants were asked what challenges they foresee, and what can be done to overcome such challenges:

- *“there is a stigma in South Africa to reuse greywater”*;
- Concerns were raised over potential risks associated with variance in water quality: one participant stated that *“potable quality water is prescribed”* and a *“constant and reliable (water) source on site”* is needed *“especially for mixing”*. Additionally, one participant felt that there would be high costs associated with producing water of the required quality;
- Concerns were also expressed over health and safety, specifically when working with the water and if it is possibly consumed on site;
- One participant stated that odour could possibly be an issue; and another that storing water on site may bring mosquitoes, which can especially pose a problem in residential areas;
- Possible jeopardising of products such as concrete, and their properties such as *“strength and durability”*;

- one participant mentioned that in rural areas, where freshwater is already scarce and often of poor quality, it may be difficult to implement a reclaimed waste water system;
- It was also expressed that the challenges would depend on the location and nature of the site, and on the availability of reclaimed water for reuse.

In overcoming such challenges, it was stated by four participants that standardising treatment methods and water quality control testing could assure quality thereby promulgating reuse in industry. However, two out of ten participants argued that this may be expensive. Contrarily, another participant argued that tests are important in determining whether the water has any adverse effects on cement-based products, and in ensuring that the desired water quality is maintained. One participant mentioned that awareness may alleviate stigma: *“I think that with awareness and explanation, as well as allowing the public access to control test results, (it) will help ease the challenges”*.

#### 4.3 Methods

When asked if they currently reuse any water on site, whether it be through direct reuse on site or through recycled water sourced from a water reclamation plant, six out of ten participants said they reuse waste water generated on site. This water is implemented for the cleaning of tools, washing of vehicles, hand-washing and in concrete mixing. Interestingly, none of the participants treated the waste water by any means prior to implementing it in the concrete or mortar mix.

For those participants that do not reuse waste water, the following reasons were provided:

- there is often little to no water left over to be reused;
- the water often contains cement and therefore cannot be reused;
- we are often told *“not to use it”* and we are not often *“encouraged”* to use it;
- reclaimed waste water is not currently available on a widespread scale;
- concerns over quality and how it will affect the end-product, such as concrete used in foundations;
- unavailable sources on site, for example, Jojo tanks;
- one participant mentioned that because they are constantly moving, they use whatever water is readily available, which is most commonly municipally-supplied freshwater.

## 5. CONCLUSION AND RECOMMENDATIONS

The consensus among the participants is that reclaimed waste water has high reuse potential in construction. However, the most notable concerns are whether the water is of the required industry standard and quality, health and safety considerations, and a general lack of awareness, knowledge and information of application in industry. Additionally, there is a lack of support and enforcement, especially from the executive levels of organisations: several participants have highlighted that managerial bodies should initiate such policies and strategies and ensure that they are heeded by the lower levels of the organisation. If there are no prescribed methodologies for water use and reclamation, contractors often opt for the more profitable option even if it is not the most environmentally-conscious or resource-efficient.

## 6. RECOMMENDATIONS

Industry quality assurance standards should be established and approved to make the recycled waste water suitable for use in all construction-related activities, simultaneously mitigating health and safety concerns. Managerial levels of companies and organisations should take more initiative by researching the applications of reclaimed waste water in industry and educate their companies thereof; making provision for such principles and practices in their strategies and operations. Municipalities can expand the availability and accessibility of reclaimed waste water. Additionally, the use of reclaimed waste water can be incentivised, for example, providing contractors who adopt the practice with a rebate, as is the case with solar water heating in South Africa.

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## **A Development Framework for Private Sector Retirement Accommodation**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The main objective of the study was to develop a framework to ensure success when developing retirement accommodation within the private sector.

#### **Design/methodology/approach**

The empirical study was conducted using a quantitative statistical approach by distributing research questionnaires to members falling within the sample population.

#### **Findings**

The salient findings suggest that: design specifications are not suited to the performance requirements of elderly residents; safety in villages impacts the quality of life of residents; residents are bored as there are insufficient social and recreational activities offered; the lack of frail care facilities provided to residents impacts on their dependency, and the type of ownership affects residents cost of living.

#### **Research limitations/implications**

The study was limited to the Kingshurst retirement apartment block, in Port Elizabeth, the Republic of South Africa.

#### **Practical implications**

The research study investigated the challenges faced by management and residents operating and living in the Kingshurst Retirement Centre in Port Elizabeth, South Africa.

#### **What is original/value of paper?**

This study will assist property developers and operators with a framework to to improve retirement accommodation in the private sector.

#### **Response to the Conference Theme**

Sustainable Human Settlements and Challenges

**Keywords:** Affordability; Design; Ownership; Quality of Life; Retirement Accommodation

### **1. INTRODUCTION**

Many studies have been conducted in other parts of the world, investigating the operation of retirement accommodation. With only a few such studies taking place in South Africa, this study will analyse the retirement culture in the Republic of South Africa, with specific focus on the Port Elizabeth region. This study investigates the adequacy and performance of existing retirement accommodation. The aim of the study is to analyse existing retirement accommodation and to determine how future accommodation can improve, based on a case study. Elder occupants move out of their houses due to their existing homes not meeting the required design requirements and therefore expect that the specially designed accommodation will be able to satisfy their changing needs (Preiser & Smith, 2011: 25.1).

This study will inter alia analyse what residents whom participate in this study perceive needs to be improved in the retirement village which they reside. Residents and management are asked to rank certain aspects of the village to enable proving of the hypotheses and solving of the subproblems. The statement of the problem reads as follows: "There is currently a shortage of retirement accommodation, which is disproportionately expensive, is not suited to the physiological needs of the elderly residents, generally does not offer frail care facilities, engenders security concerns, and the tenants are bored."

### **2. REVIEW OF THE LITERATURE**

Thirty nine percent of South African Republic citizens reported aging as a problem in a study conducted by Barker et al. (2014:5). Persons aged older than 65 years constitutes 5.2% of South Africa's population and is projected to increase to 10.5% by 2050 (Barker et al. 2014:6). the United Nations (2009) said in Hollinrake & Thomas (2015:421) that the older population of the world is growing at a rate faster than the global population. Cohn

(2010:22) encourages persons whom would like to take advantage of the demographical changes towards an elder population, to invest in companies that cater for senior citizens.

Economic growth is limited directly and indirectly when there are not many houses being built (Industrial Systems Research, 2013:2). Andrews (2012:43) says that many people first start to consider the purchase of a retirement home when they are in their mid to late sixties. Different cultures have different perceptions and expectations of retirement accommodation (Brooker & Weinthal, 2013:330). According to Hu, et al. (2017:101) the first baby boomers turned 65 years of age in 2011 and it is expected that this generation will continue experiencing phenomenal growth.

## 2.1 Affordability

Affordability of housing for moderate to low income households is a growing concern (Berens, et al., 2007:384). Affordability of housing is analysed based on two principles, firstly by measuring the ratio of housing cost to income and secondly by comparing expendable income after housing expenses are met (Jones & Watkins 2009:129). Owners of existing homes can sell these in order to obtain liquidity and afford retirement accommodation (Ball & Nanda, 2013:50). Andrews (2012:39) states that one's ability to fund the purchase of a retirement home is largely dependent on the value of your existing home. The growth experienced by the retirement housing market drives new forms of developments in the housing sector (Berens, et al., 2007:556), with the private retirement market being primarily driven by lifestyle preferences, health needs and the ability to pay (Berens, et al., 2007:23).

Globalisation and urbanisation is causing urban housing market growth and re-structuring urban cities (Pieterse, 2008:67) and require specific performance standards (Pieterse, 2008:17). Croucher (2006) says that a key issue faced by retirement villages, is making them accessible to people from different financial backgrounds (cited in Jian, et al., 2014:368-369). Cost Burden occurs when residents overspend on housing accommodation and their ability to pay for other essentials are diminished (Mallach, 2009:4).

Prospective home owners are faced with two financial challenges, either being unable to meet down payment amounts and secondly, not being able to pay the monthly rental amount (Berens, et al., 2007:383). Expensive house prices negatively affect economic growth, stability, disposable income and quality of living (Industrial Systems Research, 2013:1).

## 2.2 Supply Constraints

Affordability of housing is not only concerned with maintaining affordability in the market segment but must also ensure that more such housing is constructed (Mallach, 2009:239). Land is more expensive in high demand areas and as result developers build more luxurious homes, which are bigger in size and can be marketed at above market value in such locations (Mallach, 2009:14). The shortage experienced in the segmented retirement housing sector will force retirees to live in their existing homes, causing shortages in other segments too (Ball & Nanda, 2013:60). The housing policies will have to be adjusted in order to meet future demands, as the current system guarantees shortfalls (Ball & Nanda, 2013:46).

## 2.3 Regulations

A proper functioning housing planning system incorporates skills and knowledge to address technical and conceptual requirements of each segment (Jones & Watkins, 2009:181). Excessive regulations increases building costs and reduces the housing sector's ability to satisfy demands. Functional quality housing ensures robust health in later years of life (Grant, 2006:103). Developers whom operate in highly priced markets are more concerned with time delays than with the environmental compliance costs involved (Logan, et al., 2009:108). These environmental costs either increase selling prices or reduces the developer's profit margins (Logan, et al., 2009:109). Cooper, et al. (2009:57) states that building regulations helps to create healthy living environments.

## 2.4 Design Performance

Elderly residents have very specific design requirements according to Jian, et al. (2014:366), which contributes to the existing shortage of retirement village accommodation. Design layouts must allow for tenants to live independently, even though in a communal environment (Brooker & Weinthal, 2013:232). Aesthetical appearance of a building does not guarantee functionality and visa versa (Mallach, 2009:53). Clients make use of registered professionals, because they expect a certain standard of training and experiece (Brooker & Weinthal, 2013:82) The current generation of designers, building owners and operators had little involvement and understanding of the needs demanded by the growing aging populations (Preiser & Smith 2011: 6.6).

Jian, et al. (2014:377) foud that the green features which have been incorporated into the development, not only made the retirement village more environmentally friendly, but also automatically addressed the special requirements of the elder residents. The predominant amount of houses built today will be still be standing in the year 2050, with a few will still being inhabited in the year 2100 (Mallach, 2009:54). Jian, et al. (2014:366) argue that one of the main reasons for retirees benefitting from green buildings, is that elderly occupants not only spend more time indoors, but also pay less for their energy usage bills than the average user when incorporating green features.

Stimson and McCrea (2004) distinguishes between 'push' and 'pull' factors which influences one's reasoning for moving into retirement accommodation (as cited in Hu, et al., 2017:104). Push factors are listed as lifestyle changes, home maintenance responsibilities, social isolation problems, health issues and mobility constraints, while pull factors relates to the environment, affordability, locational attributes of the village and ability to maintain the same lifestyle standard.

## 2.5 Frail Care

People often do not realise all the different health care options associated with the different types of villages according to Hollinrake & Thomas (2015:426). According to Preiser & Smith (2011: 30.2) many special care providers experience inconvenience and work in unsafe conditions to care for the elderly. Andrews (2012:51) says that high care accommodation provides low return rates and is only used as a selling feature to attract new buyers, which is the village operator's main income source. It is therefore that high care units do not provide specialised care (Andrews, 2012:51). Reasons for adding such facilities is driven by external demand and or is often determined by the size of the development (Mallach, 2009:69). It is important to consider cost implications involved when providing medical support services (Industrial Systems Research, 2013: 128). It is forecasted that medical expenditure, demand for caregivers, quality medical care and retirement housing will continue growing, fuelled by a rise in demand, costs and life expectancy (Cohn, 2010:22).

## 2.6 Offering of Social and Recreational Activities

Single residents often isolate themselves when they grow older, with specialised accommodation helping overcome such difficulties, by providing them with socialising opportunities (Ball & Nanda, 2013:53). Grant (2006:107) describes retirement villages as a place with opportunities to grow and develop. Developers of retirement villages usually brake the conventional boundaries related to retirement (Grant, 2006:100). Examples hereof includes development of resort style villages, as these usually offer a wider range of facilities and services (Buys et al, 2017:103). Villages with amenities such as sport centres, swimming pools, multi-purpose sports halls, tennis courts, Jacuzzi's, landscaped gardens, lounges and other exclusive facilities attracts younger and more active residents according to Industrial Systems Research (2013: 116-117). Xia et al., (2014a) says that larger for-profit retirement villages are able to provide a greater number of facilities than smaller non-profit villages, as cited in Hu, et al. (2017:106). These amenities assist in adding 'value for money' to a property (Industrial Systems Research, 2013: 12). Providing a myriad of services and facilities to residents is not always a solution, because they are not all equally desired and used (Miller & Buys, 2007; Nathan et al., 2013) as cited in Hu, et al. (2017:106). Benefits of living in retirement villages includes improved quality of life, independency and encouragement of social interaction according to Gardner et al. (2005) as cited in Hu, et al. (2017:101).

### 3. RESEARCH METHODOLOGY

This study follows a quantitative approach to analyse the Kingshurst retirement complex as a case study. Two similar questionnaires were evolved, aimed at village management and village residents. The researcher reports inclusively on the findings gained from the perspectives of all parties and uses it to link the related sub-problems and hypotheses by following a holistic approach. The aim is to develop optimum insight into the retirement industry and its performance. The data collection process was administered by the village sister, as to respect the vulnerable position of the elderly.

### 4. DISCUSSION OF RESULTS

Majority of the respondents were of a Caucasian origin, with the gender ratio being distributed with 64 percent of the population sample being female and only 36 percent male. Fifty percent of the females reported to be living alone, whilst only 30 percent of the males live alone.

The average age of residents was found to be 75 years, while the average period which residents have lived in the village is 5 years. This means that most of the residents obtained life right (also when they moved into the village) at an age of 70 years. Table 1 indicates that management and residents reported that there are a sufficient amount amenities available to host social and recreational gatherings, though not enough of these events are being organised.

Table 1: Management's rating of activities and amenities

Statement	Response (%)						MS	Rank
	U	Strongly Disagree.....Strongly Agree						
		1	2	3	4	5		
There are sufficient amount of amenities to host social and recreational activities	0.00	0.00	0.00	25.00	75.00	0.00	3.75	1
There are enough activities offered to keep residents entertained	0.00	0.00	50.00	50.00	0.00	0.00	2.50	2

Table 2 indicates that management and residents respectively rated the bedroom designs with a MS of 3.50 and 4. From the open responses, a resident respondent complained about bathrooms not being designed in an all-user friendly manner and said that bathrooms should be made wheelchair friendly. The managements' rating of the bathroom design was similar to the results presented from the residents in the table below.

Table 2: Resident's rating of the bathroom design

Parameter	U	Poor.....Good					MS	Rank
		1	2	3	4	5		
Shower design	0.00	9.09	27.27	9.09	18.18	36.36	3.80	1
Toilet	0.00	9.09	27.27	9.09	18.18	36.36	3.80	2
Wash basin	0.00	9.09	27.27	9.09	18.18	36.36	3.80	3
Bathroom overall design	0.00	22.22	22.22	11.11	11.11	33.33	2.80	4
Bath design (if applicable)	0.00	25.00	25.00	25.00	12.50	12.50	2.10	5

Table 3 and 4 below represents the safety and privacy aspects of the village. All parameters in the resident table scored a MS of above 3.60, while management rated all factors with a MS of 3.67 and above. The main difference between the two tables is that management ranked privacy higher than safety, whilst residents ranked the converse – with safety being more important than privacy.

Table 3: Residents perspective of privacy and safety

Parameter	U	Poor.....Good					MS	Rank
		1	2	3	4	5		
Feeling safe indoors	0.00	0.00	0.00	0.00	20.00	80.00	4.80	1
Indoor privacy	0.00	0.00	0.00	10.00	0.00	90.00	4.80	2
Awareness of emergency evacuation plan procedures	0.00	0.00	0.00	10.00	30.00	60.00	4.50	3
Outdoor privacy	0.00	0.00	0.00	44.44	22.22	33.33	3.89	4
Feeling safe outdoors	0.00	0.00	0.00	60.00	20.00	20.00	3.60	5

Table 4: Management's perspective of privacy and safety

Parameter	U	Minor.....Major					MS	Rank
		1	2	3	4	5		
Creating indoor privacy	0.00	0.00	0.00	0.00	66.67	33.33	4.33	1
Creating outdoor privacy	0.00	0.00	0.00	0.00	66.67	33.33	4.33	2
Design of emergency evacuation plan	0.00	0.00	0.00	0.00	66.67	33.33	4.33	3
Creating safe indoor environments	0.00	0.00	0.00	33.33	33.33	33.33	4.00	4
Creating safe outdoor environments	0.00	0.00	0.00	33.33	66.67	0.00	3.67	5

The researcher included a question that investigated the financial implications and quality of frail care offered by the village. The question was left unanswered, as the village operator later confirmed that only a nursing sister service is offered. Spatial provisions have been made in the building for a frail care unit, but was not in existence at the time of conducting the study. Open responses from management later confirmed that the viability of a frail care unit is determined by economy of scale.

Only the impact of life right ownership can be determined from this study, as it is the only form of ownership offered by the village operator. The life right model allows persons to reside in the unit for the rest of their living lives. Upon exiting the village, a fee is paid to the village operator, as determined by the contractual agreement. The life right ownership model allows the developer to retain ownership over the property, therefore allowing change of the building's usage in future time – should the retirement complex no longer be the best and highest potential usage of the site. Resident are benefitted too in this ownership model, seen that a requirement of the life right model is the operator having to provide an estimate of the levies in advance (as was evidentially provided to the researcher at the time of conducting the study). Residents whom are currently participating in physical training activities scored a lower MS than those whom would actually make use of physical training facilities (whether free or required to pay). This can be deemed that residents would start being more active when the facilities are placed in the building. More residents would make use of a free gym services than when expected to pay for such a service. As per the literature review, amenities such as gymnasiums helps to attract younger residents. One cannot help but to wonder what the average age would have been, should more resort style amenities have been offered in the village.

Table 5: Analysing physical training activities

Statement	Response (%)					MS	Rank	
	U	Strongly Disagree.....Strongly Agree						
		1	2	3	4			5
I would make use of a village gymnasium if my village offered free membership	0.00	18.18	9.09	36.36	27.27	9.09	3.00	1
I would make use of a village gymnasium if I had to pay for the membership	0.00	18.18	9.09	54.55	9.09	9.09	2.82	2
I participate in physical training activities which are not offered by the village, such as sport for example	0.00	30.00	0.00	50.00	10.00	10.00	2.70	3

The Büchner illustrative framework below is the researcher's own construction of the hypothesis which has been proven to be valid. Hypotheses in the framework are arranged by the average MS which was achieved in the various interrelated questions. The parameters bearing the greatest MS weight is placed at the top and is closest to the dependent variable ('Perceived Successful Development of Retirement Accommodation in the Private Sector). Items displaying 'No MS' are proven to affect the successful development of retirement accommodation, though their magnitude of impact could not be determined from this study.

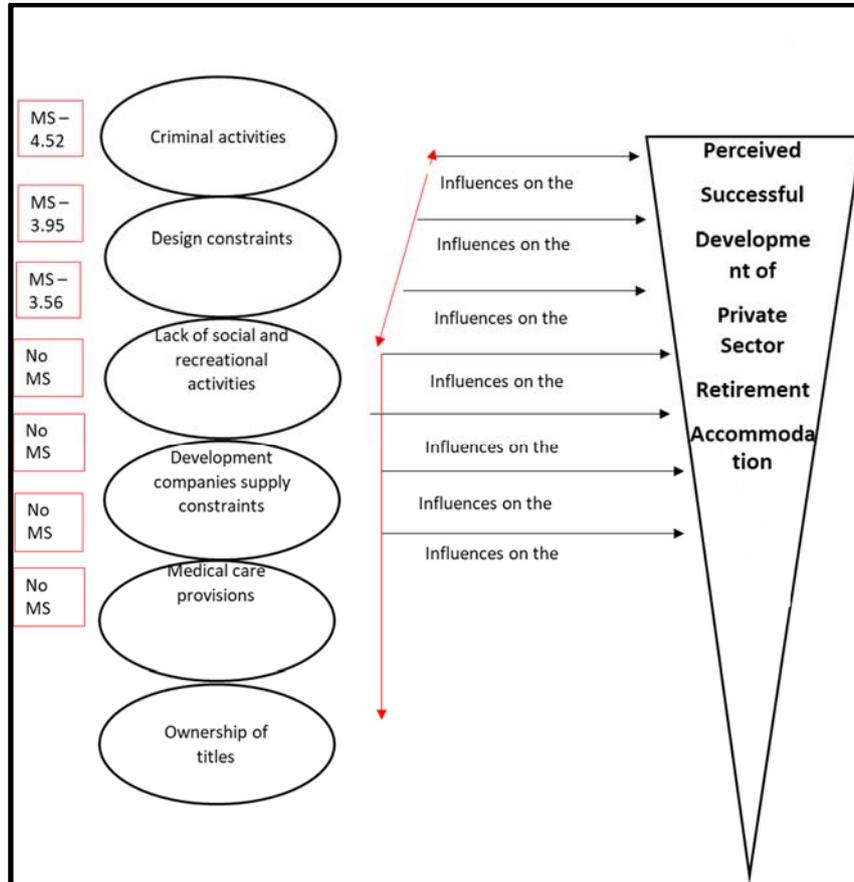


Figure 1: The Büchner Illustrative Framework for Private Sector Retirement Accommodation

## 5. CONCLUSION

Hu, et al. (2017:107) states that retirement village accommodation have positive influences on living conditions, but is not an antidote for ageing. It is confirmed in this study that residents' quality of life improved since moving into the retirement village. There is space for improvement in the retirement village industry.

Designers must pay special attention to meeting the requirements of the elderly. It is important for all managing members to understand the expectations of the residents. The green initiatives incorporated into the management system of the village impacts on environmental concerns, though it does not improve structural functioning. Management did not

expect residents to be willing to pay more to reside in a green village, though the residents stated that they would. Housing supply is further constrained by most of the people residing in the village being single. The affordability of the specific village is determined by the individual means of each purchaser. It should be noted that this niche apartment retirement village market focusses on specific client market.

The village enjoys an absolute advantage of being walking distance from the beach. Regardless of the culture which is represented in the multi-cultural Republic of South Africa, the expectations of retirement accommodation are universal.

## 6. RECOMMENDATIONS

Residents should find out about the various ownership options that is offered by the village and request for a quantification of all the fees involved. The availability of a medical care service such as a nursing sister or frail care unit should be investigated, as it provides some peace of mind when one gets older. The offering of social and recreational activities by the village will assist with the transition process of settling into the village. As older persons are vulnerable, the security measures that are used by the village should be investigated as it impacts on one's quality of life.

Designers, developers and management must ensure that all areas and rooms in the building is designed to be accessible by less robust retirees, as well as consider security measures to be installed from an early stage. The provision of a safe outdoor space is advisable, whilst also debatable in complexes such as these which are within walking distance to the beach. Promising of facilities and services (such as the frail care service which is not operating) without delivery creates bad publicity. The feasibility and viability of medical care provisions such as a nursing sister or frail care unit should be carefully considered. Consider the advantages and disadvantages of different ownership form and which will be offered to residents.

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## **Challenges of current Urban Designs in pursuit of Sustainable Development in South Africa**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

Ensuring liveable conditions within the context of rapid urban population growth in the cities requires a deeper understanding of the extent of sustainability of urban designs. This paper seeks to uncover the challenges facing current urban designs in South Africa with the intention to solicit criticism on gaps and furthermore, share a view of sustainable urban design concepts.

#### **Design / methodology / approach**

The paper is based on the review of the literature on both national and international context. Journals, conference proceedings, books, theses and

dissertations were reviewed based on their relevance to the topic and currency. The study is conducted within the qualitative research paradigm.

### **Findings.**

The study has identified six sustainable urban design concepts that if combined would produce a myriad of distinguished urban forms on attempt to address the current urban design challenges. The benefit of these forms is inter alia claimed to reduce car use, and encourage a shift towards more sustainable modes of travel, such as walking, cycling, and through increased use of public transport

### **Practical implications.**

The paper suggests that, if infrastructure development in Africa is going to be designed for sustainability then the built environment curriculum and praxis needs to integrate economic, social, and environmental issues.

### **Original / value of paper.**

The study contributes to the body of knowledge and emphasises the need for curriculum re-development in the built environment to incorporate the three dimensions of sustainability which are evident in the sustainable urban design concepts (i.e. economic, social, and environmental issues).

**Response to conference theme.** The paper responds to the **Infrastructure Design and Delivery Challenges**.

**Keywords:** Sustainable Development, Urban Planning, Urban Design, Urban Development, Urban Forms.

## **1. INTRODUCTION**

The premise of this paper is to bridge the knowledge gap in the city planning and contribute towards sustainable development goals of local governments, organisations and industries. Ensuring liveable conditions within the context of rapid urban population growth in the cities requires a deeper understanding of the sustainable urban designs. Designing new cities and perhaps revitalizing the existing ones is probably the most critical need for South African cities which are characterised by poverty and exclusion from social and economic opportunities. South African cities and the rest of the continent are disadvantaged by spatial legacy of the colonial regime such as low-density, urban sprawl, functional segregation between home and work, and overlapping racial and class separation (South African Cities Network, 2016). Research conducted indicates that the existing urban designs are unsustainable and therefore, need to be transformed.

The urgency around urban transformation prompt many cities around the world to find smarter ways to manage their challenges and thus, label them “resilient cities” or “smart cities” etc. (Chourabi 2012:1). Local municipalities

are considering new urban designs and innovative approaches beyond what has currently not worked for the existing cities in terms of addressing the past imbalances. However, re-designing urban spaces and addressing past imbalances in the South African context will result in achieving sustainable cities. With the complexity of land ownership patterns and re-distribution shortcomings, the realisation of sustainable urban designs in South Africa perhaps remains a far-fetched dream. It is not an overstatement to say that the economic, social and environmental future of any country depends on the wise use of land resources.

Land preservation is seen as an overarching issue in many governments and local authorities. Infrastructure development particularly the building of facilities such as energy networks, water supply and waste water disposal, telecommunications, etc. covers a large portion of the urban land, however, preservation of this land for social housing is of paramount importance. This study has identified several design concepts that are related to sustainable urban forms and critically evaluated them. It can be argued that different combinations of these concepts would produce a number of distinguished urban forms. The benefit of these forms is claimed to preserve land for the development of social housing to counteract the rapid urban population growth. In terms of social sustainability these urban forms will lead to better quality of life due to more social interaction, community spirit and cultural vitality (South African Department of Rural Development and Land Reforms, 2014)..

## **2. LITERATURE REVIEW**

### **2.1 Challenges of Current Urban Designs in South Africa**

According to the Integrated Urban Development Framework (IUDF, 2016), South Africa's urban areas continue to be disadvantaged by a legacy of racial discrimination, poverty and exclusion from social and economic opportunities. In South Africa the spatial legacy is depicted by low densities, urban sprawl, functional segregation between home and work, and overlapping racial and class separations. As a result, high levels of inefficiency and wasteful use of scarce resources characterize the South African cities and towns. Despite significant service delivery and development gains since 1994, IUDF (2016) states that apartheid spatial patterns have not been reversed.

Cities continue to generate new kinds of challenges. Difficulty in waste management, scarcity of resources, air pollution, human health concerns, traffic congestions, and inadequate, deteriorating and aging infrastructures are among the more basic technical, physical, and material problems (Chourabi, 2012). Additional problems are more social and organizational in nature rather than the technical, physical or material. However, the potential of urban areas is maximized with the alignment and integration of investments in transportation (public modes and roads); human settlements; infrastructure networks comprising social, economic and

ecological infrastructure; and various land-use regulations and effective governance that underpin all of the above (IUDF, 2016). In attempt to transform the urban areas, Landman and Ntombela (2006), argue that urban transformation in South Africa has been complicated by the following factors:

- The legacy of apartheid;
- Legislation and settlement planning;
- Private sector investment decisions;
- Social and economic transition;
- Intergovernmental relationships; and
- Government capacity and financial constraints.

However, they further argue that the ability to modify and improve the existing infrastructure, opportunities and facilities is essential for the country to stay competitive globally. The post-apartheid urban form, is becoming increasingly exclusionary (Landman and Ntombela, 2006), thus the impact on the growing number of urban poor and their access to urban land and well-developed public places is questionable.

These same authors postulate that the patterns of post-apartheid cities, are now reinforced by new patterns of segregation such as gated communities. They argue that the transformation of the current urban forms through the development of these communities does not integrate the poor. These communities, in South Africa, refer to physical areas that are fenced or walled off from their surroundings, either prohibiting or controlling access to these areas by means of gates or booms. It could either be residential areas with restricted access, so that normal public spaces are privatised or their use is restricted (Landman and Ntombela, 2006). Inclusiveness is crucial for effectively achieving urban sustainability. City inclusiveness (Beltrão, 2013), is about promoting equity, creating cities where everyone can participate in their social, economic and political dynamics.

In essence it can be argued that there are more problems facing land management and, at a far more practical level, there is a lack of capacity within municipalities to actually cope with land management systems globally (COJ, 2007). On attempt to resolve the matter, the following section will highlight a few design concepts of sustainable urban designs for local municipalities in attempting to re-design urban spaces and implementing the land use management strategies.

## **2.2 Sustainable Urban Design Concepts**

Ensuring liveable conditions within the context of rapid urban population growth in the cities requires a deeper understanding of the urban designs. The urgency around urban challenges prompt many cities around the world to find smarter ways to manage them and thus, label them “smart cities”, (Chourabi 2012). Research has identified several design concepts that are related to sustainable urban forms. This section presents five design concepts for sustainable development. It can be proposed that different combinations of these concepts will result in a number of distinguished urban forms.

### **2.2.1 Densification**

Densification is one central issue to the design of sustainable urban forms. Where sustainable objectives such as the efficient use of land, good accessibility to employment and key services and facilities through public transport use, walking and cycling, high density would seem to be a fundamental prerequisite (Jenks and Dempsey, 2005). Jabareen (2006) postulate that the density and the dwelling type affect sustainability through differences in the consumption of energy, materials and land for social housing, transportation, and urban infrastructure. However, Chan (2008) is of the view that the design of the sustainable urban form cannot be restricted to high-density development alone because low-densities are a reality in many places and it is therefore suggested that they will continue to be. Of necessity in the choice of densities is the incorporation of design indicators that promote social interaction, a sense of community and natural space. Social interaction should be considerate of the special needs of elderly persons and children.

Therefore, sustainable design must then be adaptable to the specific requirements of a particular urban form, be it high or low density. Chan (2008) also indicates that land saving in the process of rapid urbanisation is critical for long-term sustainability. Jabareen (2006) suggests high-rise buildings and the so called “multi-intensive land use” urban forms as land saving and sustainable designs. Multi-intensive land use maximizes land resources in a compact urban form through the mixing of land uses, intensification and connection to an efficient public transport system and pedestrian infrastructure.

### **2.2.2 Intelligent City**

Quoted by Jenks and Dempsey is Briggs (2005) who envisions cities having an intangible nature and suggests a concept of an “intelligent city”. How the form of cities, the culture and habits of its citizens may be affected by advances in communication technology. It is also suggested that intelligence and urban sustainability are intertwined, and in that one cannot exist without the other. An intelligent city has social equity as its focus, putting people back at the centre of the urban agenda, and reflecting the

sustainable development goals (Jenks and Dempsey, 2005). This same author suggests that adaptability is key to the intelligent, sustainable city and highlights the need for indicators to measure and monitor changes, in an effort to help ensure the city's long-term sustainability.

Intelligent cities sustain the rise of the knowledge-based local and regional economies. However, bridging local resources, innovation institutions and broadband networks, intelligent cities can address the challenges of global competition faced by cities and regions for knowledge and innovation (Kominos, 2009). Communication technology should, however, be understood as an enabler of sustainable development in urban design, and not leave anyone behind.

### **2.2.3 24hour City**

In response to the challenges of competitive urban revitalization Jenks and Dempsey (2005) makes reference to an author "Yang", who suggests the need for a concept "24hour-city" underlining the need for rethinking urbanism in relation to the social and economic context as well as integration. This concept suggest that, economically the shut down after working hours renders any city to be unsustainable. This suggests that both formal and informal economic sectors should be prioritised in business development support. This may also mean a review of labour laws in favour of those rules that allow a flexible engagement of labour. Of cardinal importance will be attention to urban safety and violence in the pursuit of a 24 hour city

### **2.2.4 Smart Eco-City**

Due to numerous global scale environmental, social and economic crises, Yigitcanlar and Lee (2013); Hald (2009); Jabareen, (2006) suggest a "Smart eco-city" concept sometimes called ubiquitous-eco-city or 'u-eco-city'. It considers the development that is more sensible and adopting a holistic response to minimise harmful social, economic and environmental effects in order to maintain the health of ecosystems to which human beings are a part of. A 'smart eco-city' (Yigitcanlar and Lee, 2013), "is an ecologically healthy city using advanced technologies and having economically productive and ecologically efficient industries, a systematically responsible and socially harmonious culture, and a physically beautiful and functionally vivid landscape." In pursuit of a Smart Eco urban design it will be necessary that communities as owners of the cities are involved and empowered. The promotion of advanced technologies should not lead to 'technology dumping' but favour 'technology transfer.' The latter promotes localisation of technology development through uncovering indigenous knowledge systems and local economic development.

### 2.2.5 Knowledge City

Yigitcanlar et al (2008), suggests a knowledge-based urban development concept “Knowledge city”, indicating that the evolution of the concept corresponded to developing a path towards more viable, vibrant, and sustainable form of urban development. A “knowledge city” (Yigitcanlar et al, 2008) can be seen as an integrated city, which physically and institutionally combines the functions of a science park with public and residential functions. Similarly to intelligent cities, these types of cities emphasise the development and advancement of technologies and socio-economic activities in new and existing urban developments. They play a fundamental role in knowledge creation, economic growth and development.

### 2.2.6 Green Urbanism

In addition to the urban designs and concepts as discussed above, the South African Cities Network (SACN, 2016) raises an issue of integration of ‘green infrastructure’ with urban planning. It is argued that South African cities need to find ways of embedding sustainability into their mainstream planning, developing, management, monitoring and evaluation. Embedding sustainability thinking into city planning (SACN, 2016), means providing a multitude of services such as economic, social and environmental services, allocating responsibilities for managing land and monitoring the efficient consumption of resources.

Green infrastructure, supposedly, means open space and or green spaces within the urban areas designated for public use. SACN (2016) argues that the concepts of ‘open spaces’ and ‘green space’ are used interchangeably and defines open space as “the property which is under or will be under the ownership of the council or other public authority, with or without access control, and which is set aside for the public as an open space for recreation, games, sport or cultural activity”. This very same paper postulate that the concept of ‘green infrastructure’ has emerged internationally. It has emerged as a way of understanding how green assets and ecological systems function firstly, as part of the infrastructural fabric that supports and sustains society and builds resilience. Secondly, also to secure the provisioning of ecosystem services in human-dominated city landscapes.

It refers to the entire urban green network, including all natural, semi-natural and artificial ecological systems within, around and between urban areas and at all spatial scales. In support, James et al (2009), posit that urban green space is seen as an integral part of cities providing a range of services to both the people and the wildlife living in urban areas. This is called ‘green urbanism’ which is an important urban design concept for sustainability. It makes urban and suburban places more appealing and pleasant (Jabareen, 2006).

### 2.3 Land Use Management

Given the limitations of the availability of land and that to effectively implement the abovementioned sustainable urban design concepts, there is a growing tendency for tall buildings to be developed. According to Adedeji (2007) tall buildings are an inevitable building form and part of the contemporary landscape. New design ideas are becoming common currency among progressive architects and developers. New buildings are increasingly user-friendly, offering a comfortable occupant-controlled environment all year. The creation of “internal green-sky gardens” within buildings contributes to the natural environment. Another factor that contributes to sustainable urban designs is the clustering of buildings. The clustering of buildings in densely built-up spaces is widely regarded to be very efficient in transport terms (Adedeji 2007). In South Africa radical urban transformation is key for such urban designs to be implemented effectively.

“Hulshof” was quoted by Jenks and Dempsey (2005), who concentrates on a sustainable design concept which makes use of existing urban rooftops to intensify development without creating a need for further space, helping to reduce urban sprawl and preserve open space. Vähäaho, (2014) suggests the use of underground urban space for urban infrastructure developments. Vähäaho, argues that it is good to use underground space as a resource for those functions that do not need to be on the surface. As the city structure becomes denser, more facilities suited for different purposes need to be placed underground, for an example, underground facilities for municipal and other technical services such as energy, water supply, telecommunications, etc.

### 3. RESEARCH METHODS

The objective of the study is to identify the challenges facing the existing urban designs in South Africa and share urban design concepts towards sustainable development. In order to achieve this objective, a detailed review of the related literature was conducted. The researchers believe that a myriad of studies have been conducted in this area yet the challenges in cities as specified in the previous section are still prevalent. Literature spanning a decade and a half from 2003 to 2018 was included in the study. Review materials were sought from electronic data bases and search engines including Google, Google Scholar, Academic Search Complete, and Research Gate. The key words and phrases as listed in the abstract were used and various sources such as journals, conference proceedings, books, theses and dissertations were reviewed based on their relevance to the topic and currency. Data was analysed and synthesised through a comparison of current urban designs against urban design concepts in attempt to elicit challenges and gaps.

#### 4. FINDINGS

In this section, a comparison of current urban designs used in South Africa with well-known urban design concepts on attempt to solicit criticism on gaps was conducted. Based on the review of the related literature conducted, the study evince that the current urban design in South Africa face the following challenges:-

- Spatial legacy is one of urban low densities, sprawl, functional segregation between home and work, and overlapping racial and class separations;
- Legacy of racial discrimination, poverty and exclusion from social and economic opportunities;
- High levels of inefficiency and wasteful use of scarce resources;
- Difficulty in waste management, traffic congestions, and inadequate, deteriorating and aging infrastructures; and
- Lack of capacity within municipalities to actually cope with land management systems.

Another important finding was that apartheid spatial patterns have not been reversed resulting in cities to continue to generate new kinds of challenges. The results of the study also indicate that the potential of urban areas is maximized with the alignment and integration of investments on urban infrastructure. One interesting finding is that land preservation is one of the fundamental principles of designing sustainable urban forms. Research has identified several design concepts that are related to sustainable urban forms. It can be argued that different combinations of these concepts would produce a number of distinguished urban forms.

The benefit of these forms is inter alia claimed to reduce car use, and encourage a shift towards more sustainable modes of travel, such as walking, cycling, and through increased use of public transport. Also to preserve land for the development of social housing to counteract the rapid urban population growth. In terms of social sustainability these urban forms will lead to better quality of life due to more social interaction, community spirit and cultural vitality. Furthermore, Jenks and Jones (2010), suggests that urban consolidation reduces infrastructure costs through scale and network economies and the re-use of existing capacity, whilst raising land values and so making re-development more viable, so reinforcing the spatial strategy.

It is interesting to note that some authors perceive intelligence and urban sustainability as intertwined – one cannot exist without the other. The study found that intelligent cities can address the challenges of global competition faced by cities and regions for knowledge and innovation. This confirms that information and communication technology (ICT) is an enabler of sustainable development which is not so popular in the current urban forms in South Africa.

## 5. PRACTICAL IMPLICATIONS

In this section, the practical implications of the study are presented following the three sustainable development dimensions (i.e. social, economic, and the environment). In capacitating humanity, it can be argued that if infrastructure development in Africa is going to be designed to be sustainable then the built environment curriculum needs to integrate economic, social, and environmental issues. The ability to modify and improve the existing infrastructure, opportunities and facilities is essential for the country to stay competitive globally. Public participation is another very important issue in designing urban environments. To achieve sustainability in Africa, residents need to be engaged at the planning stages of these cities. When they are engaged they appreciate what is provided, which in turn will ensure that good care is taken. Lastly, the study reveals that an integrated approach is not possible without addressing the current urban forms, land use management, transport infrastructure and services, public amenities and urban conservation.

## 6 CONCLUSION

The study sought to assess and identify challenges facing the current urban designs and share the sustainable urban design concepts to contribute towards city planning principles for new and existing cities. The sustainable urban design concepts identified suggest that the potential of urban areas is maximized with the alignment and integration of investments in transportation; human settlements; infrastructure networks comprising social, economic and ecological infrastructure; and various land-use regulations and effective governance that underpin all of the above. Local governments should avoid implementing infrastructure rather implement an urban structure. This urban structure should be underpinned by a desire for social development, economic growth and environmental sustainability in order to attain the broad outcome of sustainable development. A focus on a single dimension of sustainability with disregard of the other will defer the dream of sustainable cities in Africa. Of course, supportive and contextual city policies and regulations will be required to implement the emerging urban forms.

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## Exploring public-private partnership as an alternative housing delivery model in Namibia

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### ABSTRACT AND KEYWORDS

#### Purpose of this paper

Namibia currently experiences an increasing shortage in affordable housing as the current delivery models seem not to have provided a satisfactory outcome. This study aims to explore the viability of public-private partnerships (PPPs) as a policy tool to remedy the housing shortage.

#### Design/methodology/approach

The study adopted a mixed methodology. Ten respondents comprising 5 top officials each from the Ministry of Regional and Local Government, Housing and Rural Development, and the National Housing Enterprise (NHE) were interviewed. Structured questionnaires were also administered to 50 randomly selected representatives of Windhoek residents including contractors and real estate agents, supplemented by 10 interviews. Data analysis was undertaken through descriptive statistics.

#### Findings

The key results showed that the current housing delivery programmes had not been satisfactorily effective in meeting housing demands. However, divergent views exist regarding whether or not PPPs are the best option for

housing delivery in Namibia, because documented evidence of successful projects executed through PPP is not readily available.

#### **Research limitations**

There is need for caution in generalizing the findings owing to a relatively small sample. The fact that PPP is still a relatively new concept in Namibia also suggests limited empirical exploration.

#### **Originality/ value of paper**

The study highlights implications for guiding research and government policy towards adopting PPP in Namibia specifically, and countries newly experimenting with PPPs generally.

**Keywords: development programme, housing, infrastructure, Namibia, public-private partnership.**

## **1. INTRODUCTION**

Housing has remained a critical challenge in Namibia. Traditionally, housing delivery is managed and funded by the public sector, primarily through general taxes (Ong and Lenard, 2002). In the recent time, housing demand trends have overgrown the supply, thus creating a wide demand-supply gap (Mwilima, Fillipus and Fleermuys, 2011). The housing backlog is estimated at 100,000, and this increases by 3,000 every year (Sankwasa, 2014). According to the national household income and expenditure (NHIE) survey, 74% of households in Namibia cannot afford to purchase conventional housing, which has led to a major drawback in meeting the basic shelter needs of the majority of the population (MRLGHRD, 2013). Census records of 2001 revealed that over 54% of households lack ablution amenities. In urban areas, only 72.5% have access to flush toilets, and over 78% of the population in the northern regions use bush (MRLGHRD, 2009). As at 2007, the statistics of households that were in urgent need of housing had risen to 80,000 (Bank of Namibia, 2011). In addition, the housing study conducted by the Bank of Namibia in 2011 revealed that 73% of Namibians were unable to obtain credit financing from the financial services sector (MRLGHRD, 2013).

The housing deficit has been exacerbated by the economic stagnation of most local authorities, which limits the ability of urban centers to provide service infrastructure required by developers (MRLGHRD, 2009). Several measures to improve housing delivery have been introduced by the government. These include; subsidy system, increased serviced land delivery, direct mitigation of building materials costs, housing subsidies, and favourable monetary policies (Bank of Namibia, 2011). However, the government's role in housing delivery is perceived as provision. In this regard, a number of housing finance schemes such as the

National Housing Enterprise (NHE), the Build Together Programme (BTP) and Shack Dwellers Federation of Namibia (SDFN) have been initiated (Mwilima, Fillipus and Fleermuys, 2011). Besides, the government had introduced national laws (National Housing Policy), set up institutions (National Housing Enterprise), and introduced public programmes (Building Together Programme) to address the acute challenge of housing.

Notwithstanding the robustness of the above programmes, housing still remains a critical issue. While, it is a general public opinion to attribute the slow pace of housing provision to the efficiencies of the current delivery methods, the assertion seemingly lacks empirical evidence. There is, however, an increasing realization that governments alone do not have sufficient resources to meet the increasing housing demands. Hence, public-private partnerships (PPPs) had often being suggested by stakeholders in the Namibian construction industry in line with the global trends. PPP have been defined as formal arrangements between public and private sectors (Hodges and Greve, 2005). The concept had recently gained popularity globally as it is being embraced as an alternative model of delivering public service in both developed and developing countries to remedy the deficiencies of the traditional delivery mechanisms (Jamali, 2004; Ghobadian, *et al.*, 2004; Opawole and Jagboro, 2016).

In Africa, evidence of the adoption of PPPs for infrastructure delivery were reported in Nigeria (Adegoke *et al.*, 2010; Babatunde *et al.*, 2012; Akinsiku, *et al.*, 2014; Opawole, 2018), South Africa (Farlam, 2005; Lobina, 2005), and Ghana (Zaato, 2011; Ameyaw, and Chan, 2015; Osei-Kyei and Chan, 2017). The adoption of PPPs is relatively new in Namibia, and empirical evidence relating to its application is scanty. The basic problem that the current housing delivery models have not produced a satisfactory level of affordability has raised the research question of whether PPP could be explored as an alternative mechanism in Namibia. The purpose of this study is therefore to investigate the potential of PPPs as an alternative model of housing delivery in Namibia. To achieve this aim, three objectives were set: to determine the key factors affecting delays in housing delivery in Namibia; highlighting the main factors influencing housing shortage; and examining the potential of PPPs as an effective tool for housing delivery. The study is expected to provide insights of the implications for guiding the research focus and government policy towards adopting PPP in Namibia.

## 2. LITERATURE REVIEW

Lack of affordable houses remains Namibia's greatest challenge that is posing a socio-economic crisis that demands urgent policy response (NHE, 2015). It is very difficult for low-income people to own a house (NHE, 2015). Among the major housing development schemes that government had experimented are Build Together Program (BTP), and the National

Housing Enterprise (NHE) (Sweeney-Bindels, 2011). The NHE delivers its housing schemes through the turnkey approach, where it enters into strategic partnership arrangements with some private sector entities (e.g. Pupkewitz Megabuild, and Benz building supplier) (NHE, 2015). Private entities mobilize the financial resources needed while NHE supplies the land (NHE, 2015). Such strategic partnerships are depicted in Table 2.1. In addition to the government programmes, non-governmental organizations such as the Shack Dwellers Federation of Namibia (SFDN) had actively participated in housing development, in most instances with support from the government (Sweeney-Bindels, 2011). The problem of housing had been compounded by factors such as the absence of basic services, land related issues such as prolonged approval process, inspection, subdivision and registration, limited financial capacity of local authorities, and lack of inspectors and other locally qualified personnel. Government had responded to these problems through many policies. Among these are, the third National Development Plan (2007/2008) where government provided annual housing grants to facilitate an increase in the supply of serviced land (Summary of Blueprint on Mass Housing Development Initiative in Namibia, 2013); and municipal/town council housing schemes to increase the construction of houses. Others policies include; vision 2030, which is a long term framework for national development such as ensuring access to suitable housing for 60% of the population with low income by the year 2025 (MRLGHRD, 2009); and TIPEEG which emphasizes on creating job opportunities, and housing as one of the four important areas (Sweeney-Bindels, 2011). Three thousands houses were anticipated to be constructed per annum, to meet the population's housing needs and the estimated backlog of 80,000 units (MRLGHRD, 2009).

The Namibia National Housing Policy had earlier recognized private sector investment in the Namibian housing sector in 1991. However, empirical evidence for proper integration of PPPs into the housing delivery schemes is presently lacking. According to Grimsey and Lewis (2004), PPPs are agreements whereby private sector organizations participate in the provision of infrastructure or support for infrastructure. PPP is much supported to have originated from the UK in 1992 (Akbiyikli, 2013), and partnerships between the public and private sectors in the provision of infrastructure has existed in various forms (Yong, 2010). Although the development of PPPs has mainly focused on some sectors, such as transport, sewage disposal, and water schemes. (Akinsiku *et al.*, 2014), PPPs have increasingly been adopted for housing schemes. In India, PPP is the most noticeable urban housing policy that has developed in the last decade (Sengupta, 2006). Similarly, PPPs are increasingly becoming favourable and are being implemented by the federal government in Canada (Grimsey and Lewis, 2004).

Africa appears to have attracted the least adoption of PPPs. However, substantial adoption were reported in Nigeria (Adegoke *et al.*, 2010; Babatunde *et al.*, 2012; Akinsiku, *et al.*, 2014), South Africa (Farlam,

2005; Lobina, 2005; Rintala *et al.*, 2008; Unkovski and Pienaar, 2009), and Ghana (Ameyaw and Chan, 2015; Osei-Kyei and Chan, 2016; Osei-Kyei and Chan, 2017). Moreover, South Africa had joined Latin America and the Asia Pacific region as the fast-growing markets in infrastructure PPPs in developing countries (Pessoa, 2006). The factors influencing the adoption of PPPs in Africa are substantially the economic and socio-political complexities (Sengupta, 2006; Opawole and Jagboro, 2017). Globally, the public sector organizations had adopted different incentive measures to attract private sector partnerships. In Malaysia, Zimbabwe and Malawi, for example, the government had suggested incentives such as faster approvals of plans, reduction of land premiums, subsidization of infrastructure costs, relaxation of housing standards, granting of financial contributors to public authorities, and tax relief (Ibem, 2010).

**Table 2.1:** Strategic partnerships for housing delivery by NHE

Partners		Projects	Partner's Role
Pupkewitz Megabuild		Walvis Bay -316 houses (Feb 2011- Mar 2013)	Providing credit facility to supply building materials
Benz Supplier	Building	Ongwediva -215 houses (July 2012 - Aug 2013)	Supplying building materials for the entire project
Standard Namibia	Bank	Otjomuise - 130 houses Walvis Bay -246 houses Nkurenkuru - 27 houses Keetmanshoop - 5 houses	End-user financing for NHE conventional houses

Source: (NHE, 2015)

The feasibility of PPPs in the provision of housing had been assessed with varied observations indicating variances in the housing policies, political, socio-economic, cultural and institutional contexts in different countries (Susilawati and Armitage, 2004). Notwithstanding, there has been increasing exploration of PPPs for affordable low-income housing delivery (Scanlon and Whitehead, 2007; Moskalyk, 2008). Empirical evidence relating to PPP and its application to housing delivery is not readily available in Namibia. In this regard, the present study sets to determine the key factors affecting delays in housing delivery in Namibia, and highlight the main factors affecting the housing shortage. The possibility of adoption of PPPs as an alternative mechanism for housing delivery was also explored. The study is expected to provide implications for guiding the research focus and government policy towards adopting PPP in Namibia for housing delivery.

### 3. RESEARCH METHODOLOGY

This study adopted a descriptive research design. A mixed methodology comprising questionnaire and interview surveys was undertaken. Kowalczyk (2015) defines descriptive research design as a study aimed at representing the participants in a precise way. Besides, Denzin and Lincoln (2000) describe qualitative research as involving an interpretive naturalistic approach to the world. This means that qualitative researchers study things through a phenomenological interpretation of their natural settings. The respondents were relevant stakeholders who were directly involved in housing delivery in Namibia and thus purposively selected because of their relevant knowledge, involvement and experiences. The interviewees were 10 officials comprising 5 from the Ministry of Regional and Local Government, Housing and Rural Development, and 5 NHE staff who were purposively sampled for their active participation in housing policy and development. According to Tryfos (2007), purposive sampling technique is a non-probabilistic approach that is most effective when the research sample is based on experts' opinion in a field of study. The interviews were semi-structured face-to-face which are in the form of dialogues. The interviews were conducted in a not-so formal fashion, in the form of conversations, where the output mostly depends on the respondent's knowledge. A total of 10 respondents were interviewed. All the participants had the option to be anonymous. The questionnaire survey involved 50 randomly selected respondents who were Windhoek residents, including contractors and real estate agents. The questionnaires were delivered by hand and some were e-mailed. The questions were structured to capture the views of the respondents with regards to their views towards using PPPs as an alternative housing delivery model. The likert scale involving rating on an interval scale of 1 through 5, where 1 represents the least rating and 5 the highest rating was used. Likert scale is an attitude design that allows participants to easily complete because the degree of agreement is based on a series of identified statements (Van Laerhoven *et al.*, 2004).

### 4. RESULTS AND ANALYSIS

#### 4.1 Profile of the respondents

The residential status of the respondents is presented in Figure 4.1. About 42% of the respondents were tenants, and (22%) lived in family houses. Moreover, (20%) owned houses, (16%) lived in shack houses, and 80% did not own a proper house. These results are an indication of the housing shortage in Namibia. The analysis of the gender representation of the respondents showed that male gender represented 54% of the sample, and female was represented by 46%. The disparity in gender

representation is presumably due to the fact that the respondents from the Ministry of Regional and Local Government, Housing and Rural Development, and NHE were sampled according to their profession and expertise of which most of the officials in this category were men. About 40% of the respondents were low income earners, and 48% were in the middle income category. Combining 42% who were tenants, 22% who lived in family houses, and 16% who owned shacks, it can be concluded that 80% of the sample did not own a house. Only 12% of the respondents earned above N\$120,000.00 per annum, which forms the high income category. These results suggest that the majority of the people may not have the financial capacity to access the established housing market. Moreover, the majority of the people may not qualify for home loans from commercial banks due to their income status.

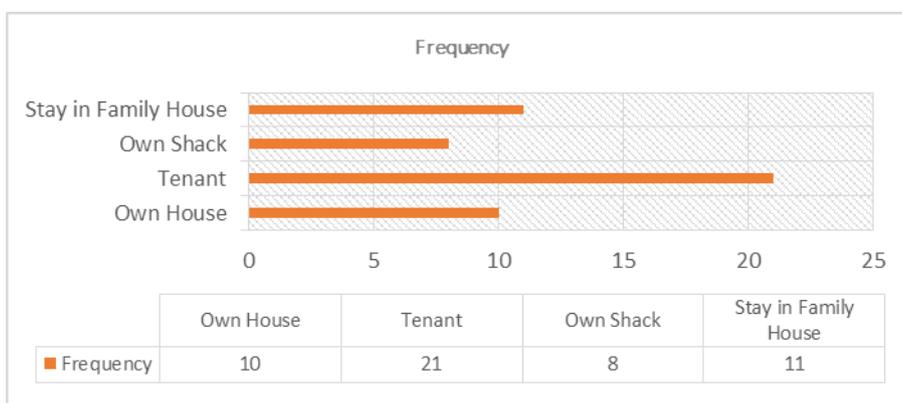
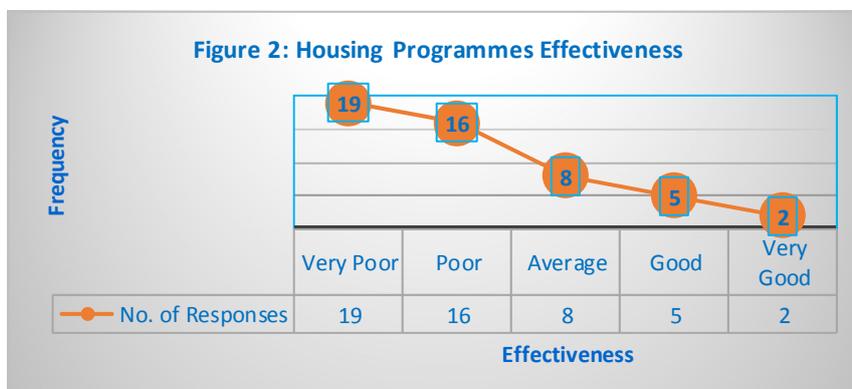


Figure 4.1: Assessment of residential status of the respondents

#### 4.2 Evaluation of effectiveness of the current housing delivery programmes

The assessment of the current housing delivery programmes was achieved by requesting the respondents to rate the notable housing programmes comprising built together programme (BTP), national housing enterprise (NHE), and mass housing (MH) programmes on a likert scale of 1 through 5, where 1 is very poor and 5 is very good. The results of this assessment are presented in Figure 4.2. Results showed that 38.0% were of the opinion that the current housing programmes were not effective and rated them as very poor.



**Figure 4.2:** Namibian housing programmes' effectiveness

About 32.0% opined that the programmes were poor, 16.0% were of the view that the programmes were good on average. About 10.0% and 4.0% of the respondents rated the programmes as good and very good respectively. Overall, 70.0% rated the delivery programmes as either poor or very poor. These findings suggest in part that the current housing delivery programmes had not provided a satisfactory outcome. The findings resonate with the MRLGHRD (2009) report that the government has a backlog of 100,000 units. Considering the fact that this report was presented 19 years after the country had attained independence and the experimentation of the housing delivery programmes, it is inferable that the delivery programmes had not been entirely effective in meeting the housing demands. Mwilima, Phillipus and Fleermays, (2011) had also indicated that the NHE failed to achieve its target of delivering 1200 houses per annum. Therefore, it implies that the housing delivery programmes need to be reviewed, most preferably using alternative strategies such PPPs in line with the global trends.

#### 4.3 Evaluation of strategies/solutions to housing problems

In Table 4.1, the respondents were asked to rate some alternative strategies or possible solutions to the housing delivery systems. The variables were rated on a 5 point scale where 1 and 5 represent the highest and the lowest rating respectively. Determination of the significant strategies/solutions was based on a cut-off mean item score (MIS) of 2.50. Mean cut-off point based on mid-points > 2.50 on a 5-point likert-type scale, or > 3.50 on a 7-point likert-type scale had been adjudged to be reasonable in determining significant factors (Muhwezi *et al.*, 2014; Opawole and Jagboro, 2015; Alao and Jagboro, 2017). In this regard, land supply and demand balance, public-private partnership, simplifying land transfer procedure, and investment in support services were all highly significant. Nonetheless, land supply and demand balance ranked first with

a mean item score (MIS) of 3.60. Public-private partnerships had a MIS of 3.50, to rank second.

**Table 4.1:** Policy tool for remedying the housing delivery deficiencies

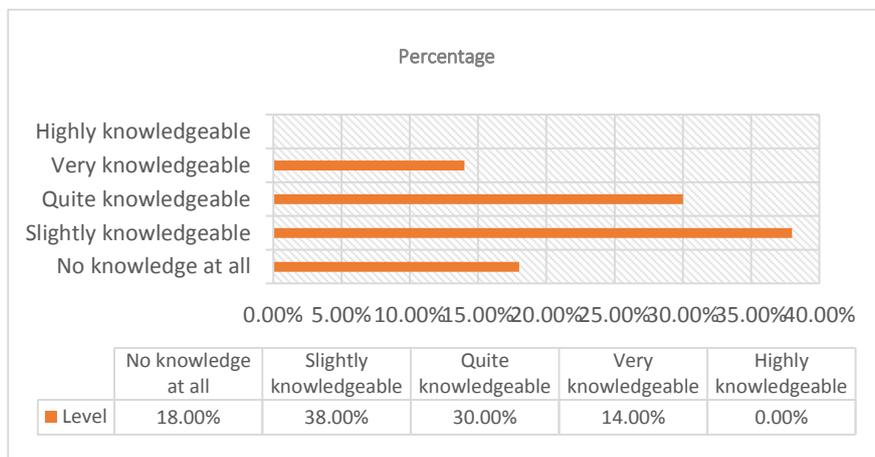
Factor	$\bar{X}$	R
Privatization of land servicing	1.42	6
Public-private partnership	3.50	2
Increase in public sector allocation for land	2.42	5
Simplifying land transfer procedure	3.38	3
Investment in support services	3.26	4
Land supply and demand balance	3.60	1

$\bar{X}$  = mean

On the other hand, the least ranked variables were privatization of land servicing (MIS = 1.42), and increase in public sector allocation for land (MIS = 2.42). A balance in the demand and supply in relation to housing delivery is significant because if serviced land is increased against increased land supply, the cost of housing will consequently decrease. This finding supports government blueprint on mass housing development initiative (HDI) which indicates that the government should increase the supply of serviced land. The high ranking of public-private partnerships suggests that stakeholders are fast recognizing the significance in solving housing crisis through this model. Muhwezi *et al.* (2014) had identified PPPs as a suitable option for funding of housing development. The third rated solution to housing problems is investments in supporting services such as infrastructure and servicing land for housing development. This should be done especially in informal settlements where the lack of supportive infrastructure is acute.

#### 4.4 Evaluation of stakeholders' Knowledge of PPPs

The evaluation of the stakeholders' knowledge of PPPs for housing delivery was undertaken through questionnaire and interview surveys. The perception of the residents was based on a scale where 1 and 5 represent 'no knowledge at all' and 'highly knowledgeable' respectively. The result of the quantitative assessment is presented in Figure 4.3. The interview survey was targeted at 10 officials comprising 5 from the Ministry of Regional and Local Government, Housing and Rural Development, and 5 NHE officials. The interview was semi-structured face-to-face which was conducted in a 'not-so formal fashion', in the form of a conversation, where the output mostly depends on the respondent's knowledge. About 38% of the respondents were quite knowledgeable, 30% were slightly knowledgeable, 18% very knowledgeable, and only 14% have no knowledge of PPPs at all.



**Figure 4.3:** Evaluation of PPP knowledge among stakeholders

None of the respondents indicated an excellent knowledge of PPPs and this could be a reflection or result of the concept being relatively new in Namibia. The results of the interview survey indicated that there are a few successful PPP projects that were implemented as reviewed in Table 2.1 (literature review section). It was indicated by the interviewees that PPPs can be of great benefit if a collaborative approach between the public and private sectors is entrenched. The interviewees revealed that there is no clear policy that regulates PPP implementation at present, hence the lack of substantive results. Among the respondents who indicated knowledge of PPPs, 70% agreed that PPPs have not been implemented effectively in the housing sector. The challenges cited by the respondents for the poor implementation of PPPs include lack of proper coordination between the public and private sectors. The government was also said to have indicated less political will for the implementation of the PPPs, and the local authorities were not willing to avail land for developments.

The respondents indicated that most of the housing projects were run by the government or its agents, like National Housing Enterprise (NHE). Moreover, the interviewees indicated that the government had involved the private investors only at the construction phase of the mass housing schemes rather than building a strong contractual partnerships. However, the scheme was criticized for its failure to fulfil the goal of affordable houses. The interviewees indicated that the tendering process used for the scheme was not appropriate leading to exorbitant construction cost and consequently high price of the houses to the consumers. Nevertheless, all the respondents agreed that, if well implemented, PPPs will be effective for addressing housing shortages. Moreover, the results showed that housing schemes that were awarded through PPP were mere

negotiations between the NHE and the private investors as there was no clear 'government-private sector' contractual partnerships.

By analysing the total number of houses that were constructed, that is a total of 939 as from 2011 to 2013, inference could be drawn that the partnership had not been successful. These findings support Ter-Minassian (2006) and Babatunde *et al.* (2012) that appropriate legal or regulatory framework and strong partnerships are necessary for the successful implementation of PPPs. This implies that a partnership framework that clearly defines the government' and the private sectors' obligations and liabilities (Opawole and Jagboro, 2016), and appropriate administrative structures would be critical for PPP success. Regarding scheme implementation, 6 of the interviewees unanimously agreed that if PPPs are well implemented, they can revolutionize housing delivery in Namibia. However, 4 of the interviewees contrasted that PPPs are not the best option, as yet, for housing delivery in Namibia, because they are simply not privy to any successful, documented projects executed through PPP arrangements.

## 5. CONCLUSION AND RECOMMENDATIONS

This study assessed the key factors affecting housing delivery in Namibia. It also highlighted the main factors affecting the housing shortage, and examined the potential of PPPs as an effective tool for housing delivery. A mixed methodology comprising questionnaire and interview survey was undertaken. The results showed that only 12% of the residents earned above N\$120 000 per annum which forms the high income category. This suggests that the majority of the people may not have the financial capacity to access the established housing market by way of qualification for commercial banks loans. The results also revealed that the current housing delivery programmes had not been satisfactorily effective in meeting housing demands. In this regard, land supply and demand balance, public-private partnership, simplifying land transfer procedure, and investment in support services were identified as the significant policy responses. Land policy adjustment is necessary for dealing with land development issues in a more practical approach. This may entail careful consideration of lessons from other countries in dealing with housing policy. Policy change should also include the adjustment of the National Housing Enterprise, which has not been assessed effective enough in bridging housing demand-supply gap.

The study recommends that response strategies to the housing challenge should also include the involvement of private sector in housing development through PPPs. The results on exploration of the adoption of PPPs as a policy tool for housing delivery showed a general acceptance of the model. However, it was argued that the existing practice of PPP in housing delivery was a mere negotiation between the government and the

private investors, as there were no clear cut 'government-private sector' contractual partnerships. Moreover, there is no clear PPP policy that clearly outlines the obligations and liabilities of the government and the private investors, as well as appropriate administrative structures. The results further revealed a divergent view that PPPs are not the best option, as yet, for housing delivery in Namibia, because documented evidence of successful projects administered through PPP is not available. The study further recommends that the fact that PPP is still relatively a new concept in Namibia, a further exploration of win-win strategies for the partnerships to work viably should be undertaken. Lastly, further studies can be built upon this study as there is need to explore this area of study in greater detail to make a more meaningful contribution to this body of knowledge especially by examining the procedures and practices of PPPs in developing countries.

Based on the findings, there is also need for public sector stakeholders to equip themselves with more knowledge of PPPs in order to exploit them and enter into meaningful partnerships with the private sector to improve infrastructure delivery. Lessons learnt from PPP arrangements need to be well documented to provide useful insights for policy makers and other relevant stakeholders who may wish to explore this alternative model.

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## **Procurement-related challenges facing emerging small, micro and medium enterprises within the construction industry in KwaZulu-Natal, Durban**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The main purpose of the study was to investigate the procurement related challenges facing SMMEs within the construction industry in order to make appropriate recommendations to the government on how to address such challenges.

#### **Design/methodology/approach**

A quantitative approach to research was used. The sample size of 130 respondents were selected using stratified sampling. Questionnaires were used to collect the data. Data quality control was determined through reliability and validity. The Statistical Package for the Social Sciences, version 25.0 was used to analyse the data. The study utilised both descriptive and inferential statistics in analysing the results.

### **Findings**

The results of the study showed that the procurement related challenges confronting the emerging SMMEs owners in the construction industry include access to finance, complex government regulations, and quality management.

### **Research limitations/implications**

The study was limited in scope and geographical location in that it applied to only the emerging construction SMMEs within the eThekweni Metropolitan area. Future research will focus on SMMEs from two or more industries like mining and agriculture.

### **What is original/value of paper?**

The study serves as a tool to the government in instituting corrective measures to address the procurement related challenges confronting the SMME sector.

**Keywords:** *Procurement, SMMEs, finance, HRM, policy mandate*

## **1 INTRODUCTION**

According to the World Bank (2015), there are approximately 445 million, small, micro and medium enterprises (SMMEs) worldwide, of which 25 to 30 million are formal small and medium enterprise; 55 to 70 million are formal micro-enterprises; and 285 to 345 million are informal enterprises. However, in South Africa, there are more than 2.25 million SMMEs (StatsSA, 2015). Several studies in South Africa show that the SMME sector has been playing critical roles towards the socio-economic development of the country, namely: job creation; poverty alleviation; equity redress; and income generation (Malapane & Makhubele, 2013; Mago & Toro, 2013). Malapane and Makhubele (2013) discovered that the SMME sector in South Africa represents about 95% of all businesses which contributes to approximately 30% of the country's GDP. In spite of the major contribution of the SMMEs towards the socio-economic development of South Africa, yet it has been found that there are several challenges confronting them. One of such challenge is the procurement related issues. South Africa is one of the few countries in the world to have public procurement subject to its constitution and recognised as a means of addressing past discriminatory policies and practices; and has, thereunder, constructed a procurement regime that provides for the preferential allocation of contracts and the advancement of certain persons, or categories of persons (Ambe and Badehorst-Weiss, 2012; Bolton, 2004; Watermeyer, 2003).

The Constitution, the Preferential Procurement Policy Framework Act [PPPFA] 5 of 2000, the Public Finance Management Act [PFMA] 1 of 1999, the Municipal Finance Management Act [MFMA] 56 of 2003, and the Broad-Based Black Economic Empowerment Act [BBBEE] 53 of 2003 comprise of the overarching regulatory framework within which the policy of preferential procurement or 'affirmative procurement' or 'targeted procurement' is implemented (Bolton, 2004; Watermeyer, 2003). According to Bolton (2004), preferential procurement in the public construction sector has accelerated the participation of historically disadvantaged individuals (HDIs) and SMMEs, however, many procurement challenges persist and remain elusive despite the strategic initiatives of the Department of Public Works, such as the 'ten-point plan'; the 'Emerging Contractor Development Programme' (set up in 1997 to deal with issue of the lack of financial support and credit facilities for emerging contractors); and the 'Contracting Entrepreneurial Training' (CET) programme (set up to address the lack of tendering and project management experience among construction SMMEs); and the use of vast construction projects to direct capital flows into underdeveloped and disadvantaged contracting. Among the HDIs in South Africa, the Black African population, which makes up 80% of the national population, has recorded the lowest growth in wealth out of all previously disadvantaged groups. The Indian community, which makes up 3% of the national population, has recorded the largest increase in wealth due to black economic empowerment [BEE] and preferential procurement policies. There were approximately 6,500 Indian millionaires in South Africa at the end of 2014, compared to 4,900 Black African millionaires. Furthermore, according to UNIDO (2017), BEE benefits only 15 per cent of the Black African population and the remaining 85% have no prospect of ever gaining BEE ownership deals, management posts, preferential tenders or new small businesses to run. Literature suggests that even though construction SMMEs are confronted with several challenges, there is limited research on procurement related challenges. The paper aims to address the gap in research.

## **2. RESEARCH OBJECTIVES**

The research objectives are:

- To identify challenges faced by SMMEs in accessing procurement opportunities
- To make recommendations pertaining to the most appropriate approach to assist SMMEs in accessing public procurement opportunities in the construction sector

## **3. EMPIRICAL LITERATURE**

### **3.1 Definition of SMMEs**

Scholars have propounded different definitions of SMMEs. The European Union and the World Bank believed that the term means the same as “small and medium enterprise” (SME) or “small and medium business” (SMB). In the South African context however, this is different as local agencies make their own determination on the term (Sitharam and Hoque, 2016; National and Credit Regulator [NCR], 2016). Nkonde (2012) postulates that the varied nature of the SMME, particularly their sizes, industry-specific definitions and dynamism makes it very complex to have a common understanding and uniformity of the SMME’s definition. Sitharam and Hoque (2016) claimed that there are diverse and conflicting discourses on SMMEs that the essence of the concept is blurred. Table 1.1 depicts the broad definitions of SMMEs.

**Table 1.1: Broad definitions of SMMEs in the National Small Business Act**

Enterprise size	Number of employees	Annual turnover	Gross assets, excluding fixed property
Medium	Between 100 and 200, depending on industry	Between R4 million and R50 million, depending upon industry”	Between R2 million and R18 million, depending on industry
Small	Between 21 and 50	Between R2 million and R25 million, depending on industry	Between R2 million and R4,5 million, depending on industry
Very Small	Between 10 and 20, depending on industry	Between R200,000 and R500,000, depending on industry	Between R150,000 and R500,000, depending on industry
Micro	Fewer than 5	Less than R150,000	Less than R100,000

Source: National Small Business Act as cited by NCR (2011)

### 3.2 Overview and contribution of the construction SMME industry in South Africa

The public sector, which comprises National, Provincial and Local Government, as well as state-owned entities, represents the largest purchaser and procurer of construction works. The construction industry's performance, therefore, is largely predicated on Government infrastructure spend – a figure reaching about R220 billion per year (PwC, 2015; CIDB, 2017). According to Windapo and Cattell (2011), a major characteristic of the global construction industry is that governments have consistently been

its largest client. In the 2015 budget in South Africa, for example, the Minister of Finance, Nhlanhla Nene, announced plans to spend R813.1 billion to develop the country's transport, water and energy infrastructure, as well as the construction of 1.5 million houses as part of the Human Settlements Vision 2030 by 2019; and also replace at least 510 mud-school buildings across the country by 2023 (Pillay and Mafini, 2017). Public infrastructure spend also plays a key role in service delivery and in the development of South Africa (CIDB, 2017).

The South African construction industry makes up around 5,5% of GDP, at least 50% of total National Capital Investment, and is anticipated to have reached an annual growth rate of 2.62% by the year 2020 (CIDB 2017; Pillay and Mafini, 2017). Furthermore, South Africa has significantly lower construction costs in terms of the cost of materials, labour and equipment, as well as imported fuels than G8, African Union (AU), and Brazil, Russia, India, China, South Africa (BRICS), countries. For example, the average cost of constructing office buildings internationally is \$1,057/m<sup>2</sup>; in Russia it is \$1,000/m<sup>2</sup>; in Kenya it is \$856/m<sup>2</sup>, whereas in South Africa construction cost is \$741/m<sup>2</sup> (CIDB 2017).

### **3.3 Procurement related challenges affecting the construction SMMEs**

#### *3.3.1 Skills and capacity shortages*

Ambe and Badenhorst-Weiss (2012) in their study discovered that the biggest restrictive factors impeding contractor success in public procurement are skills and capacity shortages, which hamper contractors' ability to deliver quality work and meet deadlines. Other scholars argued that the few Black engineers that tertiary institutions do produce often end up becoming consultants, hence the proliferation of contractors with substandard educational backgrounds in the sector (Letchmiah, 2012; Kajimo-Shakantu, 2007).

#### *3.3.2 Access to public procurement-related information*

A study done by Pillay and Mafini (2017) reveals that SMME contractors do face difficulty in accessing proper knowledge or information due to the fragmentary nature of the sector and the internal silos that keep rotating the same people, from the same major players, with the same mind-set, from one firm to another, but within the same industry. It has been found that construction procurement is plagued by unethical behaviour – such as bribery, fraud and corruption, and a general lack of integrity; contractors often do not comply with SCM-related legislation and policies leading to tender irregularities (Naude, Ambe & Kling, 2013; Ambe & Badenhorst-Weiss, 2012).

#### *3.3.3 Fraud, corruption and maladministration*

Bowen, Akintoye, Pearl and Edwards (2007) claimed that intense competitive pressures, perceptions of procedural unfairness among bidding contractors, and the complexity of contractual undertakings in the South African construction industry have engendered a proneness to unethical behaviour among contractors. Ambe and Badenhorst-Weiss (2012: citing Stemele, 2009) state that the procurement actors in national and provincial governments spent about R21 billion, wastefully and fruitlessly, in ways that contravened laws and regulations in 2010 – in 2009 the figure was R13 billion. Further finding suggests that procuring entities regularly overpay for goods and services and engage in maladministrative practices and mismanagement of finances (Ambe and Badenhorst-Weiss, 2012).

#### 3.3.4 Access to finance

Literature reveals that the emerging contractors, because of their lack of records, geographical dispersion and high transaction costs, have a relatively higher risk profile, which limits their access to finance *vis a vis* the established firms (Sitharam and Hoque, 2016: citing Haron et al., 2013; Jeppesen, 2005). The Construction Monitor (2016) reports that “inadequate access to credit is increasing as a constraint to business growth in contractors listed in Grades 3 and 4 but not for Grades 7 and 8 (CIDB Annual Report, 2017). The National Credit Regulator (2011) puts the figure of small businesses (including construction firms) with access to finance at 59% as opposed to 82% for large enterprises; and cites insufficient information on available financial products, and low levels of financial literacy as the main inhibitors to access to credit”.

#### 3.3.4 Government legislative framework

Sitharam and Hoque (2016: 279) discovered that “most SMMEs do not understand the laws that govern them; that the regulatory and legal aspects of doing business are extremely intricate, time-consuming, conflicting and costly, and, therefore, due to their inability to absorb compliance costs, many of them simply do not comply.

## 4. RESEARCH DESIGN AND METHODOLOGY

The study adopted the quantitative research approach to investigate the research phenomenon. The study population was 215, which included emerging contractors within the eThekweni Metropolitan area, in the Kwazulu-Natal province. The stratified probability sampling technique was used to select 130 respondents for the study. Close-ended questionnaires were used in this study to collect data from the respondents. The questionnaire also made use of the 3 point Likert scale to ascertain the extent to which respondents agreed or disagreed with a certain given statement. The questionnaires were pre-tested prior to the full scale

research. The reliability and validity of the research instrument was tested through Cronbach's alpha coefficient and factor analysis. The IMB SPSS software, version 25.0 was used for the data analysis. The study made of both descriptive and inferential statistics.

## 5. RESULTS OF THE STUDY-FREQUENCY

### 5.1 Demographic information

The Table 1.1 presents the findings on the demographic information of the research participants.

**Table 1.1 Demographic information**

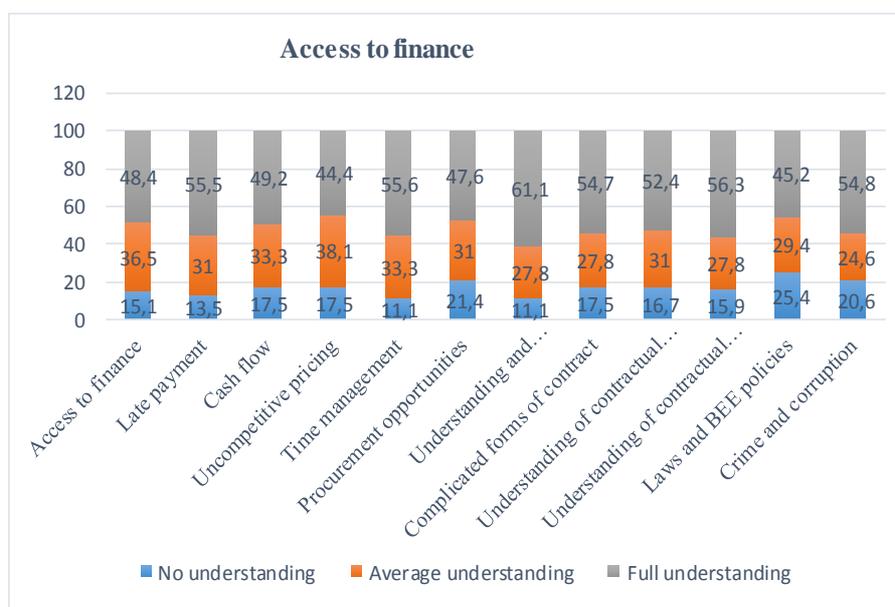
<b>Information</b>	<b>N</b>	<b>%</b>
<b>Year of practising</b>		
< 2 years	9	7.1
2-5 years	61	48.4
6-10 years	27	21.4
11-15 years	23	18.3
16 years and above	6	4.8
<b>Gender</b>		
Male	87	69.0
Female	39	31.0
<b>Position</b>		
Owner	87	69.0
Partner	21	16.7
Manager	9	7.1
Worker	3	2.4
Other	6	4.8
<b>Race</b>		
Black African	106	84.1
White	3	2.4
Indian/Asian	12	9.5
Coloured	5	4.0
<b>Highest educational qualification</b>		
Grade 8 and below	20	15.9
Grade 12	51	40.9
Tradesman	5	4.0
Certificate	10	7.9

National Diploma/Higher Diploma	20	15.9
University Degree	10	7.9
Post-Graduate Degree	10	7.9
Other	--	0.0

The information from the Table 1.1 shows that 48.4% of the respondents have been practicing between 2-5 years as SMME owners. The results further show that the majority ( $N=87$ ) of the respondents were males which constituted 69%. The results also indicate that 89% of the respondents ( $N=87$ ) were owners. Regarding race, 84.1% were Black African. With respect to educational qualification, 40.9% had Grade 12.

## 5.2 Procurement challenges

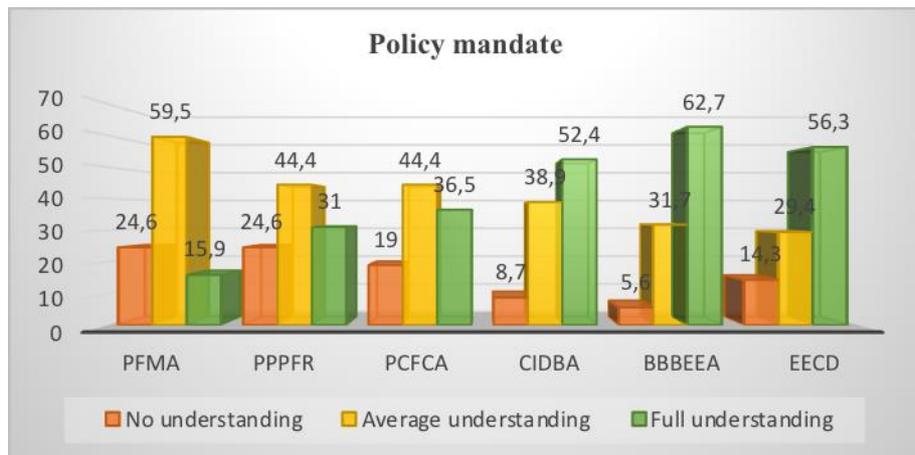
The results on the financial related challenges are presented as follows.



**Figure 1.1 Access to finance**

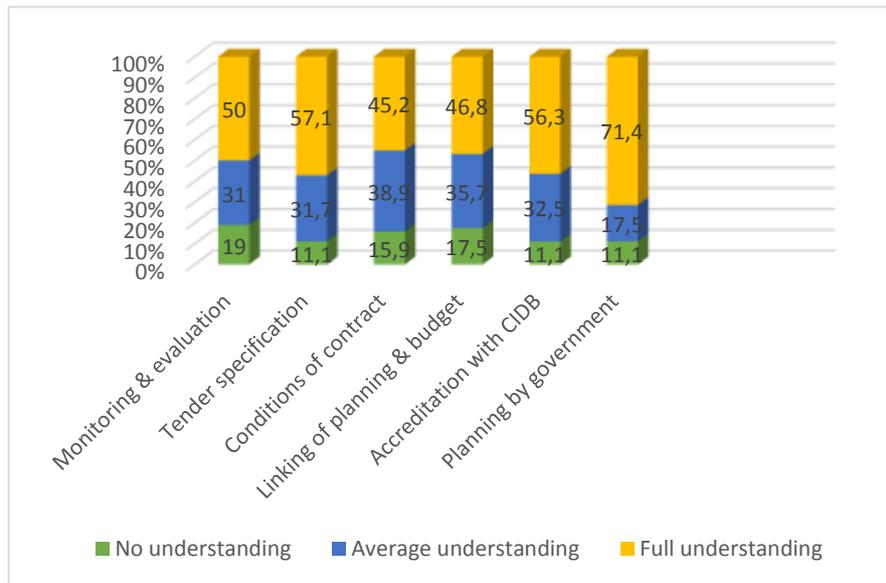
The information from the Figure 1.1 shows the following, namely that respondents reported full or complete understanding with respect to: lack of access to finance to their desired project (48.4%); late payment by government (55.5%) suggesting that that delayed payment by the South African government is one of the financial challenges facing SMMEs owners; limited cash flow (49.2%); uncompetitive pricing (44.4%); time

management issues (55.6%); procurement opportunities (47.6%); difficulty in understanding and completing documents (61.1%); understanding of the complex and complicated form of contract (54.7%); understanding of contractual obligations (52.4%); understanding of contractual documentation (56.3%); fragmentation and inconsistencies in the application of the laws and BEE policies and preferential point system (45.2%); and crime and corruption (54.8%).



**Figure 1.2 Policy mandate**

From the Figure 1.2, 59.5% of the respondents said that they had some or average understanding on the Public Finance Management Act. With respect to the Preferential Procurement Policy Framework and Regulation 2017, 44.4% said that they had some or average understanding. In terms of the Prevention and Combating of Fraud and Corruption Act, most (44.4%) of the respondents said they had some or average understanding. In relation to the Construction Industry Development BBBEEA, 62.7% of the respondents indicated that they had full or complete understanding. Concerning Eyesizwe Emerging Contractor Development, 56.3% said that they had full or complete understanding.

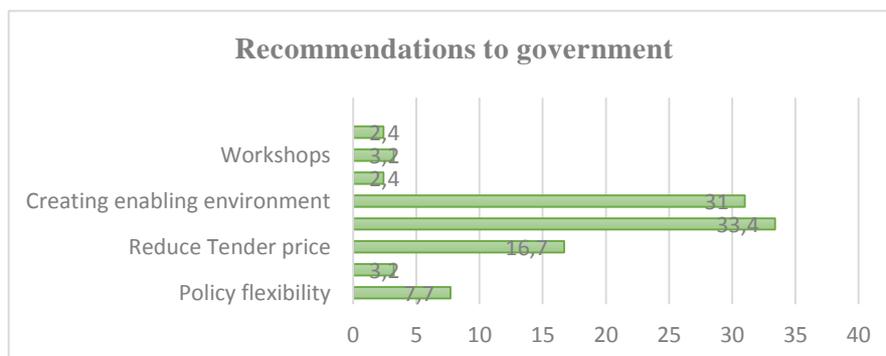


**Figure 1.3 Quality management**

The results from the study as shown in Figure 4.9 indicate that the quality management related challenges confronting the SMMEs within the eThekweni Metropolitan area are as follows: monitoring and evaluation by SCM officials (50%); correct tender specifications (57.1%) correct conditions of contract (45.2%); linking of planning and budget (46.8%); accreditation with CIDB (56.3%) had full understanding of and planning by government; (71.4%).

### 5.3 Recommendations to government

The results on the recommendations to government on how to address the procurement challenges facing the construction SMMEs are shown in the Figure 1.4



**Figure 1.4 Recommendation to government**

From the Figure 1.4, 31% of the respondents recommended that government should create enabling business environment for them to operate, 33.4% recommended that government should provide access to funds for the SMMEs, while 16.7% recommended that the tender price should be reduced.

## 5.5 Descriptive statistics

**Table 1.2 Challenges facing construction SMMEs**

Variable	Means	Ranking
Policy Mandate	2.2632	3 <sup>nd</sup>
Financial Related Challenges	2.3938	1 <sup>st</sup>
QM Related Challenges	2.3452	2 <sup>nd</sup>

The measurement scale used was the 3 point Likert scale, on the weight-scoring response choices such as: no understanding = 1; average understanding = 2; and full understanding = 3. Using this measurement scale, 1 means very low impact, 2 mean neutral and 3 means high impact. It is evident that financial related challenges had the highest mean score value of 2.3938, which indicated a positive direction. The finding implies that the financial related challenges had a positive moderate effect on the growth, survival and sustainability of the construction SMMEs within the KwaZulu-Natal. The result showed that QM related challenges had a mean score of 2.3452, which also showed a positive direction. The result further showed that policy mandate had a mean score of 2.2632, indicating a positive direction.

**Table 1.3 Reliability - Cronbach's alpha coefficient correlations**

Dimension	N of items	Cronbach's coefficient alpha
Policy mandate	6	0.7
Financial related challenges	17	0.873
QM related challenge	6	0.890
<b>All dimensions</b>	<b>29</b>	<b>0.870</b>

As reflected in the Table, there were 29 items which measured the three dimensions and the reliability score was 0.870. The various scores show that the research instrument used to collect the data was reliable.

**Table 1.4 KMO and Bartlett's Test**

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.714
Bartlett's Test of Sphericity	Approx. Chi-Square	8306.713
	Df	1711
	Sig.	.000

KMO and Bartlett's Test was employed to test the validity of the research instrument used. Hair et al. (2010) suggested that KMO measure of sampling adequacy index ranges from 0 to 1, reaching 1 when each variable is perfectly predicted without any error by other variables. The KMO and Bartlett's Test score was 0.714. The score implies that the data set complies with the requirements of sampling adequacy and sphericity for the factor analysis performed.

**Table 1.5 Correlations**

		Policy	Finance	QM
Policy	Pearson Correlation	1		
	Sig. (2-tailed)	.000		
	N	126		
Finance	Pearson Correlation	.318**		
	Sig. (2-tailed)	.000		
	N	120	120	
QM	Pearson Correlation	.311**		
	Sig. (2-tailed)	.000		
	N	126	120	126

The Pearson moment correlation was used to determine the relationship among the variables in the study. From the Table 1.4, policy mandate and financial related challenges indicated a positive significant relationship ( $r = 0.318^{**}$ ,  $p < 0.01$ ). Furthermore, finance and quality management showed a positive significant relationship ( $r = 0.311^{**}$ ,  $p < 0.01$ ).

**Table 1.6 Analysis of variance**

Item	Years of exp.		Position		Race		Education	
	F	P	F	P	F	P	F	P
Policy	0.836	0.505	0.809	0.521	1.694	0.172	2.399	0.032
Finance	1.065	0.377	1.257	0.291	5.880	0.001	3.907	0.001
QM	7.133	0.000	0.207	0.934	3.690	0.014	1.391	0.224

Anova was carried out to determine whether the demographic variables impact on all the dimensions. In terms of years of experience, the results of the study showed that there was no statistically significant difference in the policy mandate, ( $F = 0.836$ ,  $p > 0.05$ ), financial related challenges ( $F = 1.065$ ,  $p > 0.05$ ). However, there was a statistically significant difference in the QM ( $F = 7.133$ ,  $p < 0.05$ ). Concerning position, the findings revealed that there was no statistically significant difference in the policy mandate, ( $F = 0.809$ ,  $p > 0.05$ ), access to finance ( $F = 1.257$ ,  $p > 0.05$ ) and QM ( $F = 0.207$ ,  $p > 0.05$ ). When it comes to race, findings showed that there was no statistically significant difference in the policy mandate, ( $F = 1.694$ ,  $p > 0.05$ ). However, there was a statistically significant difference in the financial related challenges ( $F = 5.880$ ,  $p < 0.05$ ) and QM ( $F = 0.934$ ,  $p < 0.05$ ). In respect of education, the results showed that there was no statistically significant difference QM challenges ( $F = 1.391$ ,  $p > 0.05$ ). Nevertheless, there was there was a statistically significant difference in the policy mandate, ( $F = 2.399$ ,  $p < 0.05$ ) and financial related challenges ( $F = 3.907$ ,  $p < 0.05$ ).

**Table 1.7 One sample t-test**

Item	T	Df	Sig (2-tailed)	Mean Difference	Mean	Standard deviation
Policy	6.836	126	0.000*	.26323	2.2632	.43223
Financial	7.419	119	0.000*	.39375	2.3937	.58138
QM	6.602	125	0.000*	.34524	2.3452	.58696

\*  $p < 0.01$

One sample t-test was employed to determine whether gender influences all the dimensions. The result showed that there was a significant difference in the perceptions of male and female contractors concerning Policy Mandate, Financial Challenges and QM Challenges at the 1% level of significance.

## 6. CONCLUSION AND RECOMMENDATIONS

The construction industry, just like any other industry is faced with many challenges. The results of the showed that the emerging SMMEs in the construction industry are confronted with procurement related challenges including policy, access to finance and quality management. The respondents recommended that government should take corrective measures such as creating enabling business environment for SMMEs to operate, access to funds as well as the reduction in tender price. Besides, government should emerging contractors more procurement opportunities as compared to well established contractors.

## 7. RESEARCH LIMITATIONS AND FUTURE RESEARCH

The current study investigated the construction procurement challenges faced by SMMEs in the public sector within the eThekweni Metropolitan area, in the Kwazulu-Natal province. The study was limited in scope and geographical location. Future research should be comparative in nature. The study was limited to only public sector organisations. Future research should focus on both private and public organisations in South Africa. A key limitation of the study is that the study investigated only those SMMEs in the construction industry within the KwaZulu-Natal province. Future research should focus on SMMEs in other industries like mining and agriculture from different province.

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## Joint venture practices for successful construction projects in South Africa

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### ABSTRACT

#### Purpose

Joint ventures (JV) between construction companies are viewed as an effort in combating construction project delivery problems in South Africa. This study, therefore determines the joint venture practices for managing the successful delivery of joint venture (JV) construction projects in South Africa.

#### Methodology

A quantitative research approach was used and data was collected using structured questionnaire survey, administered to the registered professionals from the South African Council for Project and Construction Management Professions (SACPCMP) who have been involved in joint venture projects. Statistical Package for Social Sciences (SPSS) version 23.0, was used to analyze the descriptive and inferential statistics of the JV practices to determine the mean score and reliability of the construct respectively.

#### Findings

Results revealed that some of the JV practices were practiced than others in managing their JV construction projects in South Africa. Furthermore, the constructs were reliable in relation to the Cronbach alpha coefficient.

#### Limitations

The study was not conducted across South Africa, hence the findings cannot be fully generalized.

### **Practical implications**

This research provides empirical evidence for the reliable JV practices that are used in JV construction projects in South Africa.

**Keywords:** Construction, Joint Venture Practices, South Africa.

## **1. INTRODUCTION**

Construction industry plays a vital role in South Africa's economic and social development. The industry provides the physical infrastructure and it is the backbone for economic activities by providing large-scale employment to its populace (Construction Industry Development Board, CIDB, 2010). In order for the social and economic benefits of the populace to be realized, the need to manage the construction projects successfully is imperative. Hence, different management strategies have been suggested e.g. contract management, design and build and JVs but to name a few. However, despite the management strategy of JV being used. Farrel (2014), indicated that at least 40% to 70% of joint ventures fail. It is therefore critical that, during the formation of JVs for construction projects, several JV practices need to be implemented to improve the delivery of the project.

The CIDB, (2004) and Kale et al., (2013), indicated that the critical JV practices are; fair and comprehensive written agreement was a critical factor for JV projects. Furthermore, Hong and Chan, (2014) indicated that; comprehensive and fair written agreement, mutual understanding, inter-partner trust, commitment of the partners, and the ease of communication between the partners were critical for JV success. Hyun and Ahn (2013), suggested that; comprehensive and fair written agreement, mutual understanding, and inter-partner trust were critical for JV project success.

It can be inferred that different authors have suggested different JV practices. This suggests that no consensus has been reached of the types of JV practices that will be used to influence the success of JV projects. Furthermore, the measures of these JV practices contrasts and hence lacks consensus. In relation to this gap two specific research questions were stated:

- What is the reliability of the JV core practices for successful construction project delivery of JVs in South Africa?
- What are the JV practices used by practitioners in successful construction project delivery in South Africa?

## **2. JOINT VENTURE PRACTICES FOR CONSTRUCTION PROJECTS**

According to Adnan and Morledge (2003), critical success factors are those few key areas of activity in which favorable results are unequivocally essential for a particular manager to influence his or her own objectives. These critical success factors can be termed as the critical practices. On the backdrop of this background a number of practices have been identified that will influence the success of JV projects.

A JV that is not constituted by means of a *comprehensive and fair written agreement between the members*, is a panacea for failure. This practice sets out the obligations, rights, risks and rewards in the JV (Construction industry development board, 2004). Adnan and Morledge (2003) suggested that a good joint venture agreement is an essential practice and can avoid a great deal of trouble and conflict in future JV operations. The joint venture participants join through a form of agreement to contribute with resources in the form of skills, experience, financing and/or physical resources.

*Mutual understanding*: According to Adnan and Morledge (2003) and Manithana (2012), mutual understanding practice contribute to the success of JV construction projects. In fact, it is extremely important that friendly personal contact is regularly maintained between the leaders of the partnering organizations (Adnan and Morledge, 2003). The careful selection of people who are to work in an alliance will assist the prospects of mutual bonding of partners, therefore mutual understanding (Hyun and Ahn, 2013).

*Inter-partner trust*: A high degree of trust and co-operation between the members for a successful operation of a JV is important (Construction industry development board, 2004). Inter-partner trust is often considered to be a very important ingredient of managing relationships (Adnan and Morledge, 2003; Hyun and Ahn, 2014; Hong and Chan, 2014). In other words, mutual trust is indispensable to overcome the restrictions of the contractual agreement (Govindan, 1995). However, within organizations, trust contributes to more effective implementation of strategy, greater managerial coordination and more effective work teams (Adnan and Morledge, 2003).

*Co-operation between the members*: Cooperation is an important factor as problems solving reflects the degree to which the parties share responsibility both for dealing with problems and maintaining their relationship (Adnan and Morledge, 2003). Yet, the review of the effect of cooperation/conflict on joint venture performance has been a prevalent topic for many researchers, according to Govindan (1995). The power of one partner can interfere with the goal attainment of another partner and thus conflict is possible only when the interfering party has some power (Govindan, 1995). Therefore, it follows from this argument that, the more resources one partner has to contribute to the JV becomes comparative to the other partner, the more power the partner would have to affect the achievement of the other party's goals (Govindan, 1995).

*Commitment of the partners:* Adnan and Morledge (2003) as well as Hong and Chan (2014) suggested that commitment reflects the actions of some key decision makers regarding continuation of the relationship, acceptance of the joint goals and the values of the partnership, as well as the willingness to invest resources in the relationship. Moreover, it is believed by Lambe et al., (2011) that a number of researchers argued that relational factors which include trust and commitment contribute to joint venture success. Achievement of the other party's goals (Govindan, 1995).

*The ease of communication between the partners:* Undoubtedly, for any business to be run appropriately the communication / information aspect plays a major role. Adnan and Morledge (2003) as well as Hong and Chan (2014) emphasized this point by highlighting the fact that the ease of communication between the partners is another potential problem which should be considered when evaluating a potential partner's suitability. In fact, without proper communication, problems can occur as a result of differences between national or ethnic cultures, including language, as well as differing corporate cultures (Adnan and Morledge, 2003; Manitshana, 2012).

*Management control:* The management aspects of the project play a very significant role in the successful completion of a JV construction project where the role of project participants is vital in this regard (Divakar and Subramanian, 2009). According to Adnan and Morledge (2003) and Govindan (1995), the influence that major stakeholder groups have on the organization's decisions and activities which can easily be achieved in joint ventures by reporting to both majority shareholders. Thus, insufficient control over a joint venture (JV) can limit the ability of the parent to synchronize their activities, efficiently and utilizing their resources and effectively implementing their strategy (Talman, 2009).

*Partner experience:* According to Adnan and Morledge (2003), firms with multinational experience are considered more likely to have the ability to manage and monitor appropriately the joint venture. In addition, Lambe et al. (2011) argued that, partners' experience contributes to the success of the alliance because such a competence has an indirect impact on positively influencing the acquisition of complementary resources.

In order to determine the reliability and if these factors were practiced statistical analysis using SPSS was undertaken.

### 3. METHODOLOGY

Quantitative research approach was adopted for this study. A questionnaire survey was developed from extensive literature and a pilot study was conducted with professionals registered with the SACPCMP and determined the content validity of the critical practices. The final questionnaire was presented to 400 conveniently sampled SACPCMP respondents. The data was collected using email and drop and collect

method, of which 115 questionnaires were returned representing 28.75% response rate from Gauteng, Western Cape and Limpopo. It has been indicated that the response rates for mailed questionnaires are usually low, thus, a response rate of 15% to 25% is still considered appropriate and acceptable (Wahab et al., 2010), whilst according to Fryrear (2015) a response rate of 10% to 15% is still considered appropriate. It can therefore be indicated that the current response rate is appropriate for analysis.

The final questionnaire presented to the respondents consisted of eight constructs consisting of 31 practices. The respondents were required to indicate their level of agreement in practice with the measures. The measures were rated on five point Likert scale, where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree.

Other parts of the questionnaire were designed to profile the participants in terms of their; gender, experience in joint venture projects, and qualification before being registered as a construction project manager or construction manager. The questionnaire also profiled the organization in terms of; type of joint venture and geographic location. The statistical package for social science (SPSS) version 23 was used to conduct descriptive statistical analysis of the data computing the frequencies, mean scores and standard deviation. The SPSS was further used to determine the factor analyzability of the critical practices using inferential statistics. The internal reliability of the constructs were determined using Cronbach alpha. This approach is supported by the studies undertaken by Kolbehdari and Sobhiyah (2014) and Wahab et al. (2010). Field (2006), Tavakol et al., (2011), Yount (2006) and Pallant (2013), suggested that the acceptable values of Cronbach alpha would range from 0.70 to 0.95. In the current study a cut-off value of 0.70 was adopted. Furthermore, the optimal inter-item correlations mean should range from 0.2 to 0.4 in order for the factor to be reliable (Pallant, 2013). In this study a value between 0.20 and 0.40 was adopted.

## **4. FINDINGS AND DISCUSSIONS**

### ***4.1 Respondents' Profile***

Table 4.1 indicates that, 74.8% of the respondents are male while 25.2% of the respondents are female. Whereas, 35.7% of respondents were between the age of 31 and 40. The professional construction project managers and construction managers had different professional backgrounds. Majority that 19.1% of the respondents were construction project managers, whereas only 2.6% were electrical engineers. 33.9% of the respondents had been involved in JV projects for a period of less than 5 years, and 32.2% had been involved in JV projects between 5 to 10 years. The result further suggests that the type of JV the respondents have

been involved in South Africa is the combined JV with 39.1%. Further, the integrated JV was used by 36.5% of the practitioners and the non-integrated method was used by 24.3%.

**Table 4.1** Profile information of respondents

<b>Classification</b>	<b>Frequency</b>	<b>Percentage</b>
<i>Male</i>	86	74.8
<i>Female</i>	29	25.2
<i>Younger than 21</i>	1	0.9
<i>21-30</i>	23	20.0
<i>31-40</i>	41	35.7
<i>41-50</i>	29	25.2
<i>51-60</i>	16	13.9
<i>Older than 60</i>	5	4.3
<i>Integrated</i>	42	36.5
<i>Non-integrated</i>	28	24.3
<i>Combined</i>	45	39.1
<i>Less than 5 years</i>	39	33.9
<i>5-10 years</i>	37	32.2
<i>10-15 years</i>	25	21.7
<i>15-20 years</i>	7	6.1
<i>More than 20 years</i>	7	6.1
<i>Architect</i>	13	11.3
<i>Chemical engineer</i>	4	3.5
<i>Civil engineer</i>	19	16.5
<i>Construction Manager</i>	19	16.5
<i>Construction Project Manager</i>	22	19.1
<i>Electrical engineer</i>	3	2.6
<i>Quantity surveyor</i>	18	15.7
<i>Mechanical engineer</i>	5	4.3
<i>Other</i>	12	10.4

#### **4.2 Joint venture practices for construction projects in South Africa**

Table 4.2 below indicates the level of agreement in relation to a number of practices identified from literature. It can be suggested that the comprehensive and fair written agreement practice was reliable as the Cronbach alpha coefficient was above 0.70 and the inter-item correlations were between 0.2 and 0.4. The cumulative mean score of this factor was 3.956, which indicates that the respondents were in agreement. Furthermore, eight of practices that defined this factor were deemed to be practiced and were rated as strongly agree and agree i.e. the contributions by each member were set out ( $\bar{x}=4.27$ ,  $\mu=0.82$ ), percentage participation by each member including risks, rewards, losses and liabilities were recorded ( $\bar{x}=4.23$ ,  $\mu=0.86$ ), and meaningful input by partners to the policy-

making and management activities of the JV was provided ( $\partial=4.09$ ,  $\mu=0.99$ ). However, respondents are neutral when it comes to sub-factors of a comprehensive and fair written agreement such as consensus between the members was promoted ( $\partial=3.94$ ,  $\mu=1.13$ ), management body for the joint venture was provided ( $\partial=3.92$ ,  $\mu=1.22$ ), varying nature of JV objectives, inputs by the parties, and management systems of the JV was flexible ( $\partial=3.78$ ,  $\mu=1.04$ ), rapid, economical and easy interim dispute resolution process in writing was provided ( $\partial=3.71$ ,  $\mu=1.21$ ), and losses to the joint venture by the default of a member were limited through the agreed measures put in place ( $\partial=3.70$ ,  $\mu=1.17$ ). These findings corroborated with the findings of Adnan and Morledge (2003), and CIDB, (2004).

Mutual understanding was agreed to be a critical and reliable core practice for the success of JV projects. Furthermore the practices defining this factor were rated as being practiced: partners were selected on the basis of technical competence ( $\partial=4.12$ ,  $\mu=0.96$ ), partner selection criteria were observed in order to achieve mutual understanding ( $\partial=4.09$ ,  $\mu=0.97$ ), partners were selected on an assessment of their ability to form good relationships ( $\partial=4.03$ ,  $\mu=1.03$ ) and friendly personal contact was regularly maintained between the leaders of the cooperating organizations ( $\partial=3.95$ ,  $\mu=1.21$ ). Hyun and Ahn, (2013) and Adnan and Morledge (2003) agree with these findings.

The cumulative mean for inter-partner trust was titling towards agree, which is also supported by the results of the practices that defined inter-partner trust i.e.: contractual trust was met to fulfill contractual duties ( $\partial=3.97$ ,  $\mu=1.16$ ), effective implementation of strategy, greater managerial coordination and more effective work teams were enhanced ( $\partial=3.88$ ,  $\mu=1.16$ ), goodwill trust was executed to ensure partners operate in the concern of the relationship within the JV ( $\partial=3.86$ ,  $\mu=1.12$ ), capability trust was implemented to ensure professional experience from the other partner ( $\partial=3.82$ ,  $\mu=1.21$ ) and mutual trust overcame the restrictions of the contractual agreement ( $\partial=3.8$ ,  $\mu=1.29$ ).

Also, respondents believed that co-operation between the members was achieved through a number of practices i.e.: willingness to share information to enable essential coordination of activity from partners was done ( $\partial=4.17$ ,  $\mu=1.00$ ), willingness to share resources to enable coordination of activity from partners was undertaken ( $\partial=4.02$ ,  $\mu=1.12$ ), and the power of one partner that interferes with the goal attainment of another partner was normalized ( $\partial=4.01$ ,  $\mu=0.90$ ). These results are in line with the findings of Adnan and Morledge (2003) and Govindan (1995).

In addition, respondents agreed that commitment of the partners was a crucial factor when it comes to the success of the JVs they were involved in. Furthermore, practices such as actions of key decision makers and acceptance of joint goals were achieved ( $\partial=4.09$ ,  $\mu=1.05$ ), long-term relationship, resources and capabilities to the specific needs of the joint venture were met ( $\partial=4.08$ ,  $\mu=1.07$ ). However, respondents were in

agreement the other practices i.e. partnership and willingness to invest resources in the relationship were undertaken ( $\partial=3.92$ ,  $\mu=1.13$ ), full commitment to the joint venture and between partners was achieved ( $\partial=3.84$ ,  $\mu=1.25$ ).

The results suggest that communication between the partners was a critical factor to JVs success. The practices defining this factor were tilting towards agreement i.e. effective communication prevented misunderstandings and suspicion within the JV ( $\partial=3.88$ ,  $\mu=1.18$ ), effective communication prevented conflicts between different ethnicity within the JV ( $\partial=3.83$ ,  $\mu=1.20$ ) and finally, proper communication prevented conflicts of cultural difference within the JV ( $\partial=3.77$ ,  $\mu=1.21$ ).

Management control was a factor that was reliable. The results suggest that the mean value was 3.77 which was tilting towards agree. Most of the practices defining this factor were tilting towards agreement. The conducts and decisions of partners in the organization were in line with the JV's goals and policies ( $\partial=3.87$ ,  $\mu=0.96$ ), efficiency of implementing organization strategies were achieved ( $\partial=3.82$ ,  $\mu=1.07$ ), efficiency of utilizing the partners' resources was met ( $\partial=3.78$ ,  $\mu=1.16$ ), ability of the partners to synchronize their project activities was achieved ( $\partial=3.75$ ,  $\mu=1.16$ ), and finally, differences in interests in JV led to the incorporation of management control ( $\partial=3.65$ ,  $\mu=1.20$ ). This finding were in line with the findings of Divakar and Subramanian, (2009), Adnan and Morledge (2003) and Govindan (1995).

Also, respondents were tilting to agree than to neutral on the fact that partners experience was a critical core practice for JV operations. Furthermore, the practices defining this core practice were also tilting towards agree than neutral. The firms' multinational experience ensured good management of the joint venture ( $\partial=3.78$ ,  $\mu=1.18$ ), the firms' multinational experience ensured proper monitoring of the joint venture ( $\partial=3.7$ ,  $\mu=1.21$ ), and the multinational experience led to the acquisition of complementary resources ( $\partial=3.77$ ,  $\mu=1.26$ ). It can be indicated that this findings were in line with the studies of Lambe et al. (2011) and Adnan and Morledge (2003).

**Table 4.2:** Successful practices for JV projects

Successful practices for JV projects	Mean ( $\partial$ )	Std. Deviation ( $\mu$ )	Rank
<b>Comprehensive and fair written agreement Cronbach alpha= 0.746</b>	<b>3.956</b>	<b>1.059</b>	
Contributions by each member were set out.	4.269	0.819	1
Percentage participation by each member including risks, rewards, losses and liabilities were recorded.	4.234	0.861	2
Meaningful input by partners to the policy-making and management activities of the JV was provided.	4.086	0.996	3
Consensus between the members was promoted	3.939	1.133	4
Management body for the joint venture was provided	3.921	1.222	5

Varying nature of JV objectives, inputs by the parties, and management systems of the JV was flexible.	3.782	1.041	6
Rapid, economical and easy interim dispute resolution process in writing was provided.	3.713	1.219	7
Losses to the joint venture by the default of a member were limited through the agreed measures put in place.	3.704	1.177	8
<b>Mutual Understanding Cronbach alpha= 0.684</b>	<b>4.047</b>	<b>1.043</b>	
Partners were selected on the basis of technical competence.	4.121	0.956	1
Partner selection criteria were observed in order to achieve mutual understanding.	4.095	0.973	2
Partners were selected on an assessment of their ability to form good relationships.	4.026	1.030	3
Friendly personal contact was regularly maintained between the leaders of the cooperating organizations.	3.947	1.212	4
<b>Inter-partner trust Cronbach alpha= 0.719</b>	<b>3.867</b>	<b>1.188</b>	
Contractual trust was met to fulfill contractual duties.	3.973	1.165	1
Effective implementation of strategy, greater managerial coordination and more effective work teams were enhanced.	3.886	1.160	2
Goodwill trust was executed to ensure partners operate in the concern of the relationship within the JV.	3.860	1.115	3
Capability trust was implemented to ensure professional experience from the other partner.	3.817	1.210	4
Mutual trust overcame the restrictions of the contractual agreement.	3.800	1.292	5
<b>Co-operation between the members Cronbach alpha= 0.610</b>	<b>3.956</b>	<b>1.073</b>	
Willingness to share information to enable essential coordination of activity from partners was done.	4.173	1.002	1
Willingness to share resources to enable coordination of activity from partners was undertaken.	4.017	1.115	2
The power of one partner that interferes with the goal attainment of another partner was normalized.	4.008	0.903	3
Burdensome monitoring and safeguards of costs within the joint venture were reduced.	3.626	1.273	4
<b>Commitment of the partners Cronbach alpha = 0.828</b>	<b>3.982</b>	<b>1.122</b>	
Actions of key decision makers and acceptance of joint goals were achieved.	4.086	1.047	1
Long-term relationship, resources and capabilities to the specific needs of the joint venture were met.	4.078	1.069	2
Values of the partnership and willingness to invest resources in the relationship were undertaken.	3.921	1.125	3
Full commitment to the joint venture and between partners was achieved.	3.843	1.246	4
<b>Communication between the partners Cronbach alpha= 0.814</b>	<b>3.826</b>	<b>1.195</b>	
Effective communication prevented misunderstandings and suspicion within the JV.	3.878	1.178	1

Effective communication prevented conflicts between different ethnicity within the JV.	3.826	1.201	2
Proper communication prevented conflicts of cultural difference within the JV.	3.773	1.207	3
<b>Management control Cronbach alpha= 0.668</b>	<b>3.773</b>	<b>1.110</b>	
Conducts and decisions of partner in the organization were in line with the JV's goals and policies.	3.869	0.959	1
Efficiency of implementing organization strategies were achieved	3.817	1.072	2
Efficiency of utilizing the partners' resources was met.	3.782	1.160	3
Ability of the partners to synchronize their project activities was achieved.	3.747	1.161	4
Differences in interests in JV led to the incorporation of management control.	3.652	1.199	5
<b>Partner experience Cronbach alpha = 0.635</b>	<b>3.770</b>	<b>1.217</b>	
The firms' multinational experience ensured good management of the joint venture.	3.782	1.183	1
The firms' multinational experience ensured proper monitoring of the joint venture.	3.765	1.209	2
The multinational experience led to the acquisition of complementary resources	3.765	1.258	3

## 5. CONCLUSION AND FURTHER RESEARCH

In conclusion the eight theoretical core practices consisting of 31 practices were identified in the literature. The SPSS was used to analyze the inferential and descriptive statistics. The factors were reliable based on the Cronbach alpha coefficient and inter-item correlation results. It can therefore be indicated that the core practices that are used in JV construction projects in South Africa are: comprehensive and fair written agreement practice, mutual understanding, inter-partner trust, co-operation between the members, commitment of the partners, communication between the partners, Management control and partners experience

The researchers recommend that further data collection using interviews to justify the findings.

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## **Critical factors in municipal building maintenance in developing countries: a case of Buffalo City metropolitan municipality, South Africa**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The wide demand-supply gap in housing provision had necessitated government interventions in form of municipal housing schemes in most developing countries. However, the current global economic recession resulting in budget constraints had greatly reduced municipal housing projects in South Africa. Hence, the problem of public housing development in South Africa had exacerbated due mainly to budget constraints, and maintainability issues relating to the existing municipal schemes. The purpose of the study was therefore to examine the building maintenance practice in the Buffalo City Metropolitan Municipality (BCMM) buildings with specific emphasis on the associated challenges. This was with a view to exploring lessons which could be adopted for developing a sustainable maintenance practice for the municipal building scheme.

#### **Design/methodology/approach**

A quantitative descriptive methodology based on questionnaire survey was adopted. Thirty-two (32) questionnaires were administered to the officials involved in BCMM building maintenance. Data analysis was undertaken using descriptive statistics.

**Findings**

Major findings included lack of technical staff in the facilities assessment division, and decentralization of the maintenance functions. Key lessons learnt were the need for independence of the facilities assessment division in organizations managing municipal buildings, and scheduled maintenance practice such that maintenance works are timeously assessed which could be undertaken with annual budget.

**Research limitations**

The relatively small sample adopted would limit the generalization of the findings.

**Originality/ value of paper**

The study highlights implications for guiding policy towards sustainable maintenance practice of municipal building scheme.

**Keywords: buildings, facilities, municipal, maintenance, sustainable**

**1. INTRODUCTION**

Public sector intervention in housing delivery is significant in the developing countries because of greater proportion of low-income households who are constrained by the socioeconomic characteristics from accessing the established housing market (Wakely, 2014). Buffalo City Metropolitan Municipality was established on this concept to alleviate housing deficiency in the Eastern Cape Province. However, in the recent times, when public housing schemes are not adequately forthcoming owing to government budget constraint, poor maintenance of the existing municipal housing schemes are worsening the housing affordability problem (Ogbu, 2017). The Buffalo City Metropolitan Municipality is situated relatively in the Eastern Cape Province to the South-east by the coastline along Indian Ocean (Figure 1.1). The province is the second largest in land area in South Africa, as it covers 170,000 square kilometers, which is 13.9% of South Africa's total land area. Moreover, the province has the third population of South Africa's provinces, approximately 6.4 million people which is 14.1% of South Africa's people, and it is generally seen as one of the two poorest in South Africa. There are two major urban conurbations within the Province: Nelson Mandela Bay Metropolitan, and Buffalo City Metropolitan (Buffalo City Metropolitan Municipality BEPP, 2011).

The Buffalo City Metropolitan Municipality buildings have fallen into a severe state of disrepair and urgently require total refurbishment. Many of the basic components of the buildings need to be replaced (Report on Conditional Assessment of Municipal Buildings, 2013). According to Daily Dispatch 2016, more than 1,000 buildings and facilities owned by Buffalo

City Metropolitan are either in a poor or very poor condition, with the renewal and refurbishment cost estimated at R1.7 billion. The users complained of huge rats, thick spider webs on walls, plants growing through and unstable flooring. Rooms underground were covered in mould and there was concern over a mosquito infestation.

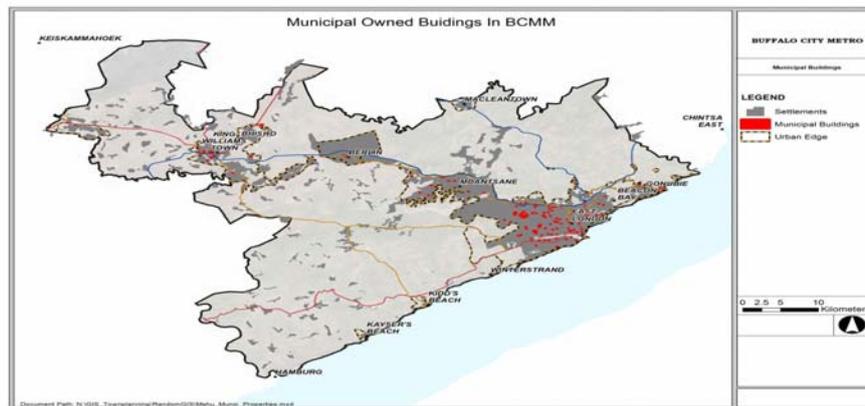


Fig. 1.1. Buffalo City Metro

The common expert opinion is that the failure of Buffalo City Metro to centralize critical refurbishment, as well as renewal and maintenance functions was responsible for the maintenance, and cost for maintenance was envisaged to increase drastically. With this proposition, many units of the municipal buildings would fall into severe state of neglect and dilapidation. Another critical justification is that there is no oversight role being undertaken by way of assessing the condition of buildings and reporting these for implementation and budget motivation. Currently the building maintenance section of the municipality 'picks and chooses' which buildings they will attend to and what type of works they will carry out. All too often the maintenance has been deferred, or not prioritized, or budgets not requested (no business plans submitted), and this has resulted in the severe backlog of works and dilapidated buildings. Therefore, in approaching this study, four aspects of maintenance were evaluated. These are the current condition of BCMM buildings, adequacy of maintenance budget, extent of centralization of maintenance function, and sustainability of the maintenance practice. The challenges associated with these components as well as appropriate policy response were examined in this study. The purpose was to develop lessons for sustainable maintenance good practices for BCMM.

## 2. LITERATURE REVIEW

Maintenance is a construction work on existing buildings undertaken with the intention of re-instating physical condition to a specified standard, preventing further deterioration or failure, and restoring correct operation within specified parameters (Allen, 1993). It also includes replacing components at the end of their useful/economic life with modern engineering equivalent, creating temporary maintenance for immediate health, safety and security reasons, and conducting conditional assessment of buildings and objective knowledge of physical and operating condition (Buffalo Department of Housing and Public Works, 2012). Maintenance is an activity within a building life cycle which ensures optimum economic use. This often combines a number of activities (Mills, 1980). Maintenance practices essentially comprise routine, preventative, corrective, new construction, and deferred maintenance. It is a practice that requires careful scheduling and control, because costs can easily become excessive if otherwise (Kyle, 2013). For economy and sustainability, a building maintenance programme should be well defined at the design stage within the capital and maintenance costs.



Fig. 2.1. A building unit in Oxford Street, East London

Generally, the maintenance of municipal building is often characterized by bureaucratic complexity which had often leads to a decentralized maintenance practice. These characteristics are evident in the BCMM building. In the case of BCMM, defects had become apparent and urgent attention is needed to forestall both the psychological and economic implications of failure (evidenced as shown in Figure 2.1). Babatunde and Opawole (2009) had identified building failure as resulting from progressive deterioration of components. The maintenance of the public housing scheme in South Africa has become imperative as new schemes are not forthcoming owing to budget constraints.

### 3. RESEARCH METHODOLOGY

The methodology adopted is a quantitative descriptive analysis which was based on primary data obtained through questionnaire survey. Purposive sampling was used in a case study approach of BCMM. The questionnaires were administered to 32 officials of BCMM who were directly or indirectly involved in building maintenance function (see Figure 1 for distribution). Respondents were the personnel in the BCMM with the official cadres of head of departments, general managers, programme managers, branch managers and senior technicians. The questionnaires were self-administered by emails and physical contacts. The questionnaire consists of four sections. *Section A* identified the profile of the respondents: years of experience, academic qualifications, and official cadres. *Section B* covered the critical issues of maintainability of BCMM buildings. *Section C* identified possible solutions to the questions in Section B, while *Section D* sought the views or general comments in respect of BCMM buildings maintenance.

The scale involving rating on interval scale of 1 through 5 where 1 and 5 represent the least and highest rating respectively was used. The questionnaires were administered between 15 November, 2016 and 13 December, 2016. The researchers made phone calls to the respondents who delayed to submit the questionnaires on time. The higher response rate obtained hinged on the advantage that one of the researchers works in the BCMM, and holds a senior management position. The closed-end format enabled the completion of a copy of the questionnaire on average of 25 minutes. The results are presented in Figure 1. Data analysis tools used include percentages and relative significance index (RSI). The relative index was calculated using the expression  $RSI = a/(b \times c)$ ..... (Equation 1); where, a = total score; b = highest response option, which is 5 in this assessment; c = total number of responses, for which  $0 \leq RSI \leq 1$ . The five-point scale (5 to 1) was transformed from scales 1, 2, 3, 4 and 5 to 0.20 (1/5), 0.40 (2/5), 0.60 (3/5), 0.80 (4/5) and 1.00 (5/5) respectively using the equation 1.

### 4. RESULTS AND ANALYSIS

#### 4.1 Profile of the respondents

The quality of the data was assessed based on the respondents' profile; official cadres, the academic qualifications, and the years of working experience (Figure 4.1). Respondents with matric certificate and higher certificate represented 2.94% each. Those with a National Diploma/Bachelor Degree (ND/B.Sc.) were 26.47% of the sample, and 58.06% held a post graduate qualifications (Honours/Masters' Degree). About 8.20% did not indicate their academic qualifications. The results of

the official cadres of the respondents showed that technicians and senior technicians, as well as administrative officers and senior administrative officers represented 5.88% each. Those that were head of directorates, general managers, programme managers and managers were 79.41% each. About 8.82% of the respondents did not mention the position that they held in the organization. Moreover, respondents had occupied their current official positions on average of 9 years. The average years of working experience of the respondents was estimated at 16, and this was the mean of about 50% of the respondents. These findings justify the position of the respondents to provide reliable data for this study.

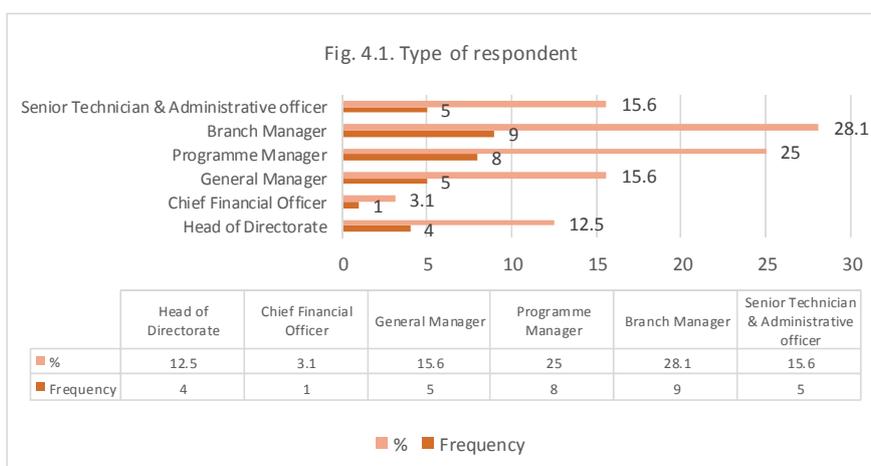


Fig. 4.1. Type of respondent

#### 4.2 Evaluation of critical challenges associated with maintenance of BCMM

The assessment of the relative significance of the factors is presented in Table 1. The ten factors which were obtained from the initial pilot survey were all either significant or highly significant ( $0.64 \leq RSI \leq 0.87$ ) on the likert scale of 1-5 used. The top challenges, however, were identified as backlogs in the maintenance and refurbishment, degree of disrepair/dilapidation, poor funding and inadequacy of personnel in the facilities assessment division, and independence of facilities assessment division. While factors such as absence of qualified personnel/officials, budget constraints, and building maintenance division not correctly positioned in the BCMM organogram, were least ranked, they were nonetheless defined as significant on the likert scale of 1-5 (Opawole and Jagboro, 2015; Alao and Jagboro, 2017). It was inferred from these results that backlogs in the maintenance and refurbishment, degree of disrepair/dilapidation, poor funding and inadequacy of personnel in the facilities assessment division, and independence of facilities assessment

division were the critical challenges to the maintenance and refurbishment of BCMM owned buildings. These findings supported the significance of lack of qualified personnel/officials and budget constraints identified in Talib *et al.* (2014). Moreover, the top ranking of degeneration of the maintenance works in BCMM building to backlog resonates with Kunya *et al.* (2007) that maintenance culture is generally lacking in public buildings in developing countries.

Table 1: Critical challenges associated with maintenance of BCMM

Factor	RSI	R
Backlogs in the maintenance and refurbishment	0.87	1
Budget constraints	0.52	9
Degree of disrepair/dilapidation	0.81	2
Absence of qualified personnel/officials	0.64	10
Absence of schedule to timeously respond to maintenance	0.76	6
Decentralization of maintenance function	0.64	7
Poor funding and inadequacy of personnel in the facilities assessment division	0.81	2
Independence of facilities assessment division	0.80	4
Building maintenance division not correctly positioned in the BCMM organogram	0.61	8
Non-prioritizing of building maintenance in BCMM	0.77	5

RSI = relative significance index

#### 4.3 Evaluation of policy response for BCMM building maintenance

Figure 4.3 presented the policy responses for improving the maintenance of the BCMM as suggested by the respondents. The results were interpreted based on the levels of agreement expressed by the respondents. About half (50.0%) agreed that improved budget would help to adequately maintain the buildings and prevent them from dilapidating to a state of disrepair. The fact that centralisation of the building maintenance function will result to well-maintained municipal buildings was either agreed or strongly agreed by 76.5% of the respondents. Also, 94.1% of the respondent either agreed or strongly agreed that BCMM needs to set aside a budget to populate the department that relates to facilities assessment. Moreover, the suggestion that there should be a building maintenance programme which is defined by conditional assessment reports was

supported by 97.1% of the respondents. Besides, the respondents responded generally that Buffalo City Metropolitan Municipality needs to allocate caretakers to each and every building so that if there is a problem with a building it can be reported timeously. The significance of the findings is farfetched by the relative indices of their rankings. The results revealed the relative indices ( $0.78 \leq \text{RSI} \leq 0.92$ ) for the variables which imply all of the factors assessed were significant in addressing the maintenance of the building.

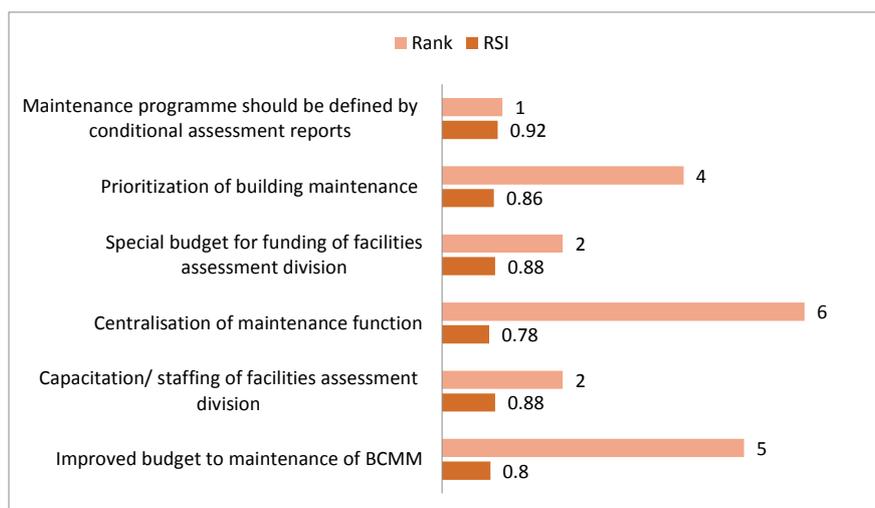


Fig. 3. Policy response to challenges of BCMM building maintenance

## 5. CONCLUSION AND RECOMMENDATIONS

This study examined the building maintenance practice in Buffalo City Metropolitan Municipality (BCMM) with specific emphasis on the associated challenges and appropriate policy responses. The study adopted a structured questionnaire which was administered to 32 officials of BCMM who were directly or indirectly involved in building maintenance function in the municipality. The findings on the challenges associated with the maintenance practice are summarized as:

- there are backlogs in the maintenance and refurbishment of BCMM buildings;
- there are not enough budgets to maintain and refurbish the municipal buildings;
- BCMM buildings are not maintained and are not refurbished timeously;
- independence of facilities assessment division contributes to poor planning of buildings that need to be repaired,

- maintained and refurbished;
- there is inadequate human resource at the facilities management division of BCMM;
- facilities assessment division is not correctly placed in the BCMM organisational structure; and
- building maintenance is not a priority in BCMM; hence some of the buildings are in a state of disrepair and are dilapidated.

Moreover, findings suggested that improved budget allocation to maintenance, centralisation of the building maintenance function, building maintenance based on conditional assessment reports, allocation of caretakers to each building, timeous reporting of maintenance works, were significant policy responses for improving the maintenance practice of the BCMM. It is recommended that the Buffalo City Metropolitan Municipality needs to prioritise building maintenance function. The management needs to ensure that sufficient funding for maintenance and refurbishment of municipal buildings is budgeted annually. The vacant positions in both facilities assessment and building maintenance should be filled with appropriate qualified, preferably the competent incumbents. One key lesson learnt is the need for independence of the facilities assessment division in an organization managing municipal buildings. Besides, maintenance and refurbishment works had increased to backlogs in the case of BCMM, which resulted in a worrisome budget. Hence, maintenance of municipal buildings would benefit from an adoption of scheduled maintenance practice such that maintenance and refurbishment works are timeously assessed which could be undertaken with annual budget.

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## Regulatory Framework of Sustainable Procurement for Construction Works – Indonesian Context

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### ABSTRACT AND KEYWORDS

#### Purpose of this paper

The objective of this paper is to discuss the recommendations for Gol to implement sustainable procurement, focusing on the construction sector.

#### Design/methodology/approach

The methodology started with exploring the initiatives of Gol to introduce this agenda through various regulations to facilitate broader campaign and further implementation nationwide. The list of regulations was compared to international best practices, i.e., UK, Denmark, Netherlands, Australia. This study was mainly based on literatures from these countries, available on the internet.

#### Findings

Based on this research, it can be said that Indonesian regulations are still lack of supports for Pre-Procurement Process compared to Procurement Process. More detailed policies and regulation should be developed.

#### Research limitations/implications

This such study has limitation, it only based on literatures that available on the internet. Misperceptions on these regulations might be inevitable

#### Practical implications

The findings suitable as a preliminary work to identify the general gaps in the regulatory framework.

**What is original/value of paper?**

This study assists the Gol to identify general gaps in the regulatory framework for sustainable procurement applications.

**Keywords:** Sustainable, Public, Procurement, Construction, Regulation

**1. INTRODUCTION**

In 2017, public procurement involved 30% of the national budget of Indonesia (Sembiring, 2017). With this significant amount, the Government has an advantage to regulate the procurement of goods and services towards sustainable development, since an effective procurement system will ensure competitiveness and economic growth through the efficient allocation of resources. Government spending on infrastructures has been one of the priorities of the 2014-2019 cabinet program, thus, construction public procurement has a significant potential to drive sustainability agenda of Indonesia because of its volume.

Procurement is an integral process of any construction project which includes all activities related to providing goods, services and consultancy for building national infrastructures. However, the procurement system, especially for construction works, has numerous weaknesses of both technical and non-technical aspects. This results in negative consequences reflected by fragile infrastructure, delayed government spending, and weak performance on other social indicators. In an effort to improve the situation, Gol has implemented reform programs (with the support of donor agencies) including: adopting new procurement regulations, strengthening the competence of bureaucrats in procurement decisions, and establishing a central procurement agency with a broad mandate to create rules and monitor compliance with existing rules (Buehler, 2012).

Awareness to integrate procurement with sustainability already exists within the construction industry by determining the selection of service providers through sustainable procurement in the regulation of the minister of public works and public housing number 5 of 2015 and presidential regulation number 16 of 2018, but this regulation does not comprehensively explain the techniques for implementing sustainable procurement. This is what causes the implementation of sustainable public procurement in Indonesia.

The constraints identified by LKPP (2013) regarding the implementation of sustainable public procurement are the perspective or perceptions of the parties involved in procurement, supra-structure readiness (legality and management), structures (institutions and organizations), and infrastructure (equipment and technology supporting), as well as the level of human management capacity or capability.

Therefore the government needs to establish technical regulations (technical guidelines) on sustainable procurement. The paper is important

to assist the government in understanding the concepts and best practices of sustainable procurement so can that formulate technically regulations.

## **2. OVERVIEW OF SUSTAINABLE PROCUREMENT**

“Sustainable Procurement” is defined by DEFRA (2011) as a process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimising damage to the environment. The definition indicates that procurement should consider the environmental, social and economic consequences of design; non-renewable material use; manufacture and production methods; logistics; service delivery; use; operation; maintenance; reuse; recycling options; disposal; and suppliers’ capabilities to address these consequences throughout the supply chain.

To implement sustainable procurement (SP) is difficult; any initiative to implement procurement as the “better” alternative to “traditional” method, should be based on the assessment of the current status of the use of triple bottom line of sustainability in the process (i.e. economic, social, and environmental factors), within each country’s context.

Procurement choices should be targeted towards maximising value. Considering which type of contract to use is only the start, other considerations are: how to engage stakeholders, how to link business strategy to select the project initially, how to define value both in its more tangible and easily explicated form, and the hidden tacit aspirations of those who are meant to benefit from the project (Walker et al., 2012). Furthermore, procurement choices should be about balancing demands and responsibilities; protecting reputations of those involved in the project against using unethical practices; encouraging innovation, best practice and knowledge transfer where it can reap value; developing project governance and reporting criteria that highlight, protect and generate value; and they should aim to attract the level of talent that can deliver stakeholder delight. Thus, this vision of procurement is far from the traditional lowest-cost/bid strategy. It requires a more intelligent treatment of how best to facilitate the project to generate sustainable value (Walker et al., 2012).

Berry (2011) suggested that to develop procurement into sustainable procurement, we should also minimizing negative impact of goods, works, or services across their life cycle and through the supply chain; minimizing demand for resources; ensure fair contract prices and terms are applied and respected; promote diversity and equality throughout the supply chain.

## **3. BEST PRACTICES OF SUSTAINABLE PROCUREMENT**

Countries with the most comprehensive policy guidance are Australia, UK, and New Zealand (Walker et al., 2012). According to Roos (2012), countries that lead in terms of Sustainable Public Procurement (SPP)

policies and programs in Europe are the Netherlands, Denmark, and the UK. This study has used literatures from these countries, but limited to the materials available on the internet. Misperceptions on these regulations might be inevitable. It is understood that such study has drawbacks, however it is suitable as a preliminary work to identify general gaps in the regulatory framework.

The countries used as benchmarks were: UK, Australia/NZ (very similar), Denmark, and Netherlands. UK put more focus on environmental issues, including the climate change. Meanwhile, in Australia and New Zealand, human rights are one of their main concerns. In Denmark, the competencies of human resources are highlighted. SP detailed implementation is locally adopted, since every country has its own challenges.

#### **4. INDONESIAN PUBLIC PROCUREMENT REGULATIONS**

Since the past decade, IT has been growing rapidly requiring business actors to improve their competitiveness, and thus influencing the strategic environment change of procurement of government goods/services. Procurement is encouraged to provide value-for-money by no longer pursuing the cheapest goods/services.

Answering to these issues, the Government Procurement Policy Institute (LKPP) has started promoting Sustainable Public Procurement since a few years ago. LKPP together with other ministries and agencies had finalized of the Road Map of SPP Development. It has been realized that SPP is a multi-stakeholder concept, thus its development should involve all parties which have strong interests in the stages starting from when/how the goods/services are produced, obtained, used, and finally demolished.

As the result, the new GPP (Perpres 16/2018) was issued in early 2018 and it explicitly considers the SPP to be implemented in Indonesia, effectively since July 2018, with the triple bottom line of sustainability principles in perspective. It is considered as a progressive policy since the former GPP (Perpres 54/2010) only introduced the green procurement concept through technical specification, evaluation criteria, and the procurement activities conducted by an organization, with the aims to minimize the use of natural resources and environmental impacts of the procurement related activities.

This new GPP states the responsibilities of procurement agents in conducting SPP, i.e., planning, budgeting, defining technical specifications, drafting contract, and developing procurement documents, and audit. Moreover, the use of on-line and Internet-based procurement tools, e.g., e-catalogue, e-purchasing, e-tendering, and e-commerce, are encouraged to streamline the procurement processes and to achieve value for money of the procurement in efficient and effective way. In economical aspect, the emphasis is on the total life cycle cost of goods or services that will be procured. In social aspect, this new GPP issues policies related to SMEs' empowerment, just working environment assurance, local businesses

affirmation, equality, and diversity. While for environmental aspect, the focus is on reducing negative environmental impacts to health, water, air and soil qualities, and on using natural resources wisely.

## 5. METHODOLOGY

With the objective to discuss the recommendations for further SPP implementation, focusing on the construction sector, the methodology started with exploring the initiatives of Gol. While the idea of SPP has been around among Indonesian policy makers, they need to introduce this concept through various more technical/detailed regulations to facilitate broader campaign and further implementation nation-wide.

International best practice was identified which included UK, Denmark, Netherlands, Australia. This study was mainly based on SPP literatures from these countries, available on the internet. Misinterpretations of these references are likely. While such study has drawbacks, it is suitable as a preliminary work to identify the general gaps in the regulatory framework.

The regulatory study was categorized into the stages of procurement: i) Pre-procurement process, and ii) Procurement process. This grouping was adopted from Scotland Resource Efficient (2013). The Pre-procurement Process included: a) Policy context (policy and regulation that directly or indirectly related to the procurement of construction works), b) Procurement strategy (to deliver professional service that achieves value for money), c) Sustainable risk and opportunities (potentials like education, employment, economic regulation, health and wellbeing, etc). The procurement process included: a) Specifications (dependent upon the type of product or services being procured), b) Supplier selection and bid evaluation (process selection and award criteria that are being used with tangible and measurable tools), and c) Contract management (improvement of the contract can be achieved by building requirements into the contract and manage it appropriately once awarded).

Huang and Hsu (2011) developed indicators for sustainable construction, as mentioned below. This sustainable construction indicator system was closely followed and cross-referenced with the category of procurement processes. The documents used in the analysis is listed in Table 6.2. Finally, Table 6.3. shows the relevance of each referenced regulations with the procurement process and the sustainable construction indicators.

## 6. IDENTIFYING REGULATORY GAPS

References available in the internet pertaining to SPP particularly for Construction Works have been gathered and listed in Table 6.2. In general, EU countries such as Denmark and Netherlands focus on Green Procurement. On the other hand, as a developing country, SPP Indonesia would put emphasis on the economic and social aspects. These references

were analysed and then cross-referenced to identify the comprehensiveness of regulations in each country, as shown in Table 6.3.

Thus, it can be seen that the obtained documents are supporting most of the SPP for sustainable construction purposes. However, there are several issues, denoted by grey cells in Table 6.3., which are still needed more directives for implementation. The findings for the related documents should be further validated, especially for the documents from abroad that were gathered only from the Internet and analysed explicitly. Focusing on Indonesian regulatory framework (checklist on Table 6.3.), the gaps have been identified, discussed below.

## 6.1 Scope of Regulations

**Table 6.1** Indicator System for Sustainable Construction

Code	Explanation	Code	Explanation
A.	Environment	B.	Social
A.1.	Resource usage	B.2.	Culture conservation
A.1.i.	Land	B.2.i.	Preservation of cultural heritage
A.1.ii.	Material	B.2.ii.	Accepting cultural difference
A.1.iii.	Water	B.3.	Social equity
A.1.iv.	Energy	B.3.i.	Regional development
A.2.	Minimizing pollution	B.4.	Social in construction
A.2.i	Air	B.4.i	Stakeholder's involvement
A.2.ii	Water	B.4.ii.	Avoidance of child exploitation
A.2.iii	Solid waste	B.4.iii.	CSR
A.2.iv	Noise	C.	Social
A.2.v	Toxic Substance	C.1.	Economic contribution
A.2.vi	GhG emission	C.1.i.	Contribution towards creation of employment
A.3	Ecology conservation	C.1.ii.	Contribution towards national economic growth
A.3.i	Biodiversity	C.2.	Eco-economic
A.3.ii	ESA	C.2.i.	Green material
A.3.iii	Afforestation	C.2.ii.	Subsidies
B.1.	Improve life of mankind	C.3.	Economic efficiency
B.1.i.	Quality of human barracks	C.3.i.	Benefit/cost for construction project
B.1.ii.	Transportation	C.3.ii.	Value added to land and building
B.1.iii.	HSE, security and threats	C.3.iii	Construction company profits

**Table 6.2.** References related to SPP for Construction Works

Country	Regulations
a. United Kingdom	Defra (2011)
b. Denmark	Danida (2007), LIFE (2014)
c. Netherlands	Grandia, J. (2015)
d. Australia/ New Zealand	APCC (2007), ECO-Buy Limited (2013), NSW Government (2017), NZBCSD (2009)
e. Indonesia	Presidential Decree 59/2017, Presidential Decree 16/2018, Constitution 2/2017, Minister Decree 5/2015, Minister Degree 2/2015, Jakarta's Government Regulation 38/2012

The regulations related to green buildings, i.e., Minister Degree 2/2015 and Jakarta's Government Regulation 38/2012 seem to cover the same scope with more emphasis on environmental aspect.

The construction service act or Constitution 2/2017 is also considered as a broad regulation that covers the importance of sustainability issues in construction works, therefore there is substance related to SPP explicitly. However, this Constitution 2/2017 should be followed by or not conflicting with other lower regulations such as Presidential Decree 16/2018, Minister Decree 5/2015, and Minister Degree 2/2015 which are more operational type of regulations.

Eventhough Minister Decree 5/2015 (General Guidelines on Implementation of Sustainable Construction) is also a general guideline for implementing sustainable construction, it covers almost all processes related to deliver an infrastructure with sustainability principles in mind, but it does not explicitly mention SPP detailed procedures related to procurement strategy and risk and opportunities identification.

The most comprehensive regulation related to SPP so far is the new Presidential Decree 16/2018 (Government Procurement of Goods and Services), reinforcing the obligation of government agencies to implement SPP for goods and services, including construction works. However, the coverage is limited, not all indicators are covered, since it was developed based on the actual and urgently need for Indonesia's context. Moreover, for construction works, SPP procedures should be further developed by the related ministry, i.e., Ministry of Public Works and Human Settlement.

## 6.2 Indicators for Sustainable Construction

**Table 6.3.** Comparison of Regulations Supporting Sustainable Procurement for Construction Works

Indicator (Table 6.1)	Pre-procurement Process						Procurement Process					
	Policy Objective		Procurement Strategy		Sustainable Risk & Opportunity		Specification		Supplier Selection/ Bid Evaluation		Contract Management	
Country	O	I	O	I	O	I	O	I	O	I	O	I
A.1.i	√	√	√	√	√	√	√	√	√	√	√	√
A.1.ii	√	√	√	√	√	√	√	√	√	√	√	√
A.1.iii	√	√	√	√	√	√	√	√	√	√	√	√
A.1.iv	√		√		√		√		√		√	
A.2.i	√	√	√	√	√	√	√	√	√	√	√	√
A.2.ii	√	√	√	√	√	√	√	√	√	√	√	√
A.2.iii	√	√	√		√		√	√	√	√	√	√
A.2.iv	√	√	√		√		√	√	√	√	√	√
A.2.v	√	√	√	√	√	√	√	√	√	√	√	√
A.2.vi	√		√		√		√		√		√	
A.3.i					√							
A.3.ii		√			√			√		√		√
A.3.iii												
B.1.i												
B.1.ii	√											
B.1.iii	√	√	√	√	√	√		√	√	√		√
B.2.i	√	√			√		√	√	√	√		√
B.2.ii	√				√				√			
B.3.i	√	√	√	√	√	√	√	√	√	√	√	√
B.4.i	√	√	√	√	√	√	√	√		√	√	√
B.4.ii					√		√				√	
B.4.iii	√		√		√		√		√			
C.1.i		√		√		√		√	√	√	√	√
C.1.ii	√	√	√	√		√			√			√
C.2.i	√	√	√		√		√	√	√	√		√

C.2.ii												
C.3.i		√	√	√	√	√	√	√	√	√	√	√
C.3.ii	√	√		√	√	√	√	√	√	√	√	√
C.3.iii		√	√		√		√		√			
B.1.iii												

As depicted in Table 6.3., some cells are greyed, and some cells are not populated with Indonesian regulations; in environmental and economy aspects, there are only two indicators for each aspect, while in social aspect, there are five indicators. It seems that social aspect is overlooked compared to the other two. In environmental aspect, biodiversity (A.3.i) and afforestation (A.3.iii) indicators are missed in the studied Indonesian regulations, even though those indicators are still relevant in Indonesia's context. It is true that Indonesia can be categorized into the richest country with biodiversity because of its archipelagic nation with vast geographical expanse and tropical rainforest and climate. However, maintaining its biodiversity and rain forest is challenging effort nowadays with higher needs of infrastructure development and overexploitation of natural resources happened in many Indonesian regions.

For economy aspect, indicators related to subsidies (C.2.ii) and corporate's benefit (C.3.iii) are not yet considered in the Indonesia's regulations. Sustainability is now becoming a common value for many countries and already declared as goals for all nations, however level of readiness of each country is different for implementing that internationally agreed value.

There are five indicators in social aspect that are not mentioned in the studied Indonesia's regulations, these are: quality of worker's barrack (B.1.i), transportation (B.1.ii), accepting cultural difference (B.2.ii), prohibiting child's exploitation (B.4.ii), and CSR (B.4.iii). However, all indicators are familiar issues in Indonesia and already taken care of, but by other regulation or guidelines. For instance, for indicators related to empowering human's life, B.1.i and B.1.ii, in construction projects are already commonly stated in technical specification and contract documents by the owners. Yet, the further mentions of aforementioned indicators in more detailed policies related to SPP are still necessary for comprehensiveness of SPP's system.

### 6.3 Pre-Procurement and Procurement Processes

Regarding the Pre-Procurement Process and Procurement Process, it can be said that the studied Indonesian regulations are still lack of supports for Pre-Procurement Process compared to Procurement Process. More detailed policies and regulation should be developed in this area related to strategic procurement and identification of risk and opportunities. The improvement in this area is needed since the current practices of

procurement by the government agencies are more procedural than strategic and anticipating the risk and opportunities for procurement innovations. The major issue is on the capacity of human resources for conducting the procurement itself. Certification that has been sanctioned by the LKPP for all procurement personnel seems to have not alleviated the capacity of individuals to empower themselves in procurement activities.

## 7. CONCLUSION

Indonesia has been developing towards implementing sustainable development. In its construction sector, sustainable construction has also been introduced to the practitioners with the government as the leader for the implementation. Regulatory framework related to achieving sustainable development goals (SDGs) and its derivatives in construction sector for public construction projects have been developed as well. Recent issuance of new GPP is considered a progressive policy to push the SPP into practice for government procurement. However, more works need to be done for completing the regulatory frameworks by developing more detailed procedures of SPP for construction works that will empower the procurement personnel.

This initial study has identified issues of gaps in regulatory framework and opportunities of benchmarks from other countries for more comprehensive and effective SPP implementation in Indonesia. Several indicators of sustainable construction are still need to be integrated when developing more detailed procedures of SPP in construction works.

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# **Delays and Disruptions on Construction Projects within the Public Sector: Integrated Project Delivery System as an Alternative**

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## **ABSTRACT AND KEYWORDS**

### **PURPOSE:**

This study aims to examine the existing construction procurement methods which determine the processes, sequence of operations and communication channels within the public sector and investigate whether an alternative procurement method, namely Integrated Project Delivery System (IPDS), could serve as a potential solution to the existing issues. The selected procurement method provides a framework for the project and the project team. The current options available within the public sector are structured according to guidelines provided by legislative framework, the Construction Industry Development Board and The National Treasury. The guidelines are aligned with the specific requirements of the country. The findings revealed that the Traditional Procurement method (TPS) is

implemented by default or due to familiarity and is therefore not always the appropriate system. This paper reports on the findings of a study dealing with delays and disruptions.

**RESEARCH DESIGN:**

The research was qualitative in nature. The research was conducted via interviews within case studies and a survey. The participants were selected via convenience sampling. The cases were confined to the KwaZulu-Natal province.

**RESEARCH LIMITATIONS:**

The study has been restricted to a sample of Public Sector construction projects within the Kwa Zulu-Natal province of South Africa. Only parties to a contract within the KwaZulu-Natal region have been considered. These parties to the contract include the Principal Agent, Quantity Surveyor and main contractor or subcontractor where relevant. The study was constrained by time as it was conducted during January 2017 to October 2017.

**RESEARCH FINDINGS:**

The findings revealed that the Traditional Procurement method is implemented by default or due to familiarity and is therefore not always the appropriate system. The research found that the Traditional Procurement systems possess adversarial relations and the industry is in agreement that a more relational system could harness greater results. In addition, the TPS unfortunately restricts contractor involvement during the inception stages which is potentially to the detriment of the project. The findings further suggested that the contractor has valuable input which should be considered during the design stages in order to improve the ease of construction and possibly reduce construction time and effectively diminish delays and disruptions. The research revealed that the consequential impact of this change will be significant.

**RESPONSE TO CONFERENCE THEME & OUTCOMES:**

This study will contribute to timeous, successful delivery of projects with improved efficiencies and assist with correct resource allocation. The study will provide an indication of the potential inhibitors to implementation of alternative forms of procurement in the South African public sector and provide a path to overcoming these barriers resulting in positive, innovative development within the built environment.

**PRACTICAL IMPLICATIONS:**

This study contributes to the body of knowledge of public sector procurement and proposes an alternative approach given its benefits to all parties involved in the project delivery process.

**VALUE OF PAPER:**

Public sector projects regularly experience delays and disruptions resulting in increased costs and dissatisfied clients. Very few studies have been done to examine holistically and thoroughly the systemic and other causes of these phenomena critically in order to understand them and their causes so that appropriate preventive interventions can be developed and implemented. The timely delivery of public sector projects is important as a national priority. This study makes a contribution to addressing the problem using an evidence-based approach. This study aims to examine the most commonly used procurement approaches and routes in the public sector of South Africa and to explore the potential impact of using the Integrated Project Delivery System on public sector projects in KZN.

**KEYWORDS:** Procurement, project delays, public sector, Traditional procurement, Integrated Project Delivery System

**1. INTRODUCTION**

Procurement method selection has been identified as a key factor contributing to successful project delivery within the construction industry (Mathonsi & Thwala, 2012). The use of traditional procurement methods by the construction industry has become notorious for failing to integrate construction with design (Trigunarsyah, 2004). As a consequence, the relationships between parties involved in the design stage and those involved in the construction phase are adversarial and counterproductive to achieving overall project success and achievement of project goals. It is essential that organizational structures such as professional teams are formed as a result of the project parameters and the project delivery success or failure be measured against these parameters. Procurement systems are the combined contributions of design, management and installation of the organizational structure (Rwelamila and Ngowi, 1996).

According to Lupton, Cox and Clamp (2007) 'Procurement' often describes the flow of relationships, both interactive and contractual, between the client, the construction teams and consultants within a construction project. The elected method is dependent on the nature and scope of the work to be performed. It is also reliant on the manner in which the work is to be carried out, the risks that it involves and the price basis on which the contract is awarded. The procurement method is often chosen prior to the commencement of the project based on previous projects of similar nature. Mosey (2009) argues that the traditional method of procurement which involves the contractor and subcontractors being appointed based on the lowest price tendered when the construction is ready to commence is a reflection of an established trend rather than a solution that addresses the specific needs of the client. While it is further argued that early project processes should not be governed by traditional

contracts when the design and procurement involving the pricing of the design thereof are agreed upon, the need for a contract is pertinent to identify the parameters of a contractor's early involvement and the associated obligations and risks. Rwelamila and Hall (1994) identify the Traditional Procurement System (TPS) as being an outdated method, displaying inefficiency and failing to effectively illustrate the appropriate client-contractor relationship. The TPS has been the default procurement method selected by consultants while neglecting consideration of its appropriateness for the given circumstances.

Arguably, the consequences of these issues are schedule delays and increased construction costs as a direct result of designers not considering buildability/constructability within their designs with many amendments having to be made to the working drawings once the construction team has given their input. Many of these changes are driven by issues of buildability or constructability (Arditi., Elhassan and Toklu, 2002). Smith and Love (2001) identify that despite time and cost overruns on building projects, procurement strategies have not evolved sufficiently in recent years. The issues of fragmentation and separation of the design and construction phases have been identified in various reports dating back to early 1960 (Mosey, 2009). Traditionally there is a separation between the design and construction phases of a project due to the traditional procurement approach which is widely used in the construction industry in KwaZulu-Natal and elsewhere. This separation deprives contractors of the opportunity to provide input into the design informed by their experience, often resulting in designs that lack buildability or structural integrity. By neglecting the concept of constructability projects are not being carried out in the most efficient manner (Motsa., Oladapo and Othman, 2008).

## **2. LITERATURE**

### **2.1 Project Delivery**

Rwelamila and Ngowi (1996) identify cost, time, quality and utility as the most dominant objectives and parameters of their projects by clients. According to The Constructor (2017) construction projects may be complex in nature and may require intricate coordination of permissions, people, equipment and material. A project can commence in spite of numerous uncertainties which frequently results in delays.

### **2.2 Delays and Disruptions**

The manifestation of projects exceeding the stipulated time and lagging in schedule is considered a frequent occurrence in construction. Delays in construction have been defined as the time which has lapsed beyond a specified completion date outlined in a contract or beyond a date for which project delivery has been agreed upon. These delays have various impacts

on the parties to a contract. The client or owner suffers a loss of income through lack of leasable space or lack of productivity due to absence of facilities. A contractor may suffer increased overhead expenses and unanticipated inflation rates due to extended time spent on the project (Assaf and Al-Hejji, 2006).

Construction delays result in increased costs which makes project completion within the scheduled time advantageous to all parties to avoid these additional costs. It therefore becomes vital that the causes of delays are identified in an effort to mitigate the risk of this occurrence and the costly consequences (Al Hammadi and Nawab, 2016). El-Razek *et al* (2008) analyze the groups of delay causes and rank their index accordingly in Table 2-1, identifying contractual relationships in the top three.

**Table 2-1:** Causes of Delays and its Ranking Index

Rank	Group of delay causes	Group importance index
1	Financing	64.33
2	Materials	53.67
3	Contractual relationships	52.38
4	Changes	47.47
5	Rules & regulations	45.00
6	Manpower	44.83
7	Scheduling & control	43.39
8	Equipment	40.00
9	Environment	30.33

## 2.3 Procurement

Procurement provides a framework which outlines the roles and responsibilities for parties to a contract. Its contribution has been identified as a key element in determining the success of a project and client satisfaction. Selecting an appropriate procurement method is therefore crucial to both the professional team and the client (Love, Skitmore and Earl, 1998). Clients within the construction industry each have their own objectives for a project which lead to vital decisions which must be made regarding the project in an effort to ensure that those objectives are met. Design procurement includes the design responsibility, risk allocation and involvement of the contractor (Cooke and Williams, 2004).

### 2.3.1. Traditional Procurement (TPS)

Consultants are appointed to carry out the design, control costs of the project and undertake the contract administration. It is the responsibility of the contractor to carry out the works as outlined in the scope of works,

which is inclusive of subcontractors, suppliers and workmanship and of materials. In the traditional approach, the contractor is awarded via a competitive tendering process based on documents provided which will provide all the required information pertaining to the project. The contractor may be appointed at an earlier stage via negotiation or based on the information available. This variant of the traditional system is frequently referred to as the 'Accelerated Traditional method' and entails utilizing a two stage tendering process or a negotiated tender process. This allows the design and construction to run concurrently within the parameters of the project. The variant will provide for the contractor to start the works on site at an early stage however it carries increased risks of cost uncertainty (Lupton *et al.*, 2007). Due to the fragmentation of design and construction the Traditional Procurement System, adversarial relationships between the project team can be easily adopted. Other results such as lack of innovation and increased cost and time implications have been highlighted. These key issues indicate that the TPS may not always provide the project with the best value for money (Trauner Consulting Services (TCS), 2007).

### **2.3.2 Public Sector Procurement**

The TPS has been greatly criticized for failing to accommodate the advancing technology and increasing complexity on construction projects (Rwelamila and Hall, 1994). "Classical (i.e., traditional) contractual arrangements call for clear and definitive allocations of risks (and responsibilities and liabilities) among stakeholders but all possible risks/uncertainties are not foreseeable and quantifiable at the outset. Even the foreseeable risks may change in importance and may influence some other risks, requiring considerable adjustments during project execution. Classically "complete" contractual arrangements are therefore not suitable for proper risk management. The objective of risk management should be to minimize the total cost of risks to a project, not the cost to any parties separately." (O'Connor, 2009: 3). The argument as presented by Rwelamila and Hall (1994) is that the fault lies within the management of the system and perhaps not the system itself.

## 2.4 Integrated Project Delivery System (IPDS)

Integrated Project Delivery System may be defined as: “Integrated Project Delivery (IPD) is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction. IPD principles can be applied to a variety of contractual arrangements and IPD teams can include members well beyond the basic triad of owner, architect, and contractor. In all cases, integrated projects are uniquely distinguished by highly effective collaboration among the owner, the prime designer, and the prime constructor, commencing at early design and continuing through to project handover.” (AIA CA Council, 2007: 1)

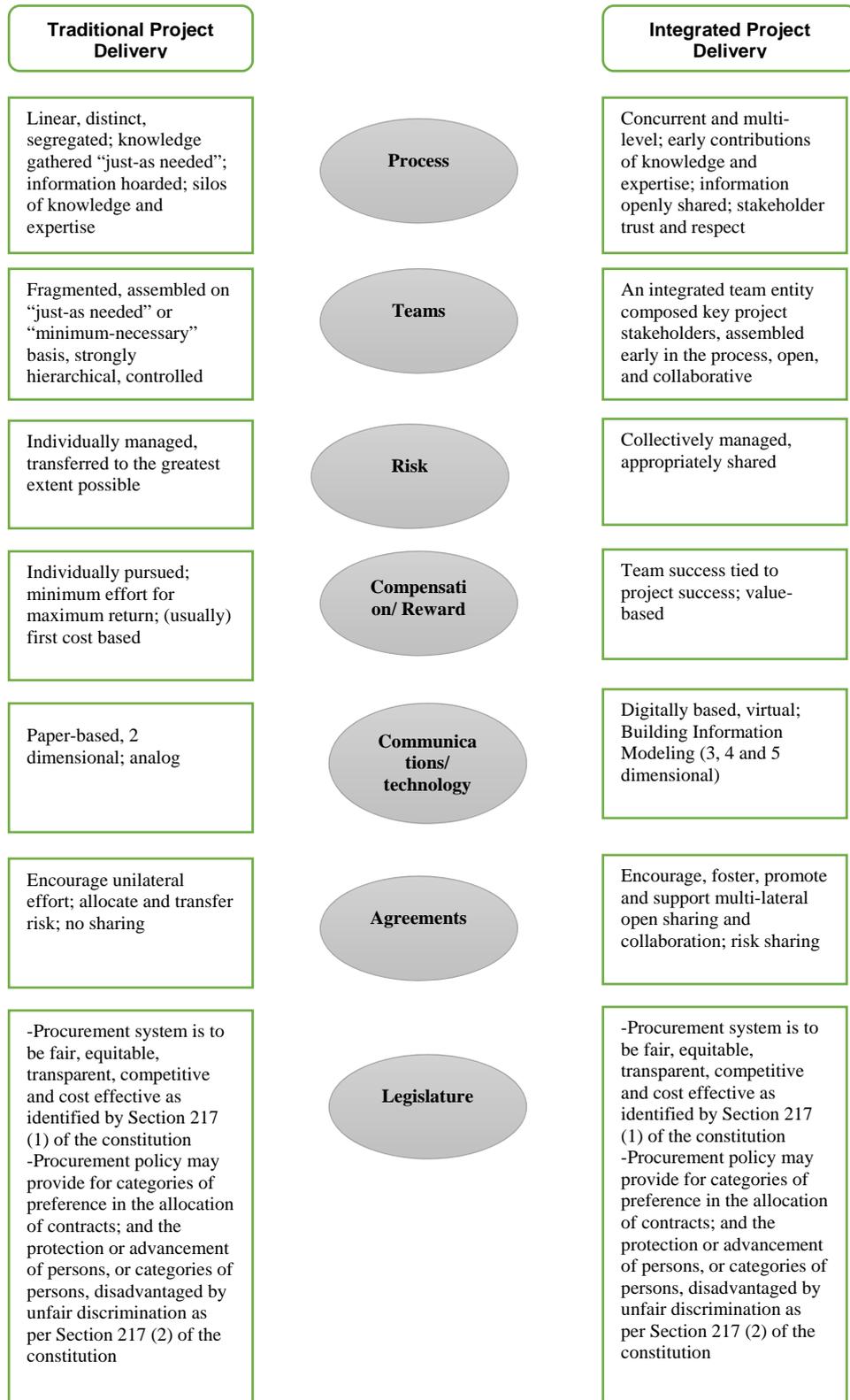
Early involvement of all participants: a vital differentiating factor of IPD is the engagement of all parties at the early stages of the design phase. This collaboration can significantly alleviate the problem of fragmentation between design and construction teams. This process has the ability optimize efficiency and avoid variations resulting in delays and cost overruns. There is no specific type of technological tools required, however information technology synonymous with Building Information Modelling (BIM) has been found to improve the effectiveness of the process in all phases of the project (Becerik-Gerber and Kent, 2010).

### 2.4.1 IPDS: The Prime Contract

IPDS diminishes the hierarchy of project participants that is synonymous with the traditional methods. There exists a single binding contract between the team and the client. This contract can be adapted to any existing form of contract which stipulates the scope of the project, the costs and planning schedules. The contract will be signed by the team as a single entity. The Multiparty Integrated Project Delivery Agreement, also identified as ConsensusDocs 300 (CD300), provides for a form of contract for IPDS. This agreement addresses key issues such as a multiparty agreement between owner, designers, and constructors, cost reimbursable payments, and risk sharing amongst relevant participants. Lean Construction techniques in the planning of the project, design as well as construction have been incorporated into the CD300. IPD was developed in an effort to eliminate the effect of different objectives amongst the participants to a contract, which is inherent in Traditional methods. The inclusion of the Lean Construction techniques into the CD300 facilitates the process of aligning all aspects of the construction process throughout. In an effort to diminish inefficiencies, Lean Construction process focus on improved planning, greater collaborative initiatives between the owners, the designers and the construction team and creating incentives which are project based as opposed to individually based outcomes ([Leone](#) and Vornehm, 2016).

## **2.5 TPS vs IPDS**

Figure 2-1 provides a comparison of the features of the Traditional Procurement System versus the Integrated Procurement Delivery System.



**Figure 2-9: Traditional Delivery vs Integrated Delivery**  
Adapted from the AIA 2007 and National Treasury 2012.

### 3. RESEARCH APPROACH

#### 3.1 Surveys

A survey was designed and developed for project participants to populate based on their experience on projects within the public sector. Every effort was made to ensure that the survey was designed to allow the participants to understand the instrument with ease and to indicate responses effectively (Kothari, 2004). A total of 20 surveys were distributed for analysis

The survey consisted of 2 scenarios:

- The first scenario required the respondent to connect various project participants/ stakeholders based on flow of communication which currently exists on public sector construction projects. They were provided options of single flow communication or two way flow of communication and were advised to comment if necessary.
- The second scenario required the respondent to connect various project participants/ stakeholders based on a desired flow of communication on public sector construction projects. They were provided options of single flow communication or two-way flow of communication and were advised to comment if necessary.

#### 3.2 Case Study

Ten case studies on projects within the public sector were identified and interviews based on those cases were conducted. The participants were selected via convenience sampling. The cases were identified based on construction projects within the public sector which were complete and had experienced delays in order to analyse the details of the delays.

### 4. FINDINGS AND DISCUSSIONS

#### 4.1 Survey Analysis

The findings from the survey which was conducted on various project stakeholders assessed the relationships and flow of communication which exists on projects within the public sector and the desired changes to optimize efficiency on these projects. A total number of 20 survey responses were received. The results were analysed as illustrated in Table 4-1 below.

**Table 4-1:** Communication and Relationship Change Analysis

Project Stakeholders	Unilateral Relationship	Bilateral Relationship	No Relationship Indicated
	→	↔	
Client – Project Manager	0	-2	2
Client – Architect	-1	0	1
Client – Quantity Surveyor	0	12	8
Client – Engineer	1	-9	8
Client – Contractor	-1	-2	3
Client - Subcontractor	-1	-2	3
Client - Manufacturer	0	-1	1
Project Manager – Architect	-3	2	1
Project Manager – Quantity Surveyor	-1	0	1
Project Manager – Engineer	-1	-2	3
Project Manager – Contractor	5	-6	1
Project Manager – Subcontractor	-2	-1	3
Project Manager – Manufacturer	-2	-5	7
Architect – Quantity Surveyor	1	-5	4
Architect – Engineer	1	-2	1
Architect – Contractor	2	-5	3

(Continuation) Project Stakeholders	Unilateral Relationship 	Bilateral Relationship 	No Relationship Indicated
Architect – Subcontractor	0	-2	2
Architect – Manufacturer	-1	-6	7
Quantity Surveyor – Engineer	0	-1	1
Quantity Surveyor – Contractor	1	1	-2
Quantity Surveyor – Subcontractor	-2	0	2
Quantity Surveyor – Manufacturer	0	-4	4
Engineer – Contractor	2	-4	2
Engineer – Subcontractor	1	-3	2
Engineer – Manufacturer	0	-1	1
Contractor – Subcontractor	4	-4	0
Contractor – Manufacturer	6	-5	-1
Subcontractor - Manufacturer	-1	-1	2
Total number of changes = 204			

The survey findings revealed that there were a total of 204 added or altered directional lines of communication between the existing procurement model that was predominantly used in the public sector and the desired flow of communication as part of procurement arrangements. The project participants illustrated a preference to a procurement model and contractual arrangement that allows for more interaction and communication between all the various stakeholders. The significant increase in desired relationships and corresponding decrease in lack of

relationships hints at the preference for a system which is more relational that could potentially yield improved results when compared against current practices.

#### 4.2 Case Study/ Interview Analysis

The study provided insights into the experience and opinions of key stakeholder on procurements processes.

**Table 4-2:** Reasons for Project Delivery Failure within Public Sector (n=10)

Primary Reasons for Project Failure	
Delays	70%
Budget	40%
Other	40%

All respondents claimed that most projects in the public sector did not satisfy the usually required project objectives, listing the primary causes for project delivery failure as delays (70%) and budget overruns (40%) as shown in Table 4-2.

**Table 4-3:** Project Delivery Success Rate (n=10)

Percentage of projects which attained complete project delivery success	
0%	30%
0-10%	30%
50%	30%
>50%	10%

It is evident that most respondents (90%) reported a success rate of less than 50% on public sector projects.

**Table 4-4:** Reasons for project failures (n=10)

Reasons for failed projects	
Poor project briefing and scope definition	50%
Delayed decision-making and processes	50%
Limited stakeholder experience	50%
Poor communication	40%
Political interference	30%
Lack of planning	30%
Poor project document and procurement process alignment	20%
Budgetary constraints	10%

It is evident from Table 4-4 that project briefing and defining the scope; delayed decision making; limited stakeholder experience and poor communication appear to be the dominant issues contributing to project failures.

**Table 4-5:** Procurement route primarily selected on public sector projects (n=10)

Procurement Route	
Traditional Method	100%
Design-Build	10%
Collaborative Methods	0%
Management Orientated	0%

All respondents identified the Traditional Procurement method as the primarily selected route within the public sector.

The participants were asked whether a relationship between the method of procurement and successful project delivery existed. Table 4-6 summarizes the responses.

**Table 4-6:** The relationship between the method of procurement on a project and successful project delivery (n=10)

Yes	80%
Sometimes	20%
No	0%

From Table 4-6 it is evident that 80% of respondents associate the method of procurement with project delivery success while 20% attribute the association between the method of procurement and project delivery success to the complexity and size of the project.

The participants were asked whether the option of using alternative procurement routes had been explored. Table 4-7 lists the responses.

**Table 4-7:** Use of alternative relational and non-adversarial procurement routes (n=10)

Yes	90%
No	10%
Positive outcome on projects which used alternative procurement methods	90%

In Table 4-7, the respondents indicated that they have explored implementation of alternative procurement methods which resulted in a positive outcome in all instances.

**Table 4-8:** Willingness to implement IPDS (n=10)

Consideration of IPDS implementation
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Yes	60%
Uncertain	30%
No	10%

While majority of the participants (60%) indicated from Table 4-17 that the method would be a welcomed alternative, 30% displayed hesitation to implement this approach.

## 5. CONCLUSION

The findings suggest that while the Traditional method is primarily selected on public sector projects, it may not always provide for the most appropriate method. Stakeholders indicated that the Traditional Procurement route is synonymous with segregation of project participants. The findings suggest that this fragmentation can be associated with one of the primary causes for delays, disruptions and cost overruns on projects. When an alternate route which fosters relational features as opposed to being adversarial in nature was introduced, the participants revealed interest in implementation. The stakeholders identified key features within IPDS which would assist in reducing delays, disruptions and the consequential cost implications on projects. Potential barriers to implementation within the public sector were highlighted.

The study found that the South African legislative framework appears to have a great impact on the implementation of alternative procurement methods. Any alternate route explored would need to be adaptable to the existing framework in order to be considered as a viable option. While the stakeholders have highlighted barriers to implementation, the benefits of IPDS appeal to them. The study provides evidence that a change in the methods is desperately needed. There exists a resistance to change among a few professionals due to the risk associated with exploring an option which is unfamiliar however the industry is evolving and it is essential that South Africa keeps up in order to improve project delivery success and the industry as a whole.

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# Exploring underlying structures of risk response measures: A study among small and medium contractors in Gauteng, South Africa

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## ABSTRACT

### Purpose of this paper

Construction undertakings are often associated with numerous risks which can jeopardize successful completion of projects. In order to curtail risks, risk responses have been developed. However, there appears to be a paucity of studies exploring underlying structures of risk response measures especially among small and medium construction enterprises (SMEs). The paper evinces findings from an exploratory factor analysis (EFA) of risk responses measures.

### Research methodology

A questionnaire was used as a data collection instrument from 187 construction SMEs who were conveniently sampled in Gauteng (South Africa). The data was analysed using the Statistical Package for the Social Sciences (SPSS) version 23.

### Findings

Findings revealed that risk response could be measured by two constructs namely; avoiding risk and mitigating risk. These findings suggest the use of two constructs as measures of risk response, supporting extant literature.

### Research limitations

The findings revealed in the study are limited, and should not be generalized to all South African SMEs since the respondents were exclusively construction SMEs and were all based in Gauteng province.

### Practical implications

The study provides factual evidence to industry professionals in their risk response options. The measures established in the current study using EFA will enhance measures used in responding to risk at project level of construction SMEs.

### Value of paper

The study is of value to the theme of risk management (RM), where empirical evidence establishing underlying structures of risk response measure in the construction industry (CI) is at present sparse, especially among South African construction SMEs.

**Keywords:** Constructors, underlying structures, exploratory factor analysis, risk response measures, South Africa.

## 1. INTRODUCTION

The construction industry (CI) is considered risk inclined, due to its long, dynamic and complex project undertakings (Gao *et al.* 2013). There are also multiple stakeholders and investors who place immense pressure on the construction team to achieve project goals (Taroun, 2012). The rate of cancelled and challenged projects in the CI is amongst the highest of all industries (Rounds and Segner, 2011). Fischer (2015), indicated that construction enterprises face major difficulties in meeting their project planned objectives in the most cost effective and at a desired quality especially among small and medium construction enterprises (SMEs) whose contribution to economy is substantial. In South Africa, the CI employed 1 395 000 people (formal and informal sectors), accounting for 9, 6% on average of GDP between 2008 and 2016 (StatsSA, 2017). A report released by StatsSA (2011) revealed that construction SMEs represent 78,6% of enterprises in the South Africa construction industry (SACI); hence these enterprises are vital in job creation and the well-being of the country's economy. Due to the importance of SMEs for the national economy, the South African government has awarded in recent years most projects such as school renovation in the Highlands area of north Johannesburg, police station, and magistrate court projects and many other projects to construction SMEs. However, despite the support provided, projects not delivered within established objectives continue to occur in the SACI (Chihuri and Pretorius, 2010; Shunmugam and Rwelamila, 2014). A plethora of studies (Marcelino-Sadaba *et al.* 2014; Chiliya *et al.* 2015; Poba-Nzaou *et al.*, 2014) revealed that many SMEs do not or not adequately apply risk management practices, mostly because they cannot afford to rededicate resources due to their constraints.

All enterprises need to adopt a RM strategy and methodology to identify, assess and treat risks (Verbano and Venturini, 2013). Though SMEs often face the same risks as larger enterprises, but Poba-Nzaou *et al.* (2014) indicated that SMEs are more exposed to risk than their larger counterparts. Raghavan (2005) believed that SMEs need to practice RM much more than their larger counterparts owing to resource restraints to respond promptly to potential threats. However, in order to achieve the rate of project success, they need to make risky decisions and engage in risky activities so that they can protect the innovativeness of delivering project (vergas-Hernandez, 2011).

RM is the process by which risks are identified, assessed and a number of techniques and actions can be selected to address them (Lavia lopes *et al.* 2014). Several tools and methods are available for risk handling in SMEs, However, despite the increasing volume of literature on RM in recent years, research into RM and the techniques or measures used in responding to risks seems to be scant in the SACI in general and in particular among construction SMEs. Regardless of the substantial

contribution of SMEs to national economies as noted above. The non-existence or rareness of studies establishing responses measures used by SMEs in the management of project risks faced in construction of may be regarded as a gap, which the current study aims to close. Therefore, the current study aims at establishing the underlying structure of risk responses measures among construction SMEs in Gauteng, South Africa. By establishing the structures of these measures, researchers and industry professionals will have information on risk responses actions employed by construction SMEs.

## 2. MEASURING RISK RESPONSE

There are different ways in which risk in construction can be treated. According to Urban and Gupta (2011), employing a set of measures provides a greater indication of project performance than concentrating on a sole measure (or indeed an insignificant number of random measure). Good risk response measures should be quantifiable and permit statistical inferential procedures and should be valid and representative of what is to be measured (Thun *et al.* 2011). The interpretation should relate to the system and its operational context (Brustbauer, 2014). The following measures were identified from extant literature as being measures of risk response:

- Responding to risk by avoiding (Toor and Ogunlana, 2010; Juliano and Alexander, 2013; Jun *et al.* 2010). Also known as risk elimination, risk avoidance entails adjusting the project plan so that the conditions triggering a risk event are no longer present and the risk is eliminated. This metric has been traditionally used to respond to risk in construction. However, some researchers (Gao *et al.* 2013; Poba-Nzaou *et al.* 2014; Sukumar *et al.* 2011) are of the opinion that risk avoidance in construction is not generally recognized to be impractical as it may lead to projects not going ahead. For example, a contractor not placing a bid or the owner not proceeding with project funding are two examples of totally eliminating the risks.
- Responding to risk by mitigating (Gajewska and Ropel, 2011; Aimable, 2015).
- Responding to risk by retaining. This is the method of reducing controlling risks by internal management (Zhi, 1995); handling risks by the company who is undertaking the project where risk avoidance is impossible, possible financial loss is small, probability of occurrence is negligible and transfer is uneconomic (Akintoyne and MacLeod, 1997). The risks, foreseen or unforeseen, are controlled and financed by the company or contractor.
- Responding to risk by transferring. This is essentially trying to transfer the risk to another party. For a construction project, an insurance premium would not relieve all risks, although it gives some benefits as a potential loss is covered by fixed costs (Tummala and Burchett, 1999). However, Urban and Gupta (2011) stated that in construction for example, the decision as to which

risks will be transferred to the Contractor will have a significant effect on the ultimate cost of the project as the Contractor will, in most cases, endeavour to level the playing field based upon his perception of the project risks he has undertaken by ensuring that he is appropriately compensated for accepting those risks.

- Predefine actions to counter the identified project risks (Smit, 2012; Gajewska and Ropel, 2011).
- Prepare and implement risk action plan (Alberto and Timur, 2013; Aimable, 2015)

The aforementioned metrics are common and used in construction as risk responses, after potential risks have been identified. They were therefore adopted as the measures of risk response in the current study.

### **3. RESEARCH METHODOLOGY**

A population refers to the entire group of individuals in which the researcher has an interest (Neuman, 2006). For the purpose of this study, the population of SMEs in the Building Construction Industry in Gauteng was selected from the Construction Industry Development Board (CIDB) register of contractors. The reason for sampling from the CIDB population was that it contains potential respondents. An internet search was therefore conducted on the CIDB website to identify the potential respondents. In identifying potential respondents, the researcher ensured that all respondents were graded 1 to 6 and that they had a valid registration with CIDB in order to participate in the study. The respondents included owners, owner-managers, managers, project managers and other personnel with strong knowledge about the organisation and risk management practices.

After generating a list of potential respondents, the questionnaire was collected via personal hand delivery method. However, in a study of construction SMEs in South Africa, Agumba (2013) used both the drop and collect and emails method to collect the data. However, the researcher used only the drop and collect (i.e. personal hand delivery method). This method was chosen because it ensures very high response rate and that the researcher makes a physical contact with the target respondents.

225 questionnaires were administered, 187 were returned of which six were excluded from the study due to various ambiguities (questionnaire incorrectly answered, respondents' information missing and inadequate information provided). Consequently, the remaining 181 questionnaires were deemed usable representing approximately 80% response rate. Non-probability sampling was employed to get the sample for the study. Vosloo (2014) indicated that non-probability sampling is one in which decisions regarding the individuals to be included in the sample are taken by the researcher, based upon a diversity of criteria which may include knowledge of the researcher issue, or aptitude and preparedness to partake in the study. Non-probability sampling is one which convenience forms the basis for selection (Neuman, 2006). Convenience sampling was deemed to be the most appropriate method owing to the small sample size to represent the entire population. Furthermore, Zikmund (2003) indicated that convenience sampling is the process of acquiring sampling units or people who are most conveniently available and is used when researchers want, swift and a cost-effective approach to obtaining a large number of completed questionnaire. Potential respondents were identified by sampling on the CIDB contractor register website in South Africa.

SPSS version 23 was employed to perform descriptive statistical analysis of the demographic data and to establish the factor analysability of the risk response measures, which were interpreted using Oblimin with Kaiser Normalisation rotation method. Equally, EFA was used to assess the internal consistency reliability of the measures (section 4.2). However, prior to performing EFA, important assumptions for the factorability of data were taken into consideration. The sample size for the current study was of 181, which were larger than the lowest size of 150 (Pallant, 2013). This result indicated factorability of the sample size. Furthermore, both Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were conducted to assess factorability. Outliers were identified and removed before analysis. Items with eigenvalues above 1 were retained using the Kaiser's criterion. The decision to retain factors was further supported by the scree test, where all factors above the elbow on the plot were retained (Pallant, 2013).

The measurement instrument was also tested for validity and internal consistency. Chou *et al.* (2013) indicated that when measuring the outcome of project purposes, it is essential to ensure the outcome measure being used is appropriate. Therefore, for a project of this nature employing a questionnaire as an instrument to collect data, it was indispensable to ensure validity and reliability of the questionnaire which is compulsory to assess the construct validity and reliability of the project outcome variables. Validity was ensured as a result of conducting an extensive literature review by consulting previous related studies, this was requisite to specify the variables. The questionnaire was reviewed and revised by experts (academics, researcher's promoter, and a professional statistician) before conducting the pilot study with the intended respondents.

Reliability on the other hand was ensured by determining the internal consistency of variables using Cronbach's Alpha. Reliability is the correlation between two scores ranging from 0 to 1.00. A generally agreed upon minimum limit for Cronbach alpha is 0.70 (Hair *et al.*, 2006:8-9). However, a cut-off value of 0.60 is common for exploratory research and values closer to 1 suggest good reliability (Zaiontz, 2014). For this study, a cut-off value of 0.60 was adopted as used by Sakaran (1992). Reliability results are presented in section 4.2.

## **4. RESULTS AND DISCUSSION**

This section of the study reports on results from descriptive statistics and exploratory factor analysis. Descriptive statistics were used to analyse data on the profile of the respondents and the company. Exploratory Factor Analysis (EFA) was used to gather information about the unidimensionality of the variables. The results are presented hereunder.

### **4.1 Descriptive statistics**

This sub-section reports on the profile of the respondents and the company. Results revealed that among the respondents, 81.80% was male while 18.20% was female, 87.56% were either owners or manager of their enterprise, 56.40% were African/Black, had either matriculation (22.70%) or a certificate (20.40%), 43.10% of respondents had 10 years' or less

experience in construction. Furthermore, it was found that 37.60% of SMEs were subcontractors or general contractors (31.50%), working mostly in Johannesburg (41.40%) and Tshwane (30.90%) Metropolitan Municipalities. Nevertheless, the subcontractors either operated for the main contractor or were sole trade contractors.

#### 4.2 Reliability of the constructs

Cronbach's Alpha was used to assess the reliability of the empirical constructs. A generally agreed upon minimum limit for Cronbach alpha is 0.70 (Hair *et al.* 2006). However, a cut-off value of 0.60 is common for exploratory research and values closer to 1 suggest good reliability (Zaiontz, 2014). For this study, a cut-off value of 0.60 was adopted (Sekaran, 1992). The overall Cronbach's alpha of the factor was 0.864 and the one of each item ranged from 0.812 to 0.952. These were all greater than the suggested value of 0.60, indicating good reliability (Zaiontz, 2014). Reliability results are presented in Table 1.

Table 1. Cronbach's Alpha of empirical constructs

Code	Risk response measures	Overall Cronbach's Alpha 0.864
RP1	Identify risk treatment options by avoiding risk	0.952
RP2	Identify risk treatment options by mitigating risk	0.944
RP3	Identify risk treatment options by retaining risk	0.860
RP4	Identify risk treatment options by transferring risk	0.812
RP5	Predefine actions to counter the identified project risks	0.940
RP6	Prepare and implement risk action plan	0.922

#### 4.3 EFA results

Prior to conducting EFA, suitability of the data for EFA was tested. Results of correlation matrix coefficient (Table 2) revealed that the coefficients ranged from 0.331 to 0.584. These values were all greater than the suggested cut-off value of 0.30, indicating that the four measures (RP1, RP2, RP3, RP4, RP5, and RP6) were good measures of the factor.

Table 2. Correlation matrix for risk response measures

		RP1	RP2	RP3	RP4	RP5	RP6
Correlation	RP1	1.000					
	RP2	-0.083	1.000				
	RP3	0.201	0.051	1.000			
	RP4	0.011	0.255	<b>0.492</b>	1.000		
	RP5	-0.171	<b>0.377</b>	0.076	0.189	1.000	
	RP6	<b>0.344</b>	-0.005	<b>0.436</b>	0.227	<b>0.354</b>	1.000

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The KMO value (Table 3) was 0.796, which was greater than the cut-off value of 0.60. The Bartlett's Test of Sphericity reached statistical significance at  $p=0.000$  ( $<0.05$ ). These results supported the factorability of the correlation matrix (Pallant, 2013). These results further supported the factorability of the data set (Pallant, 2013).

Table 3. Test of data factorability

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		<b>0.796</b>
Bartlett's Test of Sphericity	Approx. Chi-Square	200.715
	df	15
	Sig.	<b>0.000</b>

Of the six measures of risk response, it was revealed that only two measures (Table 4) had eigenvalues above 1 (2.041 and 1.451). These results explained 34.02% and 24.18% of the variance respectively and accounting for 58.20% of the total variance (see Table 3). The scree plot (Figure 1) further supported the decision to retain the two components which accounted approximately 58.20% of the total variance, despite the break observed after the third component. Therefore, sufficient evidence of convergent validity was provided for this construct.

Table 4. Percentage variance explained by the risk response measures

Component/Item	Eigenvalue	% of explained Variance	Cumulative %
<b>1- RP1</b>	<b>2.041</b>	<b>34.021</b>	<b>34.021</b>
<b>2- RP2</b>	<b>1.451</b>	<b>24.177</b>	<b>58.198</b>
3- RP3	0.962	16.037	74.235
4- RP4	0.784	13.067	87.302
5- RP5	0.442	7.365	94.667
6- RP6	0.320	5.333	100.000

The two components retained were further interpreted measures using Oblimin with Kaiser Normalisation rotation method. Results revealed that three items loaded strongly on each of the two components (Table 5). Hence, the two components were retained and adopted as the empirical constructs.

Table 5. Component matrix for risk response measures

	Component	
	1	2
RP3	0.742	-0.292
RP6	0.727	-0.302
RP4	0.696	0.127
RP1	0.276	-0.699
RP2	0.368	0.657
RP5	0.516	0.582



Figure 1. Output from scree plot for risk response

The results indicated that construction SMEs in South Africa only consider risk avoidance and risk mitigation as reliable measures to respond to the risks that they are faced with in their projects and that other measures such as risk retention and transfer seem not to be attracting considerable attention. The findings provided support to existing literature which advocates the conventional risk response measures of risk avoidance, risk mitigation, risk transfer, and risk retention the triple time, cost, and quality to measure project success in the construction industry (Toor and Ogunlana, 2010). The current results are also in line with the studies of Juliano and Alexander (2013); and Jun *et al.* (2010) where risk response and action planning were empirically measured by three constructs which included risk avoidance, risk mitigation and risk transfer. These results are however contrary to those of Urban and Gupta (2011) where it was statistically established that project risk response and action planning were measured by retaining and transference.

A possible reason for SMEs considering risk avoidance is that there is a risk of unsuccessful completion of certain projects in part due to the issue of health and safety risks which may hamper the completion of the project. As indicated by Thun *et al.* (2011) though not all risks can be avoided but by avoiding certain risks, some benefits may be forfeited. Furthermore, in many firms, some projects have been difficult to carry out due to some clients having to refuse to allow for occupational health and safety in the contingency fund. Berssaneti and Carvalho (2015) supported this statement by stating that, a project without H&S plan has a potential to cause many costly problems because compliance by all parties on the project may not be seen as a priority.

## 5. CONCLUSION

The objective of the study was to establish the factor structure of risk response measures at project level of construction SMEs. Risk response

was found to be measured by two components. The two components were found to have both positive and negative item-loadings. These item-loadings are measures of risk response and should therefore be used to respond to risk at project level of construction SMEs. Other measures, such as risk transferring and retaining are enticing increasing attention. The current findings support literature which advocates the constructs established in this study as risk response measures used to respond to risk in construction. Furthermore, the risk response measures established in the study could be beneficial to stakeholders involved in risk management, enabling informed decision making regarding enhancing risk management and consequently maximizing project performance. The findings could also boost prevailing knowledge on the theme of risk management in construction.

Regardless of the achievement of the study objectives, there are boundaries to the conclusions. The study was conducted in South Africa; however, it was delimited to the province of Gauteng. The surveyed respondents were small and medium enterprises in the CI; hence, the findings of this study may not be representative of the entire country. Furthermore, data were collected quantitatively. Other methods such as interviews could have been used to gather in-depth information from respondents.

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## The Potential of Drone Usage in the South Africa Construction Industry

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### ABSTRACT AND KEYWORDS

#### **Purpose of this paper**

Drones usage is a fairly new concept in the South Africa construction industry. This paper gathers data on the perception, knowledge and awareness of the usage of drones in the construction industry.

#### **Design/methodology/approach**

This study utilised a qualitative approach. Interviews were conducted with ten construction managers who were purposively sampled in the Durban region.

#### **Findings**

This study found that not all construction managers were fully aware of the extent of using drones along with the many benefits they provide in construction but they would however like to broaden their knowledge on this form of technology and would encourage their firms to introduce the use of drones.

#### **Research limitations/implications**

This study was limited to the Durban region, which will be expanded in further studies.

#### **What is original/value of paper?**

This study is beneficial in influencing the construction sector in employing a technologically advanced method of performing site activities and in

providing a broader understanding of the use of drones which could potentially save time and cost.

### **Response to the Conference Theme**

Innovation in Construction Means, Methods and Materials

**Keywords:** Unmanned aerial vehicles, drones, cost saving, aerial photography.

## **1. INTRODUCTION**

Drones has introduced 'technology integrated construction' which has advanced by leaps and bounds with the intervention of drones into the construction industry. The knowledge regarding drones is very limited as not many people are fully aware of this type of technology used in construction. Drones are known as aerial modules that are operated by a predetermined flight plan or by a manned remote. The invention of drones being used by military, delivery services, security firms and other forms of surveying jobs, have now become more accessible to the general public and therefore can be used by companies in a wide array of tasks and industries such as the construction sector (DroneGuru, 2017). The objective of this study was to gain an insight on the general perception and knowledge of drones in the South African construction sector.

## **2. DRONES AND THEIR USE**

Unmanned aerial vehicle technology covers everything from the aerodynamics of the drone, materials in the manufacture of the physical unmanned aerial vehicle (UAV), to the circuit boards, chipset and software which are the brains of the drone (Read & Digest, 2018). Drones are equipped with different state of the art technology such as infra-red cameras (military UAV), global positioning systems (GPS) and laser (military UAV) and are controlled by remote control system also sometimes referred to as a ground cockpit.

The Southern African construction industry is a growing market offering attractive business opportunities (Collins, 2017). Drones have already begun changing the way the construction industry operates, and those changes will have continued and lasting effects (Janssen, 2015). During construction drones can be used to, reduce costs and establish a safer environment. They also help during roof inspections, for insurance surveys, during emergency assessments, and post-disaster relief. Drones can also be used to complete post-blast surveys, and also as a marketing tool for real estate agents (Rodriguez, 2017).

Unmanned aerial vehicles can be used for various reasons in the construction industry. Listed below are the various applications of drones.

*a) Aerial Photography*

UAVs have added the ability to collect views of construction projects starting from the start of the project right through the end, at viewpoints and various heights, on up to top views above the site at. This can be done in a very short space of time and is more affordable than using the aeroplane (Molla, 2015). The aerial images produced by drones can be taken day-to-day in order to plan the flow of workers and vehicles in and around the site and placement of materials stored on site (*ibid*). Drones with GPS technology are being used with programmed waypoints to capture images from the same aerial viewpoint over time so to track the actual construction progress compared to the planned progress. Routes are pre-programmed so that the drone can follow predetermined routes independently (Tatum, Liu, 2017).

*b) Inspection*

Drones can inspect a building area that is not accessible; it can capture numerous photos from various angles and zoom settings in a short space of time. The whole operation could be conducted without installation of suspended scaffolding or road closers, at lower cost than alternative inspection techniques, and with little safety risk (Pritchard, 2015).

*c) Surveying*

UAVs can provide an economical platform for obtaining survey data, if it is equipped with appropriate sensors and camera technologies. Global positioning systems (GPS) enabled drones are used by surveying services providers, because they automatically follow a GPS controlled flight path planned in advance. Using photographic systems which can provide high resolution images, overlapping photos taken by the UAV are put together in mosaic fashion which is then transformed into high resolution 3 dimensional (3D) surface models that can be used for topographic mapping, volumetric calculations, or three dimensional representations of job sites (Devries, 2015). Also drones equipped with thermal imaging can be used to discover energy leaks by conducting building envelope surveys (*ibid*).

*d) Safety on site*

Construction safety officer's productivity can be increased with the help of drones on the construction site. Using drones to provide actual cooperative communication allows the safety officer to communicate with employees anywhere within the construction site (Tatum, Liu, 2017). Videos and images captured by drones gives the safety officer valuable documents of jobsite conditions in circumstances where accidents do occur and the

drone provides the officer with a tool to cover a larger area of the construction site in a short space of time (*ibid*).

e) *Security Monitoring*

The use of drones can also improve security of the construction site. A drone integrated into the security alarm system can dock on a rooftop station that provides a nonstop charge to the battery. The drone is deployed and hovers above the construction site to capture video of what's happening, when an alert is received. The high definition camera will be able to identify vehicles or individuals within its view and the video can be watched from a smartphone. The drone will also have the ability to be programmed for periodic security sweeps and it will return to its rooftop station automatically (Tatum, Liu, 2017).

f) *Project Progress Reports*

Construction progress reports are regularly prepared on a monthly basis, to record site progress against the project programme. These reports include the quantity surveyor taking multiple photographs of various parts of the site (Ayemba, 2018). A regular drone flight can be a quick way to record and see project progress. Through a series of aerial shots and video project stakeholders can gain a better insight into the progress that has been made without actually being on-site and have regular daily or weekly updates (*ibid*).

g) *Other uses such as*

- *Photogrammetry* - which is the science of making measurements from photographs Corrigan (2017). The output of photogrammetry is typically a map, a drawing or a 3D model of some real-world object or land mass so drones can perform the activities and produce the software outputs that photogrammetry consists of.
- *Building Information Modelling (BIM)* - drones offer a precise, rapid solution to gathering a comprehensive overview of the site, identifying challenges before they become issues further into the project.

## **2.2 Advantages of drones in construction**

Drones are seen as a tool that improves communication, safety, and marketing (Rodriguez, 2017). Drones can offer many advantages when used in some applications on a construction project which includes:

- **Precision** - one of the key benefits of drone usage is precision. The degree of accuracy in the data is phenomenal, better than any other method (Shore, 2015).

- Less wasted materials - the construction industry consumes about 50% of global steel production and three billion tons of raw materials. BIM capabilities allow companies to precisely measure raw materials, from the amount of backfill and timber needed before the project begins to the intricate details like how much electrical wiring will be required (Ly, 2017).
- A more productive workforce - drones can be used as tools that make your existing workforce more productive. Modern contracting practices demand cheaper and more frequent surveying. In addition to speeding up the pace, drones can get into hard-to-reach places or places that might be unsafe for humans (Ly, 2017).
- Cost savings - drones can be operated much cheaper than a manned aircraft. Because of the significant cost savings, data can be gathered more frequently, increasing the data accuracy even more (Kespry, 2017)

### ***2.3 Disadvantages of drones in construction***

The possible disadvantages of drones are:

- The need for insurance - it is suggested that the aerial reach of drones also brings with it the possibility of collisions with people, buildings and other aircrafts, leading to property damage, personal injury, and loss of life in extreme cases. Construction companies using drones will need to ensure that their insurance cover these risks (Catterall, 2016).
- Drone regulations - companies will need to ensure their drones comply with the South African Civil Aviation Authority's requirements; this includes strict airspace restrictions (Grind Drones, 2017).
- Shorter lifespan - Even though drones are convenient, the battery lifespan is shorter than the traditional cameras that are used to capture images. The life span has an average of at least four hours applied by most drones because the batteries designs are smaller (FullDrone, 2016).
- Easily hacked - hackers can easily invade the main control system of the drones, replacing the original users as the new drivers or controllers of the device. The network and control systems of drones contain vital information that is easy to hack without the knowledge of the original user (FullDrone, 2016).

Drones in South Africa are being used in a wide area of construction and is able to improve construction activities and make them more efficient. It is not only benefitting the country's economy by creating jobs and generating revenue but also allowing the South African construction sector to become more technologically advanced. With more awareness and that needs to be implemented in the industry, drones can work along with the many other

digital programmes that can have a huge impact on the construction sector by allowing contractors to have an easier and more effective method of conducting their jobs and running their business.

### 3. RESEARCH METHOD

This study adopted a qualitative research approach through the use of semi-structured interviews. Due to the fact that drones in construction are still a growing trend and many people are not fully aware of their full potential, an interpretivist, philosophical paradigm was implemented in this research method. The researcher's aim was to understand the perception among construction professionals regarding drones, the effect they have in the industry and the benefits as well as the challenges drones pose to construction methods. A sample of ten construction managers were purposively selected in the Durban area for this study. Before data collected had commenced, approval of ethical clearance had to be obtained which was issued from within the university. Thereafter, the data was collected using semi-structured interviews and was analysed using content analysis. To ensure reliability, the researcher ensured the same questions were asked to all interviewees and only the correct and accurate responses were used when analysing the data. Therefore, some simple techniques were used to increase the validity of qualitative studies such as thoroughly reading through interview transcripts before thematic analysis begins (Harding, 2013).

### 4. ANALYSIS

All the participants knew what a drone was but they did not necessarily know what they are used for and majority of the construction managers (n=7) knew that it could be used in construction. But even these respondent who were aware of drones being used in construction had very little insight as to how or why drones were used and how they can benefit their firms.

When asked whether or not drones should be used more frequently in the South Africa construction industry, 7 of the participants agreed that it will assist the industry. One participant stated that it will *"greatly assist the income generated in the construction economy as well as speed up construction activities on site by providing an aerial view of the entire project"*. Another participant stated that *"South Africa is lacking in the use of innovative technology but drones can help with the progress in solving this problem"*.

All the respondents believed that drones will have a positive effect on the South African construction sector with one of the respondents who had briefly been exposed to the use of drones on site stating that *"drones*

*had efficiently carried out tasks on site which produced valuable information which made site work much easier*". The respondent further added that *"although drones have to still prove their worth in the construction sector, they are making a difference to how construction is currently being carried out"*.

It was unanimous that the use of drones is the way forward in terms of South Africa becoming technologically advanced and that drones should be implemented in the construction industry. Some of the responses received were that

- *"drones will promote increased efficiency on construction projects and improve overall site safety which can positively impact the South African construction sector"*;
- *"it will be highly favourable"*;
- *"it will bring about possible positive change"*;
- *"it will impact the industry in a positive manner and ensure the construction industry make attempts to being more on par with the rest of the world"*;
- *"...drones should be implemented in the South African construction industry to improve the industry to make it more efficient"*; and
- *"I believe drones are the future of construction and in order to propel South Africa in the direction of being technologically up to date, drones should be implemented from now"*.

These statements indicate that drones are and will be preferred among many in industry as they tend to promote growth, efficiency and progression towards South Africa being ahead in terms of technological advancements.

Although the concept is new to many and many have not had personal experience with drones, they still show a favourable attitude towards drones and their uses even though there is still a lot to be learned about these robotic machines.

Some of the applications of drones in construction, according to the literature review, included aerial photography, site surveying, improved health and safety of site workers, project monitoring, security of materials, material management and photogrammetry and according to the majority of the respondents, site surveying was rated as the most common use of drones followed by site inspections as human error is avoided and then safety on site.

Six of the respondents believed that drones would be a feasible investment for their firms. Some of the negative comments received about drones included that

- *"there is no need for drones in construction"*;
- *"they are unnecessary costs that will increase project budgets"*; and
- *"they still need to be proven as an effective tool"*.

When asked about the implications of using drones, majority of the respondents implied that cost will be a factor which prevents companies from utilising drones. One respondent stated that *“unless the technology is made more affordable, drones will rarely be used within this firm”* and another stated *“...as well as the power source of the drone and how long they can operate for before having the need to be charged”*.

Given the option of training employees and sub-contracting drone companies to carry out site activities, 6 of the respondents replied by saying that they would prefer training employees internally within the company as *“only a site employee will know what he or she requires as would the rest of the construction professionals, also to sub-contract is just an additional cost that should be avoided”*. However 4 of the respondents would rather sub-contact drone companies as it would *“save money, time and cost on obtaining a drone licence as well as training employees”*.

Some of the concerns raised about drone usage were the

- “possibility that there will be a misuse of drones on site by personnel that is not commissioned to use drones,
- the safety of workers are at risk as drones are airborne and could fall from above due to a potential malfunction and the battery life of a drone is very limited”.

As per the literature review, there are many advantages of using drones and these advantages have been adapted to to the construction industry. Drones can be used for many on-site activities which can provide an easier working lifestyle for professionals. With this new style of conducting business, firms will be able to attract new clients as well as use drones as a part of their marketing strategy to add a type of exclusivity to their company image.

According to the respondents when asked if they would use drones on their next project, almost all of the participants (n=8) suggested that they would with one respondent stating that *“it will be a time saver and will allow for construction professionals to focus on perfecting the project”*. However the remaining respondents said no as they indicated that it would be unnecessary to employees and would pose as a hazard on site.

## 5. CONCLUSION AND RECOMMENDATIONS

Drones are yet to be proven as becoming ‘the next big thing’ in South Africa as there is not a large amount of firms within the country that use drones in the construction industry. The purpose of this study was to determine the uses and perception of drones in the construction industry as well as whether or not the use of drones will be acceptable among professionals in industry. The results from the data collected indicates that the respondents are not fully aware of drone capabilities but are in favour

of the use of drones and would like to use them in their future projects even though there is a low demand for drones in the South Africa construction. Although drones are not used frequently, the respondents had given, mostly positive feedback about the impacts drones can have on the construction sector. It was also determined that drones can therefore assist the South African construction industry in becoming more technologically advanced as we are currently not up to standard in comparison to other countries.

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## A review of transportation systems in Trento (Italy) and challenges facing its implementation in Durban

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### ABSTRACT

#### Purpose of this paper

This paper reviews enhanced and sustainable mobility in Trento, Italy through information technology (IT). The paper also investigates the challenges faced by Durban city in the implementation of mobile technology systems in developing world cities.

#### Design/methodology/approach

Data obtained from the Trento municipality was analysed using StudioR program together with Microsoft Excel. The study involved the use of the motor car, buses and trains over the period of 2013 to 2015. Reports from eThekweni municipality were also utilised to determine implementation challenges in Durban.

#### Findings

Results from this study show that the use of IT has enhanced cities towards sustainable urban mobility. This is shown by a significant reduction of accident rate, congestion and reliance on motor vehicles in the city of Trento. Implementation challenges in Durban involved the coordination of existing modes of public transport such as mini-combys and the enhancement of infrastructure to promote the use of train facilities.

**Practical implications**

The review of the challenges faced in developing countries in implementing IT. This is done by means of mobile service Apps is aimed at promoting sustainable infrastructure in Durban.

**Original/value of paper**

Lessons from Trento are assessed for implementation in Durban to alleviate the challenges of urbanisation.

**Keywords:** Sustainable Mobility, Information Technology, Public Transportation

**1. INTRODUCTION**

Currently, the urban population in developing countries is predicted to double from 2010 to 2050, while remaining constant in developed countries. Over the next 13 years, the world's population is estimated to increase to 8.6 billion in 2030, to 9.8 billion in 2050 and 11.2 billion by the year 2100 (UN, 2017c). In developing countries, medium-sized cities grow at a fast rate due to urban migration. Cities in developing countries often have fewer resources to implement new transport measures and can be more vulnerable to fluctuations in the world economy. Due to the increased population in developing countries, urbanisation increase has led to challenges in this regard. Transport plays a crucial role in urban development by providing access for people to education, markets, employment, recreation, health care and other key amenities. The propensity for private vehicle use in most developing countries results in increased traffic congestion. In most developing countries affordable accessible public transportation services and systems infrastructure are lacking these include cycling trails and walking paths (UN, 2017a; UN, 2017b). Transportation can be improved through traffic decongestion. Therefore, implementing the appropriate policies within the transportation system is essential to improving the quality of life of urban inhabitants (Pinna, Masala and Garau, 2017; World Bank, 2017). One of the greatest challenges is to plan and invest wisely in infrastructure for sustainable urban transport (UN, 2017b). However, the use of IT using mobility service delivery have been implemented in developed countries to improve the socio-economic levels of society (UN, 2013). IT is extensively used in developed countries such as Italy, Sweden, Finland, Singapore, Netherlands, United Kingdom, Norway, Switzerland, Hong Kong, United States and South Korea. Personalised information is used in order to access mobility information for integrated mobility planning (Ahvenniemi, *et al.*, 2017). Furthermore, sustainable mobility also meets up with the Sustainable Development Goals 2030, with regards to industry, innovation, infrastructure and sustainable cities and communities (Ayik, *et al.*, 2017).

Furthermore, the increased propensity for private vehicle use in the majority of developing countries results not only increase traffic congestion but also in additional health hazards due to pollution, noise, greenhouse emissions and road accidents. Transportation can be improved through traffic decongestion. In developing countries, affordable accessible public transportation services and systems infrastructure are lacking. These include cycling trails and walking paths (UN, 2017a; UN, 2017b). Therefore, implementing the appropriate policies within the transportation system is essential to improving the quality of life of urban inhabitants (Pinna, Masala and Garau, 2017; World Bank, 2017). One of the greatest challenges is to plan and invest wisely in infrastructure for sustainable urban transport (UN, 2017b). IT is extensively used in developed countries such as Italy, Sweden, Finland, Singapore, Netherlands, United Kingdom, Norway, Switzerland, Hong Kong, United States and South Korea. The uses of IT have been implemented in developed countries to improve the socio-economic levels of society by means of mobility service delivery (UN, 2013). IT can, therefore, be used in developing nations in its improvements. In the majority of Smart Cities, personalised information is used in order to access mobility information for integrated mobility planning (Ahvenniemi, *et al.*, 2017). Furthermore, sustainable mobility also meets up with the Sustainable Development Goals 2030, with regards to industry, innovation, infrastructure and sustainable cities and communities (Ayik, *et al.*, 2017). This paper reviews the current transport system of a developing city, in this case, Durban, South Africa the ways in which IT can be utilised in the transportation system of a developing city. Challenges and opportunities are sort in the implementation of such systems.

## 2. LITERATURE REVIEW

The use of IT is one of the most critical aspects in achieving sustainable development. An important consideration in the use of information technology is the determination of private and public data as well as finding out ways in which they can be utilised to improve sustainable development of a city. Information and Communication Technology (ICT) in transport systems can be used to assist when achieving, prosperity, security, competitiveness, innovation and effectiveness (Ahvenniemi, *et al.*, 2017). Additionally, new intelligent technologies are seen as a key factor in improving energy efficiency and reducing greenhouse gases in cities (Ahvenniemi *et al.*, 2017). The need for these technologies to be smart, lean, integrated, cost-efficient while meeting sustainability goals in terms of the environment and socio-economic factors remains paramount. Therefore the implementation of IT is used to achieve economic, social and environmental sustainability (Giffinger, 2007; Nam and Pardo, 2011; Neirotti, *et al.*, 2014; Ahvenniemi *et al.*, 2017). Additionally, to accomplish efficiency in private

and public sectors; including well-being and mobility systems (Ahvenniemi *et al.*, 2017). It is suggested, for more environmentally sustainable infrastructural development, the use of both private and public sectors are essential when using data and IT. The provision of services is optimised as the existing infrastructure available. This also improves the socio-economic sectors and encourages innovation both private and public (municipal) businesses (Neirotti, *et al.*, 2014; Ahvenniemi *et al.*, 2017)

## 2.1 Urban Mobility Challenges

According to the United Nations Habitat Report, the flow of mobility is the key to the dynamics of urbanisation. Access to places, activities and services remains difficult (UN, 2013). At times it is less convenient in terms of time, cost, comfort access to locations in cities and general moving around. This indicates that the majority of the world's cities are faced with unsustainable mobility systems, including urbanisation associated problems such as uncontrolled motorization and traffic congestion. One of the major challenges in urban mobility in the Province of Kwa Zulu Natal is the high accident and fatality rates. While the majority of people in the KwaZulu Natal Region use public transport. The graph in Figure 1 (eThekweni Municipality, 2018), shows the total accident rates in the eThekweni municipality between the years 2000-2013. It is noted that there has been a reduction in accidents from the highest peak in 2007 until 2013. However, improvements to the transportation system can further lower the rate of pedestrian accident occurrence.

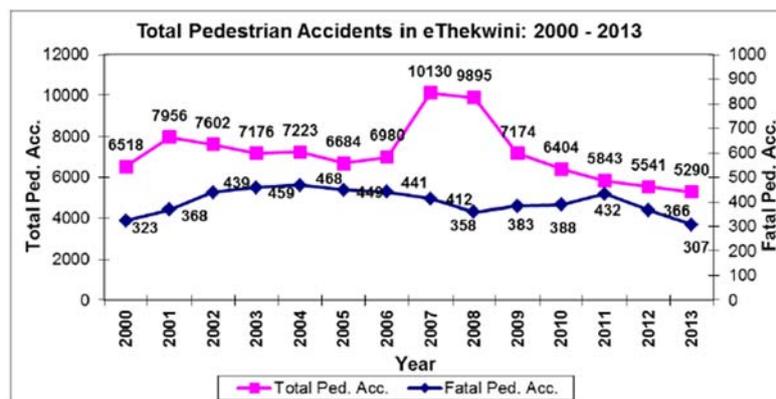


Figure 1: Pedestrian Accident in eThekweni (Source: eThekweni Municipality Report)

## 2.2 Sustainability in transportation

Sustainability in transportation is defined as meeting the environmental dimension which consists of understanding the physical environment in relation to industry practices. Sustainable transportation, therefore, involves having the capacity of the mobility needs of the people and information that is conducive to the environment. In transportation, sustainable development is associated with environment protection, economic efficiency and social progress. The balance between socio-economic, environmental aspects is sought to achieve sustainable transport solutions (Diaz-Sarachaga, 2016). Under the economic dimension of sustainable transportation, the objective consists of orienting progress in the sense of economic efficiency. Sustainability in transportation so has the capability to satisfy the quality desires of commuters with regards to data transfer and sharing, significantly its use in mobile applications. A key aspect in meeting the growing demand within the provision of transport involves technology development and preparation (Ahvenniemi *et al.*, 2017). Furthermore, integrated solutions for property in transportation include: improved travel decisions, economic incentives for public transportation usage, institutional reforms and technological innovations (UN, 2013; Diaz-Sarachaga, *et al.*, 2016). For example, one of the main ways to resolve problems associated with transport systems include the use of car-restricted pedestrian friendly zones in central areas, a higher parking fee for limited parking spaces in the Central Business District (CBD) areas. Moreover, the use of a public transportation system, intensive use of IT systems in the improvement of public transportation (Pojani and Stead, 2015; Diaz-Sarachaga, 2016). The enhancement of the quality of life has an important significance with regards to technology and information components. Therefore in improving urban transportation will not only improve the economy but also social and environmental factors (Pojani and Stead, 2015). Car sharing, for example, is a trend which allows more sustainable utilisation that could remove up to 90% of vehicles from roads. Furthermore, freight transportation must be taken into account be in this process considering the substantial growth of raw materials and goods being traded in a global economy (UN, 2007).

## 2.3 Automobile dependence

Automobiles dependency is the reliance on motor motors as the predominant mode of transportation. This is commonplace in the majority of developing cities. Long distance journeying is occurs for most town dwellers using private vehicles (Pojani and Stead, 2015). Private motors

hence turn out to be the market centre of interest and preferences for sustainable mobility, such as battery powered motors grow to be available. In developing cities, nearly all public transit structures are financially unsustainable imposing burdens on the society due to congestion, accidents, air pollution and greenhouse gas emissions (UN, 2013; Pojani and Stead, 2015). Transportation in regard to auto mobility is preferred, this is supported through the UN Planning and Design for Sustainable Mobility, which states that in 2010 more than 1 billion motor vehicles were reachable for users. Nearly 50% of journeys have been made via motorcars. In 2010 growing worldwide areas had double the extent of the use of motorcars (UN, 2013; Pojani and Stead, 2015; Ahvenniemi *et al.*, 2017). There is a large range of responses to environmental sustainability in line with national and global regulations. These policies involve a variety of fees in transport operations that must be constructed into the rate of presenting transport facilities (Ahvenniemi *et al.*, 2017). Furthermore, environmentally sustainable transport competitive market and cope with the changes in transport demand and supply.

### 3. METHOD AND DATA

The method of this study involves non-participant observation studies on the transportation systems of Durban, South Africa and Trento, Italy. Data from the Trento municipality was analysed using StudioR program together with Microsoft Excel. Data from Trento municipality was obtained from a data base which records daily mobility of different modes of transport such as motor vehicles, auto buses and motor bikes. Data selected for the purposes of this study involved the use of motor cars and public transport (Auto buses and Trains) between the year 2013, 2014 and 2015. This is because these were the most complete set of data available at the time of data collection. Firstly the differences between the two cities with regards to sustainable mobility development are assessed. Thereafter, sustainability in terms of transportation is examined. Other sources of information include discussions with experts in both the Trento municipal government and eThekweni municipality. Discussions were focused on the topics of sustainability, technological advancements and innovations. Data were obtained to determine levels of auto mobile dependence, traffic congestions and road accidents. Transportation data from both cities were obtained to determine the usage frequency of motor vehicles and buses. For the city of Trento, data were collected to compare the differences before and after the implementation of Applications (Apps), namely, Open Move and Viaggia Play & Go.

### 3.1.CASE STUDIES

#### 3.1.1 Trento Smart City

The city of Trento is located in the Alpine Valley and has a population of 121577 in 2018 (Trento Population, 2018). The city has developed a number of technological advancement in terms of making mobility easier. In an interview with the Trento municipality, a number of projects that they are working on came into account. For example, they have involved a company called Open Move which is an application used by commuters for transportation. Further to this, the municipality deploys games projects such as the Viaggia Play & Go. Since the implementation of Open Move in 2015 and Viaggia Play & Go in 2016, there has been a great achievement of a sustainable city in the transportation services, as part of the city goals. Open Move was launched in Trentino on 16 March 2015. The Autonomous Province of Trento (PAT) has had a crucial role in the evolution of Open Move, pushing transport companies, for example, Trentino Trasporti - Investee Company dealing with transportation in the province of Trento & Trenitalia - national railway company. In the following year, 2016, Viaggia Play & Go was first proposed in Rovereto and Trento. This is also an application which uses QR codes and commuters gain points for using sustainable means of transportation such as walking, bike riding, bus and train usages. The points are accumulated and prizes are given. Prizes range, for example from free trips to destinations where there is free mountain hiking or biking. However there are challenges, as mentioned by the Trento municipality, involved with regards to this, the one that is most common is people cheating by claiming they have travelled by bus, but according to the GPS recording, they were used a high way. The municipality monitors this by checking via the GPS which will show if the person used the bus route, and there were stops made on the way.

#### 3.1.2 Durban City

The population of South Africa is 55.6 Million. KwaZulu Natal Province contains the largest number of inhabitants s most of whom rely on public transportation. The KwaZulu Natal province comprises of rural areas and farms. Zululand, which is part of the province covers the largest amount of land and it is ranked 9 out of 11 districts with a total of 54.3 people per km<sup>2</sup>. Urban areas are more populated compared to the less dense rural, farm-type areas such as Zululand. Whilst eThekweni covers a smaller amount of land area with a total of 1502.34 people per km<sup>2</sup>.A large proportion of the population concentrates in urban areas such as eThekweni. The urban core of eThekweni municipality consists of 1.18 million people. This comprises of the central region is the Urban Core of the municipality and is home to

approximately 1.18 million people (34.54%). Residents comprising of 47% travel using public transport (rail = 15%, bus =17% and Taxi = 68%. There are on average 1710 bus routes which are unidirectional. They have 200 operators and are mixed between subsidised contracts and unsubsidised services. Approximately 1673 taxi routes are being catered for by 110 taxi associations. Unprofitable rail and bus trips (buses usually run without customers), making the public transportation system economically inefficient (eThekweni Municipality, 2018).

The majority of the population on average live away from the major highways. Transportation costs comprise between 17% and 35 % of the total monthly household income. This, therefore, puts an economic strain on the household expenditure most of which goes into debt or have to find other means of family support. Other challenges include Lack of adequate public transport, the integration between transport modes, adequate control and enforcement over public transport modes, a limitation of capacity with regard to safety and security at public transport pick- up and drop-off points (eThekweni Municipality, 2018). There is also a low drive to make public transport sustainable. Furthermore, the KwaZulu Natal Department of transport has the vision of prosperity through mobility. This is in line with the suitability goals for 2030 (eThekweni Municipality, 2018). The Department's mission is to strive to provide the public with mobility through an affordable transportation system which is safe, integrated, regulated and accessible, to meet the developmental needs of the province. One of the department's values is to improve the quality of life by the provision of mobility to the public and liaise with the province in ensuring the maintenance of 32 890 kilometres of road infrastructure by the year 2020 (eThekweni Municipality, 2018). The aim of the mobility infrastructure is to achieve a balanced, well-maintained road network that stimulates development and economic expansion. With the population of South Africa being 55.6 Million. KwaZulu Natal Province contains the largest number of inhabitants most of whom rely on public transportation. This justifies, the need for sustainable solutions with regards to transport infrastructure and commuter services.

#### **4. ANALYSIS**

The analysis was carried out in regards to the use of two types of mobility transportation systems, namely motor cars and public buses. The use of taxis, motorcycles and bicycles is excluded from the analysis because in the case study of Durban, there was insufficient data. In the case study of Trento, there was data from the year 2001 until 2015. Firstly, the city of Trento is compared thereafter to Durban city in regards to the motor car usage and public transportation (buses and trains).

#### 4.1 Trento

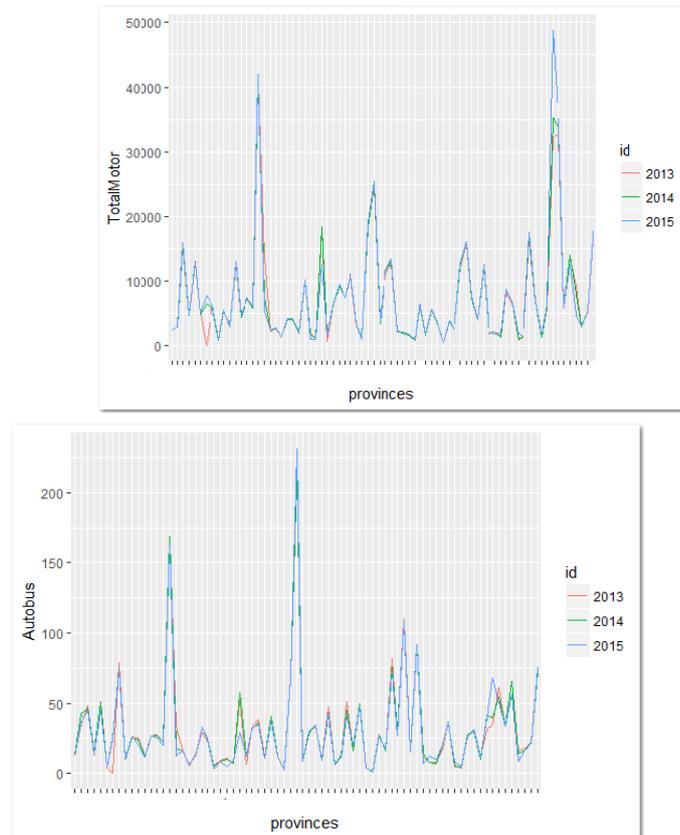
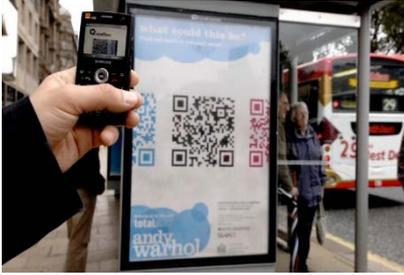


Figure 3: Auto bus Use: Trento

The analysis show that there has been an increase in Auto buses usage in the Year 2015 (Figure 3). Nevertheless, Motor Car use in 2015 had a 25% increase from that in 2014 (Figure 2). Furthermore there has been a constant use of battery powered cars in the city of Trento, Figure 4 (a) is referred. Figure 4 illustrates observations conducted in Trento Smart City.

#### Trento Transportation

	
<p>(a) Battery powered motorcar, being charged at parking area.</p>	<p>(b) City centre, bus station, display board showing bus numbers and times in which they pass the area. There is also a printed version of the bus times, stops and destinations.</p>
<p><b>Figure 4: Trento Transportation Picture</b></p>	
	
<p>(c) QR code is used in the buses and outside the train railway lines to validate the ticket or scan a QR code.</p>	<p>(d) Validation with cards and using a smart phone of bus trip payment is done inside the buses. There are places to match the QR codes.</p>

#### 4.2 Durban – South Africa

Motor Car uses in the Province of Kwazulu Natal.

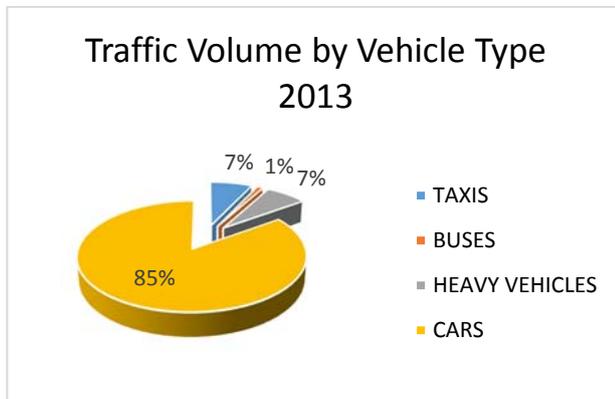


Figure 5: Traffic Volume by Vehicle

According to the graphical illustration, buses in eThekweni Municipality comprise only 1% of the type of bus vehicles are used. Taxies comprise 7% while cars are the most widely used, comprising of 85% (Figure 5).

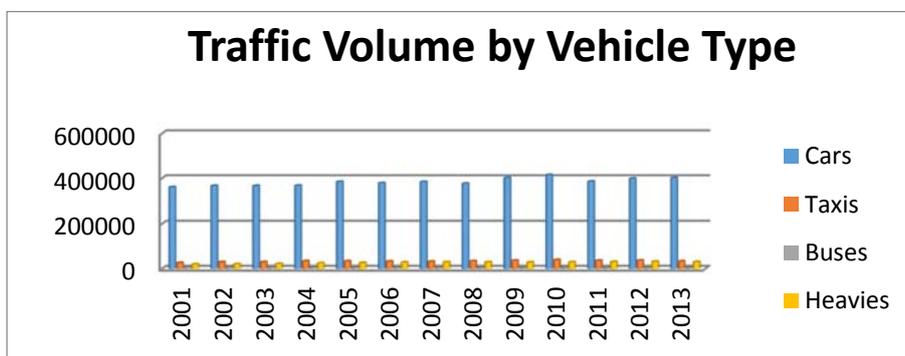


Figure 6: Transportation (Including: Cars, Buses, Heavy Vehicles and Taxies )

According to the graphical expression in Figure 6, traffic volume growth between 2001 and 2013 is most common among cars, the highest representing the year 2010 being 489 182 (traffic volume level) followed by 2013, being 470 823 (traffic volume level). However, it is important to note that there has been a decrease of 4% and this is attributed to the challenging economic challenge of the region (eThekweni Municipality, 2018). The following Figure 7, shows the state of the Durban city observations.

Durban Transportation	
	
<p>(a) As seen from the picture, motor cars are most used mode of transport due to convenience. The aim of implementing App systems are to encourage the average motor car commuter to use public transportation.</p>	<p>(b) Business Centre in Umhlanga, Mall and office buildings, and offices, with the increase the flow of people. Bus route system whereby certain lanes are allocated for buses. The use of IT by the implementation of the Apps would complement sustainable urban transport development. (Source;royal haskoningdhv)</p>

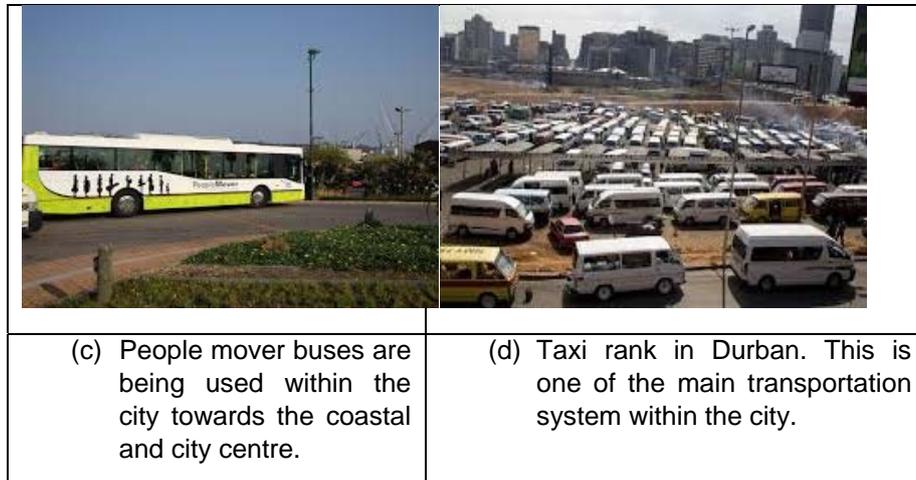


Figure 7: Durban Transportation Pictures

## 5. DISCUSSION

In Durban, the most common use of public transportation is the mini-combies, as referred in Figure 7d. These are also the main mode of transportation in general. Municipal buses are used, however, to a limited extent (Figure 7c). Personal vehicles are the most attractive form of transportation due to their convenience and efficiency (Figure 7a). Additionally, there are limited incentives to encourage the general population to use public transportation, cycle or walk. In contrast, the main mode of Transport in Trento are buses (Figure 4d) and trains. From the analysis, the increased auto bus use has contributed the use of IT systems mobility apps. Although there is also an increase in motor car usage, this is likely due to the battered powered vehicles. Trento has a well-developed transportation infrastructure comprising of an intergraded rail and auto bus system (Figure 4 b, c and d).

All international trains are connected with the city of Trento and Rovereto. These two cities are well accessed to Verona, Venice, Milan, Rome, Munich (Germany) and Innsbruck (Austria). Two local railways start from Trento and run across Val di Non/Val di Sole including Val Sugana (Trentino.com 2006-2018). It is easier for people to get access services using public transportation and there are incentives (price, vacation trips) when commuters use public transportation, cycle and walk (Figure 4).

Trento's Open Move and Viaggia Play & Go are good examples of the use of IT in transportation service delivery. It uses Quick Response (QR) codes to register customer personal information into the system and tracks their activity including the purchase of credits. The use of QR codes also supports many different marketing functions, some include making purchases, receiving discounts and coupons, including the interaction with social media (Figure 4 c and d). QR codes are especially convenient due to the proliferation and accessibility of smartphones (Devuyst, 2000). The challenges of urbanisation in developing cities have resulted in a situation where the infrastructure is lagging behind the demand for mobility services. Additionally, the use of public transport systems such as buses, trains, cycling and walking are considered less attractive than private vehicles. Car dependence becomes a better option for commuters due to convenience, especially with regards to the time and reliability. Furthermore, the increase in traffic and congestion levels has become a problem for commuters both in public and private transportation (Figure 7a). Therefore there is a need to evaluate the current systems, a key concern being to create efficient, sustainable and non-resource heavy mobility systems that alleviate these challenges. IT is a tool that has been implemented in developed cities and could provide practical solutions to these challenges.

Observationally, Durban and Trento are both growing medium-sized cities in the sense that there are not mature to the point that major changes in the infrastructure cannot be made. The main transportation objectives in a medium-sized city are a reduction of use of private vehicles, traffic congestions, accidents and road safety. As well as the quality of life concerns such as mobility of commuters, especially disabled and senior citizens (UN, 2013).

This study explored the possible implementation of IT in developing country cities like Durban in order to promote sustainability in the transportation system. The study further addressed stakeholders' and government concerns faced by developing cities such as auto mobile dependence, traffic congestions and road accidents by means of application of IT through mobility applications (Apps). It further investigated options of implementation of mobility applications (Apps) for the improvements in public transportation to improve commuters' mobility within the city. Conclusions and recommendations regarding the study are further explained.

## **6. CONCLUSIONS AND RECOMMENDATIONS**

According to the results provided in the city of Trento, there has been a significant increase in the use of public transportation between 2015 and 2016. Due to the introduction of IT mobility systems such as Open Move and Viaggia Play & Go Applications. It was concluded that medium-sized cities more especially in the developing world can offer greater potential for more sustainable transformations. Using of Trento as an example and its utilisation of Apps such as Open Move and Viaggia Play & Go the city of

Durban can use similar IT Apps to combat transport challenges faced by the provincial government. This research, therefore, recommends the following which may be applied in developing cities, such as Durban in terms of developing their mobility system with regards to the integration of IT into the transportation system:-

- Assist the mobility of urban poor and the mobility needs of the disabled and senior citizens. For example issue of discounts for elderly people and other incentives such as restaurant discounts and winning trips.
- This would resolve the problem of the lack of public transport and buses going around without customers.
- The increase of bus usage and integration between transport modes will further assist with energy security and reduction of greenhouse gas emissions.
- Road safety in terms of decreased accidents rates would result due to adequate control and enforcement of IT applications over public transport modes (buses and trains).
- The implementation of, for example, security cameras in strategic locations, would increase the capacity in regards to safety and security at public transport pick- up and drop-off points.
- The suggestion of taxis to operate over long distances and buses for shorter distances in a city. This would reduce competition for customers between bus drivers and taxis and would increase order within the city in terms of mobility.
- Another suggestion would be the use of technology by means of Apps, these would provide a sense of order for commuters on expected time frames and routes for buses. This would make the public transportation system more attractive in terms of reliability and time took.
- An increased level of cycling trails and walking paths within the city would encourage users to use fewer motor cars.
- A monitoring system can be set for the future years on how to implement IT in the improvement of mobility services. This would be used to monitor how urban transportation changes.
- Promote sustainable economic transformation through empowerment programmes for private and public sector businesses, these should include the use of IT such as the Apps companies. This will assist in the promotion and support of sustainable economic development and transformation empowerment programmes and sustainability policies.

### Acknowledgements

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ASOCSA2018-069

# The Incorporation of Photovoltaic Systems in Commercial Buildings

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## ABSTRACT AND KEYWORDS

### Purpose of this paper

This study investigates the gap between the immense positives solar photovoltaic (PV) panels can provide to society with the lack of implementation on commercial buildings.

### Design/methodology/approach

The qualitative approach was adopted for this study where semi-structured interviews were conducted with ten commercial buildings within the Durban region. These buildings were specifically selected through purposive sampling techniques choosing buildings that are both owned and leased by firms.

### Findings

This study found that majority of the interviewees preferred to occupy sustainable buildings and are fully aware of global warming and the detrimental effects it has on society. Building owners hold the key towards the implementation of solar photovoltaic panels within buildings but lack any or no public sector support. There is a need for Government to do more in promoting renewable energy sources rather than conventional energy. The call for private sector is to provide building owners with viable alternatives that could make the transition easier.

### Research limitations/implications

This pilot study was limited to the Durban area. A study encompassing other geographical areas is currently been undertaken.

### Practical implications

This innovative renewable energy solution is an alternative to reduce dependency on fossil fuels, decrease commercial buildings carbon emissions and stimulate sustainability within companies.

### What is original/value of paper?

This information is beneficial to enhance the utilisation of solar technology by promoting solar photovoltaic systems on commercial buildings.

## Response to the Conference Theme

### Sustainable Construction

**Keywords:** Commercial buildings, Solar energy, Solar Photovoltaic

## 1. INTRODUCTION

At the rate at which man has been consuming Earth's natural energy resources, one would assume an endless supply for future generations to come. Yet reserves are depleting at an alarming rate. This has been the result of the deliberate exploitation and excessive use of Earth's non-renewable energy (Friends of the Earth Europe, 2009). The South African economy is predominantly directed towards the coal industry (Musango, 2011). Coal is the primary fuel source for electricity although it has an intensifying effect on greenhouse gas emissions. Globally, buildings utilise approximately 35% of energy and are directly responsible for 35% of global emissions. Two-thirds of the world's electricity production is intended for building operations. After combining construction and maintenance of buildings, the global resources consumed by buildings escalates to nearly 50%-60% (Meggers *et al.*, 2012). Buildings contribute to climate change and therefore solar photovoltaic (PV) systems have been developed to produce "renewable" electricity from sunlight. These PV systems could be recognised as an essential element in the reduction of various climate change approaches as renewable energy technologies offer ideal opportunities to reduce greenhouse gas emissions and diminish global warming by means of substituting conventional energy sources (Musango, 2011). This paper discusses the possibility for the incorporation of PV systems in commercial buildings.

## 2. LITERATURE REVIEW

*"I would put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that"* (Edison, 1931).

The sun is the greatest source of energy that provides approximately 1366 watts per square meter per second ( $W/m^2/s$ ) which equates to 170 000 terawatts ( $TW/m^2/s$ ) on the Earth's surface. The formation of non-renewable fossil fuels is a result of solar energy being trapped and captured within the Earth's surface over long geological periods (Kalimeris, 2016).

Renewable energy as *"any naturally occurring, theoretically inexhaustible source of energy, as biomass, solar, wind, tidal, wave, and hydroelectric power, that is not derived from fossil or nuclear fuel"* (Iberdrola, 2018). Technological advancement in renewable energy is

something that companies across the world are investing heavily in. The use of sunlight, or solar energy, can be directly used as lighting and heating of the home or other buildings, generating electricity, solar cooling, hot water heating and a variety of alternate industrial or commercial needs (Alrikabi and Nada, 2014).

Most individuals spend close to 90% of their time in buildings, either in the comfort of their homes or at their offices at work. Both residential and commercial buildings consume close to 60% of the world's electricity (REN21, 2017). At a national level, building energy usage amounts to between 20-40% of total energy use of the country, with the world averaging approximately 30%. This percentage depends on the level of urbanisation, the amount of building area per capita, the degree of electrification as well as local and national policies which promote building efficiency (REN21, 2017).

## 2.1 PV technology

Solar photovoltaic technology directly converts light into electricity at an atomic level via semiconductors. Certain materials present a property known as the photoelectric effect which instructs them to absorb photons of light and emit electrons. When the sun's energy strikes the semiconductor within the PV cell, electrons are freed and form an electric current (Knier, 2008).

Beyond the adoption of energy-efficient appliances and light-emitting diode (LED) light bulbs, the use of solar energy can assist individuals, families, and businesses achieve conservation goals. There are various different types of PV systems that one could adopt dependant on the nature, size, and intention of the building such as:

- *Photovoltaic (PV) direct* – this is a simple system with no energy storage) which is ideal when power is only needed during daylight hours (Maehlum, 2013).
- *Battery-based system* – stores power for times when there is no sunlight (Tazvinga and Hove, 2010).
- *Off-grid system* – is a system not connected to municipal utility lines.
- *Grid-connect system* – connects to your local electric utility. Electrical energy during daylight hours is provided by the PV system, and the building is supplied by the municipal utility connection during non-daylight hours (Maehlum, 2013).
- *Grid-connect interactive system* - may be designed to include a battery-bank or generator that can provide backup electrical power in the event of a power outage (Teitelbaum, 2016).
- *Hybrid System* – contains more than one energy generating source such as adding wind or hydro energy (Rycroft, 2013).

## 2.2 Advantages and disadvantages of solar photovoltaic systems

Solar PV panels are becoming very attractive in the energy industry (Green Power Technology, 2018). Key advantages and disadvantages of solar panels are described below.

### *Advantages of Solar PV*

- it is free and abundant (Alrikabi and Nada, 2014);
- are one of the leading renewable energy systems that have financial incentives therefore they are an attractive investment alternative (African Infrastructure Investment Managers, 2018).
- be readily accessible wherever there is sunlight (Alrikabi and Nada, 2014);
- the panels produces electricity in a direct electricity generation way (Knier, 2008);
- operating and maintenance costs are low in comparison to costs of other renewable energy approaches (Green Match, 2018);
- the costs of solar PV panels are fast reducing (African Infrastructure Investment Managers, 2018);
- has a promising future both for economic viability and environmental sustainability (Green Match, 2018);
- they have far fewer breakages and require less maintenance than other forms of renewable energy systems (Knier, 2008);
- It is pollution-free and assists in reducing carbon emissions making them environmentally friendly (Alrikabi and Nada, 2014); and
- they are completely silent and do not contribute to noise pollution, making them an ideal solution for urban applications (Knier, 2008).

### *Disadvantages of Solar PV*

- intermittency concerns, the sun does not shine at night but also during the day the weather may be cloudy or rainy which can affect the amount of electricity that is generated (Green Match, 2018);
- additional equipment such as solar inverters is required for solar PV panels to convert direct electricity (DC) to alternating electricity (AC) in order to be used on the power network (Knier, 2008);
- they are fragile and can be damaged fairly easily hence additional insurance is necessary (Green Power Technology, 2018);
- For a constant supply of electric power, PV panels require inverters and storage batteries; hence overall increasing the costs significantly (Teitelbaum, 2016);
- Large areas are required for deployment of land-mounted PV panel installations (Green Match, 2018); and
- Electricity production is influenced by a countries exposure to sunlight (Green Power Technology, 2018).

### 2.3 Integration of PV systems in commercial buildings

The growing demand for energy coalesced with increasing electricity prices, carbon taxes and national energy conservation policies recommended by the government have compelled electricity users to become more energy conscious (Winkler, 2017). Presently, climate change and climbing temperatures are posing a risk to the environment and global businesses. Alternatives need to be created for companies to improve their energy efficiency to prevent depletion of energy in a building or factories. This is created to assist commercial buildings in conserving the environment and supporting a sustainable business. In return, commercial buildings will experience profitable returns such as investing in renewable energy, leads to sustainable business practices and transforms into improved long-term revenues (Ackerman, 2018).

In the time frame of two years, the cost of solar PV systems has dropped globally, due to improved productivity in manufacturing and the technology. In this highly competitive market, the number of suppliers is expanding and as a result, this facilitates in decreasing the cost of solar PV systems (Guevarra, 2018). A few years ago, the outlays of a photovoltaic system was R5 kWh in comparison to Eskom's R0.50 per kWh. However, presently with the substantial growth in the market, Solar PV systems plummeted to R1.00 per kWh whereas Eskom has climbed to R1.80 per kWh (Eskom, 2018).

By companies installing solar panels, it represents their commitment to improving and protecting the environment. Every kilowatt of solar power installed decreases greenhouse gas emissions, reduces the company's carbon footprint, and diminishes the amount of carbon dioxide in our atmosphere. Customers are attracted to businesses with the green badge of honour. Businesses that promote their environmental impact are more likable to both their customers and employees. These companies attract denotations and pledges by promoting the business's environmental impacts and creates awareness (Anova Energy Solutions, 2018).

According to Statista (2018), global investment in solar energy technologies inflated from \$4.11 billion in 2004 to \$160.8 billion in 2017. A key driver for the advancement of PV systems has been the shift in policy landscape and precisely the launch of feed-in tariffs is a policy procedure designed to fast-track investment in renewable energy technologies (Clean Technica, 2016).

Feed-in tariff payments is a Government incentive to promote the application of solar PV. Payment is received for every kilowatt per hour the solar PV system generates. The payment rate rises with inflation and payments are received for 20 years. Any energy that is not utilised, is exported back to the grid and people are able to claim the Export Tariff. The combination of energy savings and feed-in tariff payments delivers

outstanding returns on investment (Guevarra, 2018).

## **2.4 Financing options available for solar PV systems**

Solar energy is a low-risk improvement to ensure the operating expenses are cutback. Upfront financial investments are not required to install solar energy on properties (Soventix South Africa, 2014). Solar energy is becoming very attractive in the market and more businesses are deciding to lease their solar arrays and take advantage of the low or zero-upfront costs of a power purchase agreement (PPA) (Guevarra, 2018).

The PPA is when an organisation signs a long-term contract with a solar energy provider or a financial guarantor. The solar energy company will assess the organisation's property and design and purchase the suitable solar equipment. The business will accept all the upfront costs, permitting, and financial risks. Thereafter the solar panels will be installed on the business's property and connected to the power grid for a small charge. The solar panels will immediately begin to generate electricity (Soventix South Africa, 2014).

Given that the solar energy provider owns the solar panels, they will sell the electricity that is generated on the property to the business at a discounted rate that is cheaper than the utility company. The solar energy company will also install, maintain, repair and control the solar panels. A solar lease agreement guarantees a low, fixed electric rate for 15–20 years to assist a business with budgeting (Statista, 2018).

The outright purchase agreement entails a higher initial cost. This financing option comprises of a full 20-year warranty on the PV panels with most solar energy companies. However the cost excludes maintenance, but an additional maintenance contract can be purchased. This solution provides the greatest savings over the 20 year period and a break-even period of the investment can be determined (Sola, 2013).

## **2.5 Installing solar PV systems on commercial buildings**

In most cases, solar PV mutually benefits landlords and tenants. Though, the gap between the economic and environmental benefits is influenced by the structure of the lease. Normally commercial buildings are able to slash operating expenses through the installation of a PV system as this can provide a hedge against escalating energy prices (Alta Energy, 2014). Commercial buildings establish lower costs of capital and higher market value because of this condensed risk.

Solar PV benefits for landlords are:

- Condensed utility electricity consumption steers towards decreased operating costs, and minimised exposure to the volatility of energy prices;
- Enriches marketability of the building;

- Reduces occupancy costs which assist the facility to charge higher rental; and
- Enhances tenant retention due to decreased operating expenditures (Blue Star Energy, 2015).

Solar PV benefits for tenants are:

- Reduces electricity costs;
- Stabilises electricity costs;
- Advocates corporate sustainability goals; and
- Reveals environmental responsibility to employees and the community (Blue Star Energy, 2015).

With more efficient technologies being developed that would help reduce the energy demand placed on government, this study realises that incorporating such energy efficient methods such as the inclusion of PV systems within the building's infrastructure, will help to reduce the buildings total energy consumption needs (Guevarra, 2018).

### **3. RESEARCH METHOD**

For this study, the qualitative approach was adopted. A total of ten firms were specifically selected within the Durban region through the purposive sampling technique (Etican, 2016). These ten firms were both owners of their buildings (n=20%) as well as tenants (n=80%).

The semi-structured interview process was adopted where interviews carried out was held with senior members of management within each firm. The interviews were designed to assess the degree of knowledge these occupants had pertaining to green technology, solar systems and the firms use of solar systems within the building. Once the interviews were concluded, the thematic content analysis approach was used to analyse the data obtained using similarities and differences and grouping them into themes (Anderson, 2007).

### **4. ANALYSIS**

This section is broken down into the following themes sustainable development and solar energy incorporating PV systems.

#### ***4.1 Sustainable development***

The participants were asked to provide their understanding of sustainable buildings, some of the responses' received included:

- *“Sustainable buildings are made out of renewable resources and minimise the use of natural resources as well as reduces pollution during the construction process”;*
- *“Sustainable buildings are buildings that are self-sustaining and have the ability to exist for a theoretical period of time”;*
- *“Buildings that are able to provide basic amenities such as electricity and water without leaving a lasting impact on the environment”.*

Majority of the interviewees (n=90%) said that they would prefer to work in a sustainable building because they believe working in a sustainable building is a contribution towards lessening the impact posed on the environment and to conserve the earth's natural resources.

A number of interviewees said that the company they worked for had various corporate sustainability goals. One interviewee stated that *“the firm they worked for shuts down operations at least once a year across the world in order to give back to the community and also to promote and uplift their brand image within the community”*. Another said that their *“company aims at reducing paper wastage and is slowly becoming an online company. This assists them with the distribution of information to numerous people across the globe in a faster and more efficient manner”*.

All the interviewees agreed that carbon credits should be implemented in South Africa and it will be beneficial. Some said it would *“drive companies to incur the costs of converting to cleaner energy sources, as it would save them money and also earn them a better reputation”*. One expressed the view *“when there are restrictions placed on companies, they tend to realign themselves in order to meet such restrictions. The country would therefore act more responsibly towards the environment”*. Another said that *“it would definitely help building owners as well as the government in regulating carbon emissions. If there is an incentive provided then owners will start adopting greener technology within their buildings. It would be appealing to a larger audience”*.

#### **4.2 Solar Energy**

All the interviews agreed that they would use solar energy as it is free energy that is available to everyone. Some of the responses received were:

- *“we should harness solar energy for use in lighting so as to limit the electricity we require from coal-driven electricity plants. We should also harness solar energy in terms of heat to limit the expenses and electricity requirements of air conditioning”*.
- *“solar energy should be used. The crux of solar energy though comes down to its inefficiency and maintenance. On a small scale, the cost incurred is not beneficial enough to warrant installation in most places. It could be used in large-scale operations as a backup and partial replacement to conventional fossil fuels”*.

- *“Yes we should use it... it will be more mobile, easily accessible, off-grid so you won't be relying on Eskom. More dependability and if used correctly it should reduce monthly costs”.*

All the interviewees were aware of solar panel technology. Most interviewees (n=90%) said that they would consider solar panels as a possible option, *“by storing unused electricity in batteries that can be used when experiencing load shedding”.* One stated that *“yes, it is nature's free alternative and is seen as an attractive, 'green' and cost-effective solution, particularly when compared to noisy diesel- or petrol-powered generators. In South Africa, we receive many sunlight hours, therefore, it would be a viable option”.* Whereas another interview stated that they would not consider the use of solar panels as *“our current consumption required to be supplied is great. It would require a large number of solar panels to satisfy our need and we do not have the space to install the required amount”.*

Many interviewees expressed their views on the benefits that solar panels would provide to their building:

- *“it is a form of clean green energy that does not harm the environment”;*
- *“the decrease in the electricity consumption can result in a decrease in the operating costs of the building”;*
- *“there is a good return on investment as government incentives and the decrease of solar equipment costs means the utilisation of solar power is a good financial decision for businesses. It generates both long-term savings and quick payback”;*
- *“once the solar panels are installed, the system does not require much maintenance and the system will provide electricity quietly and cleanly for 25 to 40 years”;* and
- *“they provide huge benefits in the form of saving energy and utilising renewable energy from the sun. It is a practical solution especially in South Africa since we see many daylight hours where the sun is present. Although initial costs are expensive, it proves to be a viable long-term solution”.*

All of the interviewees stated that the buildings they occupied did not have solar panels systems. Some of the barriers that prevented the installation of solar panels were mainly focused around the high initial costs that would be incurred. Others also mentioned the lack of information on the options available to purchase the products and how they work. One interviewee outlined his concern about the space required for the solar panel installation.

All the tenants of commercial buildings interviewed (n=80%) said they would support the landlord in adding sustainable initiatives (waste management systems, LED lighting, solar panels, etc.) into the lease

agreement. Most of these tenants (n=50%) were not aware that they did not need to necessarily own the solar panels but could rather lease it from a third party or buy solar produced electricity directly from the owner. One interviewee said *“it would be more attractive to me the tenant in wanting to extend my lease agreement with the owner. The overall building will be more attractive to work in if it produces clean, renewable energy. The building will be off the grid and we won’t experience load shedding”*. Five of the tenants were in favour of purchasing solar produced electricity from a third party whereas the rest had some hesitation due to their company’s policies.

The landlords who were interviewed stated that they would *“indeed consider solar panels within their buildings in the near future”* either by *“purchasing the solar panels as it would amount to greater returns for the company in the long term”* or by *“purchasing the electricity produced by the solar panels from a third party”*. They agreed that entering into the solar market would be more advantageous via the feed-in-tariff mechanism where the government compensates the company for every kilowatt produced. The electricity produced would be best utilised within the building in common areas such as passages, garages, canteens, car parks and the like.

## 5. CONCLUSION

There has been a global shift in society’s perception and understanding of climate change and the detrimental effects that are affiliated with it. The way forward seems to be utilising renewable energy sources, yet little effort has been made by government and private sector in making this change. This study investigated the degree of knowledge building owners as well as tenants have on sustainable development, as well as their perception and view point on the incorporation of solar photovoltaic technology in commercial buildings.

The findings revealed that the interviewees had an understanding of sustainable development and would prefer to operate their practice or be a part of a firm situated in a sustainable building. All the interviewees agreed that the harnessing of solar photovoltaic energy is the way forward describing it as clean green energy that is readily available. Yet none of their buildings contained any form of solar photovoltaic technology.

All interviewees seemed enthusiastic about solar energy and the advantages such technology would add to their buildings but frown away from the actual implementation of solar PV systems. All tenants fully support the inclusion of solar panels within their lease agreement. The lack of initiative shown by both the public and private sector with the high upfront capital needed for installation and the lack of attention showed by government are some of the reasons interviewees highlighted as being the cause towards solar panels not being implemented in their buildings.

## 6. RECOMMENDATIONS

Government needs to support and provide incentives that would assist with the implementation of photovoltaic panels within commercial buildings. Government should also take a stronger stand on buildings and their carbon footprint which may aid in the shift towards more renewable sources being utilised. The greater public as well as individuals that have the ability to implement solar panels within their buildings infrastructure should be made more aware of the technology, the positives and negatives that may come with it, the rate of return, longevity of equipment and other maintenance factors.

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## **Computer Software Programs' Usage In Consulting Built Environment Firms - A 21<sup>st</sup> Century Outlook**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose:**

The study aimed at investigating the extent of utilising computer software to aid consulting firms with current technology, quality information and performance of services provided to clients.

#### **Design/Methodology/Approach**

The objectives of the paper were achieved through a twenty questionnaire survey submitted to five multi-disciplinary firms and relevant literature on studies done in other countries, South Africa included, were reviewed. The reviewed literature provided a more detailed outlook on the scope of software programs used in consulting firms.

#### **Research Limitation/Implications:**

The research was conducted in Gauteng Province, South Africa.

#### **Findings based on Empirical Research:**

Initial findings indicate that software programs have been accepted but not fully utilised. The impact brought by these software programs has sped up performance and increased quality productivity. However, that is not realised fully due to lack of training to professionals and few specialists in these software programs. The requirement for an increase in the skills

development budget for Information and Communication Technology (ICT) training of employees in companies is apparent.

**Response to Conference Theme:**

Increased utilisation and dependency on technology widens the necessity of evolution hence, this paper identifies the magnitude of ICT usage by the built environment-consulting sector.

**Value of paper:**

The paper identifies the magnitude in which ICT is utilised within the consulting built environment sector in South Africa.

**Keywords:**

**Computer Software, Scope, Productivity, Information and Communication Technology.**

## **1. INTRODUCTION**

The 21<sup>st</sup> century marks the beginning of a new millennium and the century ends 2100 AD. According to Clarke (2003), Information Technology was introduced in the late 20<sup>th</sup> century and it has gained momentum in terms of exposure and the world relying on it more in the 21<sup>st</sup> century. Research and development of software technology during the year 2000 and 2001 period promoted IT application and development for industrialisation and modernisation (Anson, Chiang and Raftery, 2004). A study by Adwan and Al-Soufi, (2016) reflected that a rigorous review of ICT technologies applied in the construction industry is still missing. Whilst Anson, Chiang and Raftery, (2004) stated that initiatives on the use of construction IT are notably increasingly pursued in design work and in the quantity surveying environment in many construction consultant corporations. In addition, Karkonen and Laurikka, (1992) report that project managers use computer based scheduling software programmes as an important tool for generating and managing construction schedules. The built environment professional is ought to be technically trained, thus Kubricky and Castkova (2015) mentioned that the basic philosophy of technical education assumes that technology is one of the critical factors of current and future being. The primary aim of the study is to assess the usage of computer software in the built environment and engineering sectors, and the knowledge of professionals as far as ICT construction programs are concerned. This is

achieved through in-depth understanding and acceptance of ICT programs by 21<sup>st</sup> century consulting firms.

## **2. INFORMATION COMMUNICATION & TECHNOLOGY**

### **2.1 What is ICT?**

Hamidi et al., (2011) defined Information Technology as the knowledge process and its application methods, which includes processing, transferring and making information in progress. ICT is an extension of IT; it has been amended with the element of communication, whereby separate computers and closed networks began to communicate among each other.

The term ICT has addressed the manner in which information and communication were applied in a parallel system; however, information and communication are inseparably connected (Hubackova and Klimova, 2014). Information and communication technology were created with the vision that people would communicate more efficiently, including the production, dissemination and understanding of information (Yudi, 2013).

### **2.2 What impact does it have on the new generation (21<sup>st</sup> Century Professionals)?**

Atkinson (1999) proposed the adoption of Information System and Information Technology in project management to get over the 50-year record of projects using (the Iron Triangle) time, cost and quality in measuring success of projects. Soeiro (2002) mentioned that technological developments have influenced the daily life to an unexpected rhythm and significant changes in the areas of design and construction. HM Government (2015) pointed out that the global construction industry will grow up to 70% by the year 2025. Sulakatko (2016) mentioned that based on recent changes in other industries, an increased adaption of ICT could help manage the growth effectively. Soeiro (2002) is convinced that the tools and ways used in communication and exchange of information have had an influential and crucial role in the construction industry. Sulakatko (2016) emphasised that the construction sector is maturing in the context of understanding the strategic benefit of ICT investments and project-oriented views are changing to strategic views in the context of business.

### 2.3 Computer software used in construction consulting firms

Most companies in and around South Africa have moved with time in terms of growth in magnitude and multi-disciplinary services; however, the main question is, would this be a reflective picture that computer software programs have a positive outlook into the future? According to Ali et al., (2012) in a survey conducted in Malaysia, some construction managers experienced resistance from elder employees whenever a modern technology tool was being implemented. However, Ahmadi (2011) stated that the relation between techniques, knowledge and set of skills is related to the application of information and communication technology.

Yudi (2013), mentioned that the use of ICT promotes the effectiveness of education and learning supported by a number of conditions, namely:

- The positive attitude of people in ICT is indicated by the large number of users and internet-based ICT service providers
- The price of ICT devices is relatively cheap and can be purchased by the public
- The ability of technology to process data quickly and to have a large storage capacity, and
- The extent of access or communication network/internet.

Table 2.3 below indicates the name and where the software program is used or can be used.

Table 2.3.: Software Usage in Different Disciplines of the Built Environment

	Bid Management	Consultants	Contractors	Commercial	Sub-Contractors
ArchiCAD		√			
AutoCAD		√	√		√
BIM/Revit		√	√	√	√
BillCost	√	√		√	
CCS	√	√	√	√	√
Civil Designer		√	√		
Inducta		√	√		
MS Projects	√	√	√	√	√

GIS	√	√	√
Primavera	√		√
Prokon	√		
WinQS/QS+	√		√

The below Gauteng based companies are the leading international built environment and engineering consulting firms and competitively use computer software as their main business resources or tools.

- *AECOM: Define themselves as a global network of experts working with clients, communities and colleagues to develop and implement innovative solutions to the world's most complex challenges.*
- *AURECON: Aurecon brings ideas to life, to design a better future. Imagining what is possible, turning problems into solutions. Aurecon provides advisory, design, delivery and asset management services on projects across a range of markets, in locations worldwide.*
- *ARUP: Arup is an independent firm of designers, planners, engineers, consultants and technical specialists, working across every aspect of today's built environment. Together they help their clients solve their most complex challenges – turning exciting ideas into tangible reality as they strive to find a better way and shape a better world.*
- *DELTA BEC: Delta Built Environment Consultants (Delta BEC) is a multi-disciplinary organisation. As a Level 2 B-BBEE company, Delta BEC provides services in mining, property development, agriculture, aviation, health, logistics, housing, energy, education, water, waste management and transportation.*
- *Royal Haskoning DHV: This company is an independent international engineering and project management consultancy, leading the way in sustainable development and innovation. With over 6000 employees, Royal Haskoning DHV is driving positive change through innovation and technology, helping clients use resources more efficiently and creating solutions that connect with people to make their lives easier, happier and safer.*

## 2.4 The benefits of ICT in built environment sector

According to Zachiang (2016), the primary benefits of ICT are critical to the performance of the construction industry in reducing the time for data processing and communicating information, and to improve communications for effective decision-making and coordination among construction practitioners to enhance construction productivity. Sulakatko (2016) stated that technology has changed the way clients and suppliers communicate, and there are numerous of obvious alternatives.

The end objective of a business is to create additional value. Soeiro (2002) mentions that ICT uses electronic processes to allow the use of resources at a lower cost in a shorter period. Sulakatko (2016) added that innovators of software have to understand the changing business environment and use the most effective technologies to create value for the client.

Adetola (1998) pointed out that the derived benefits of ICT in the construction industry are:

- It improves the quality of work and increases the document quality
- Complex tasks are made easier to perform
- Saving of time and speed of work
- Improves and increases productivity
- Enhances public image
- Enhances in cost saving
- Facilitates decision-making
- Reduces proportion of new work, design & construction error

The unequivocal importance and role of ICT in construction is being a prime tool that has potential to modernize societies, boost economy and bridge huge barriers such as distance, equity and time associated with the traditional world (Adwan and Al-Soufi, 2016). Witty (2008) acknowledged that builders are now beginning to be drawn into the 21<sup>st</sup> century by the need to collaborate more closely with their more IT-savvy colleagues; the architects and engineers responsible for the ideas behind their work. The architecture, engineering and construction industries' day-to-day business struggled because of the need to communicate, review project drawings and share proliferating number of associated documents that are too large to send by e-mail. This initiation introduces and fast tracks the acceptance of a paperless working environment and communication within the construction industry to vastly improve, become more instantaneous, reliable and trackable. Polekar and Salgude (2015) agreed that due to tremendous amount of information and data changes in a project, the project management system cannot meet the demands of today's projects.

Lastly, Vukomanovic, et al., (2012), stated that the need for software to be used for managerial purposes was eminent whereby the PMS (*project management software*) can also serve as a quality management system

### **3. METHODOLOGICAL APPROACH**

A questionnaire methodology was used to ascertain the views of respondents on the use of computer software programs in Gauteng based consulting built environment firms. Questionnaires were administered to the professional leads in five different firms, and in each firm four divisions or departments (building and engineering) were considered as participants. Twenty questionnaires were submitted by hand to the participants and a 95% response rate was achieved. The quantitative data was analysed using MS Excel. For the first section, using a three-point Likert scale (Agree-Not Sure-Disagree and Yes-Maybe-No), participants had to rate their level of satisfaction in terms of statements and questions separated into Sections A and B.

### **4. DATA ANALYSIS AND RESULTS**

Respondents come from different companies and various schools of thoughts in terms of background, experience and present occupation working culture. However, there are similarities that are standardised or regulated either by a government entity or professional council, for example Bill of Quantities format. Table 2.3 presents a matrix arrangement of the type of software program on the y-axis and the type of business sector on the x-axis, showing the number of programs used per business sector. Figure 4.1 presents categorically the average usage of computer software in each discipline that participated in this research from all five consulting firms. In this case, 36% of engineering respondents are dependent on software programs, whilst 32% are the architects and 16% both project managers and quantity surveyors are dependent on software programs. This confirms the dependency of each discipline on software programs based on their nature of work or requirement.

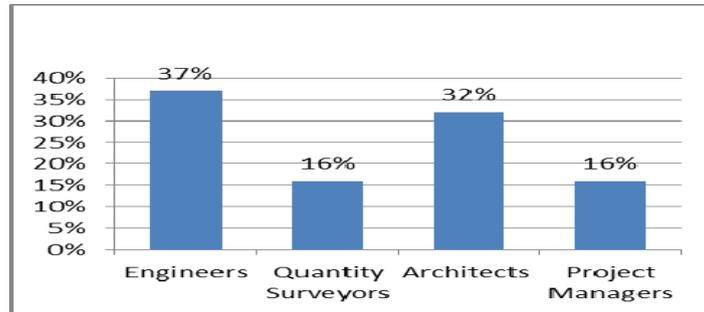


Figure 4.1: Average usage of software by disciplines in all five firm

**4.1. QUESTIONNAIRE SECTION (A) FINDINGS**

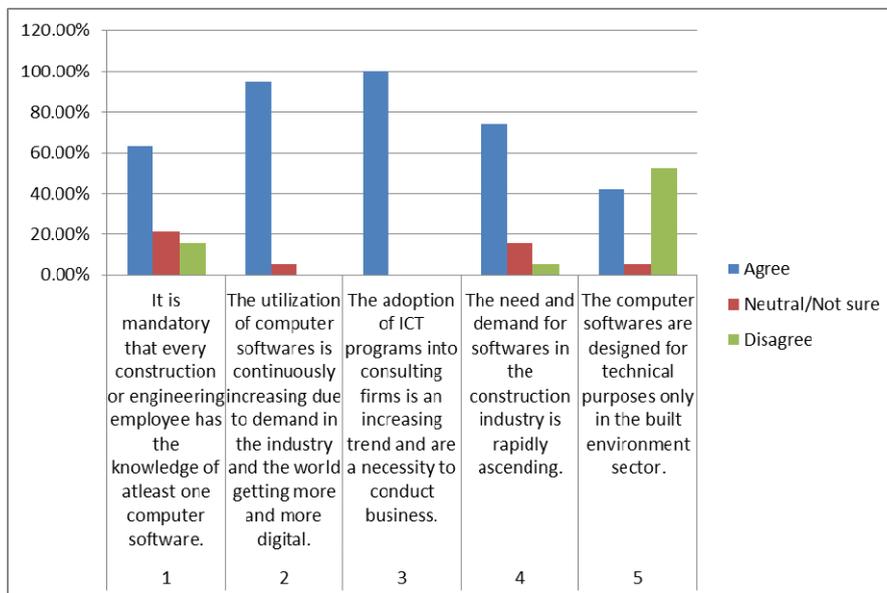


Figure 4.2: Statements on ICT usage in the built environment sector

Based on the collected data through the questionnaires, Figure 4.2 presents five statements. In Statement 1, the respondents agreed with a 63% rating that every construction and engineering professional in the 21<sup>st</sup> century is mandated to have or acquire knowledge by using at least one computer software. According to the respondents' Statement 2, a 0% rate disagreed and 95% agreed that since most parts of the world have accepted industrialisation, the world is now swiftly moving into a digital era and the demand for ICT in construction is ascending as shown in Statements 3 and 4. Each software program is designed for a particular

reason; one of the reasons is communicating information effectively and improving service productivity in a technologically sophisticated way, which requires a trained professional to conduct the exercise (Vukomanovic, et al., 2012). Statement 5 queries whether software programs are designed for technical purposes only in the built environment sector. The respondents largely disagreed with a 53% rating and 42% of respondents agreed with the statement.

#### 4.2 QUESTIONNAIRE SECTION (B) FINDINGS

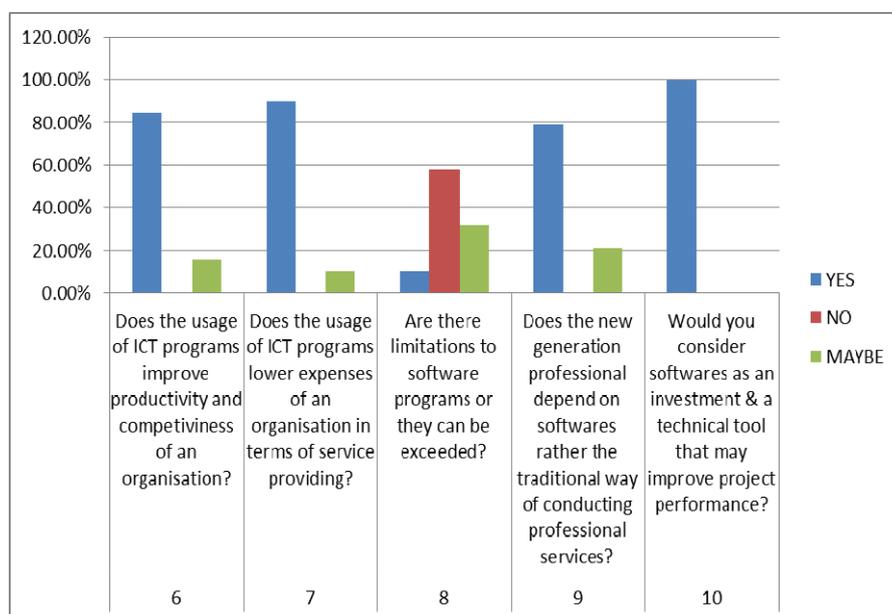


Figure 4.3: Questions on ICT usage in the built environment sector

Figure 4.3 presents Section B of the questionnaire. Question 6 shows that the respondents are largely convinced that the ICT programs improve productivity and the competitiveness of an organisation within the built environment sector, as only less than 20% disagreed. Question 7’s findings are similar to that of Question 6, with most respondents agreeing with over 80% that the ICT programs lower expenses of an organisation conducting business. Question 9 wanted to find out whether the present 21<sup>st</sup> century generation depends on computer software and have given away the traditional way of conducting their professional duties, the respondents mostly agreed with a rating just below 80%. A 100% of the respondents scored YES to Question 10, which queried if software programs were an

investment and a useful tool that may enhance project performance. Lastly, over 50% of the respondents said NO to Question 8's query about software programs having any limitations of not producing what they are designed to produce.

## **5. DISCUSSION AND CONCLUSION**

This research has confirmed that ICT software programs in South Africa, particularly the software that the built environment-consulting firms use, are a primary tool required for professional services. This research study has confirmed that the construction industry is catching up in terms of applying information technology. It disagrees with Björk's (1999) view that the industry is lagging behind other sectors and engineers and surveyors whose knowledge of computing is very often limited to what systems has been implemented for. The South African construction industry has influenced tertiary institutions to introduce computing at second year level of architecture, building science, engineering, construction studies, land and quantity surveying and project management degrees. The conducted research study provided insight that most of the participants' firms confirmed using ICT programs surely improve performance and productivity; however, not every department in the firms are exposed to information technology. Therefore, more employees require software program training to ensure the adoption of ICT and to maintain productive performance in their work. Based on the reviewed literature that the digitalisation of the built environment will have a higher impact and influence in future projects. The introduction of ICT into companies is a beneficial strategy that helps reduce losses in projects and improves productivity. Further research is recommended, companies should solicit benefits of ICT from the possibilities of average performance and to gradually eliminate development costs of projects.

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# **An Evaluation of the Relationship between an Organisation's Innovative Culture, Employee Satisfaction and Turnover**

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## **ABSTRACT AND KEYWORDS**

### **Purpose of this paper**

High labour turnover impacts on organisational performance and survival. Despite an organisation's level of development, employee retention is unavoidable. Therefore, devising strategies to improve employee retention has become a priority for most organisations. The research aimed to determine the relationship between innovative culture, employee satisfaction and retention, which has been conducted to a limited extent in South Africa.

### **Methodology**

A questionnaire survey, developed from an extensive literature review, was used to collect data from Moving Consumer Goods (FMCG), Manufacturing and Construction, and Services companies. A relationship was inferred from the data obtained from the questionnaire.

### **Findings**

Findings revealed that a relationship existed between an organisation's innovative culture and employee satisfaction. Organisations with a high rating on innovative culture also had a high rating on employee satisfaction. However, surprisingly, this did not translate to employee retention.

### **Value**

Although a causal relationship was not established at this stage due to the analysis methods and the sample size used in this study, which could have influenced the results, it was concluded that innovative culture of an organisation was a factor to employee satisfaction but not really employee retention. Consequently, organisations seeking to improve employee satisfaction should consider fostering an innovative culture within their organisations.

**Keywords: employee satisfaction, innovation, labour turnover, organisations, retention, South Africa**

## **1. INTRODUCTION**

High labour turnover and job dissatisfaction pose a recurrent challenge to organisations globally. There is virtually no organisation that is immune to labour turnover, regardless of the size, technological advancement, market focus or economic sector (Hana, 2013; Akinyomi, 2016; Harden et al., 2016; Park et al., 2016). Organisations faced with unhappy employees and high labour turnover lose skilled and qualified employees, and run into financial and non-financial problems including poor organisational performance, low employee morale, increased costs (for recruiting, training and development of new employees, cost of inefficiency of new employees), delays on tasks, poor quality of service and lower productivity (Thomas, 2013; Ayegba and Agbo, 2014). Five out of ten businesses do not survive past the first five years in operation, with the majority not even making it past the first year and this is partly as a result of high labour turnover, job, career and pay satisfaction, unionization and so on (Thomas, 2013). Many strategies have therefore been espoused to address the problem of labour turnover. These include supervisor support, improving learning and working climate and conditions, employee rewards and incentives, as well as improved remuneration packages (Govaerts et al., 2010; Terera and Ngirande, 2014; Akinyomi, 2016). However, few studies have focused on the role of innovative culture in the employee retention in an organisation. Innovation in an organisation is a critical driver of competitive advantage, success and economic performance (Hana, 2013). An innovative culture in organisations contributes to increasing their potential, competitive advantage, a higher efficiency of processes and a higher profit.

Extant literature investigated the relationship between innovation and size as well as type of organisation/sector; and the role of knowledge in innovative culture enhancement (Hana, 2013). Habib et al. (2014) explored the impact of organisational culture on job satisfaction, employee commitment and turnover intention, but did not really include innovativeness. Furthermore, the relationship amongst innovation, training and turnover was focused on in Kesen (2016) and between turnover intention and actual turnover in Sun and Wang (2016). In addition, Kundu and Gahlawat (2016) investigated the relationship between human resource (employee retention) practices on an organisation's performance. However, few studies have investigated the relationship between innovation, employee satisfaction and retention, especially in South Africa. The current study posits that an innovative culture leads to employee satisfaction and retention in an organisation. The study was motivated by anecdotal evidence which purported that a relationship existed between innovation, employee satisfaction and employee retention in a Fast Moving Consumer Goods (FMCG) company, which was production-focused, but did not seem to accommodate its employee's ability to innovate. This, in turn, affected employee morale and resulted in high labour turnover. Furthermore, a review of extant literature revealed that there were no extensive studies on the relationship between innovative culture, employee satisfaction and retention especially in South Africa. The objective of the current study is therefore to establish a relationship between an organisation's innovation culture and employee satisfaction as well as between innovative culture and employee retention. Findings from the study will assist employers in developing strategies to manage and maintain a productive workforce.

## **2. LITERATURE REVIEW**

### **2.1 Organisation culture**

Organisational culture is a set of different value systems, beliefs, attitude, behaviour, norms, rules and regulations that reveals how the organisation functions (Habib et al., 2014). Each organisation has a specific culture which can be determined by a number of factors. Culture can be defined as the underlying values, beliefs and codes of practice which define and make

a community what it is (Dalkir, 2005). However, culture could either be innovative or destructive, depending on the way an organisation functions.

## 2.2 Innovative culture

Innovation was first conceptualised by Schumpeter in 1934, with theories centered around entrepreneurial innovations (Śledzik, 2013). However, his views have changed over time to include a wide range of spheres and approaches including social, organisational, institutional and political perspectives (Śledzik, 2013; Park et al., 2016). Innovation is basically the introduction or adding of new things or methods to existing ones (Okpara, 2007). Innovation can be described as the use of skills successfully in order to create new technologies or products or improve on existing technologies or products. Innovation is akin to creativity, which is the ability to make or otherwise bring into existences something new, whether a new solution to a problem, a new method or device, or a new artistic object or form; however, innovation is the implantation of creative inspiration (Okpara, 2007). Innovation can be divided into five, namely: launch of a new product or species of already known product, application of new methods of production or sales, opening of a new market, acquiring new supply sources and new industry structure such as creation or destruction of a monopoly position (Śledzik, K. (2013).

Innovation within an organisation is crucial. Organisations seeking profits must innovate in order to be competitive and dynamic (Śledzik, 2013). Most organisations cannot stay afloat without improving the ability to innovate in order to remain competitive, as was the case with Kodak, which were complacent in innovating new photographic and imaging products and could not keep up with the technological challenge of global competition (Forbes, 2012).

In order to successfully create an environment of innovativeness in an organisation, certain traits must be inherent or exhibited by the organisation, which in turn becomes a way of doing things in the long run, described as culture.

Therefore, in order to understand whether an organisation is innovative or not, we need to identify what traits an innovative organisation should have. These traits are building blocks of innovation, which form an essential foundation to any organisation's innovative culture (Rao and Weintraub, 2013). These include:

- i. The organisation's **Values** have to be in line with that of an innovative culture. Innovative organisations create an environment conducive to learning and creativity and are typically entrepreneurial organisations
- ii. Certain **Behaviours** are necessary for maintaining an innovative organisation. Management needs to inspire employees to carry out challenging tasks. In order for this to be successful, employees need to be engaged regularly and provided with the necessary support and coaching. This will assist in creating an environment where employees are able to adapt where necessary. The ability to handle change and adapt is essential in any organisation
- iii. An innovative **Climate** (or environment) cultivates engagement and enthusiasm. It also challenges employees to take risks within a safe environment, thus fostering learning and encouraging independent thinking
- iv. The **Resources** of the organisation play a significant role when managing innovation. It is necessary to have the correct resources, such as human, finances and time, in order to innovate. Without sufficient resources, it becomes difficult to be innovative because tasks have to be carried out with less than the employees require. This leads to frustration and the likelihood of employee dissatisfaction increases.
- v. In order to function efficiently, the organisation must have adequate **Processes** governing the entire system, from idea generation to execution. Even innovative organisations require processes to ensure that functions are carried out smoothly.
- vi. The **Success** of the organisation plays a role in ensuring that individuals are motivated and remain happy to be a part of the organisation. Unsuccessful organisations become stressful environments and it becomes difficult to encourage employees in these organisations. It is also necessary to assist employees to be more successful in their own tasks and departments. This might include having reward schemes and creating a sense of purpose in employees. When people feel like they are a part of something big, it motivates them to do their best.

A culture of innovation therefore means that an organisation holds internal assumptions, values, beliefs and management practices that foster developing new ideas into products, processes, objects and services (Aiman-Smith (2004).

### **2.3 Employee satisfaction**

Employee satisfaction is an individual's assessment of how the working environment fulfils their needs (Habib et al., 2014). It is related to self-actualisation and fulfilment at work. Employee satisfaction is essential to the success of every business. It has a negative impact on an organisation because employees who are unsatisfied at work are more likely to be unproductive (Branham, 2005). There are various factors that contribute to employee satisfaction, including salary, efficiency in work, supervision and co-worker relationships (Parvin and Kabir; 2011). Many companies have retention strategies in order to keep the employees happy and prevent them from seeking employment elsewhere. However, these retention strategies do not guarantee employee satisfaction and only go so far to prevent employees from leaving the organisation for greener pastures. A clear indication that an organisation is plagued with dissatisfaction amongst employees is a high labour turnover rate.

According to Irvine (2013), there is a direct correlation between happy and innovative employees. In an examination of Google, the author stated that there are three keys to ensuring that employees are happy and innovative. These include:

- Ensure employees understand the big picture;
- Tell employees their role in achieving the big picture; and
- Empower employees

These three keys were emphasised in the American coffee company, Starbucks, whereby employees were allowed to be shareholders in the company by creating the Bean Stock. This allowed the employees to understand the big picture of the organisation, to have an active role in the success of the organisation and, in addition to that, it empowered the employees. This suggests that there is a relationship between empowerment of employee through innovation and their satisfaction.

### **2.4 Labour turnover**

Turnover is generally defined as the movement of an employee out of an organisation (Sun and Wang, 2016). It is the rate at which an organisation loses its employees. It is the rate at which an organisation replaces its workforce (Akinyomi, 2016). It is necessary to note that an affliction such as high labour turnover does not go unnoticed in an organisation. A desirable degree of turnover is acceptable as it creates incentives and helps maintain creativity (Kesen, 2016). Nevertheless, excessive turnover is detrimental to

organizational performance because it can disrupt service delivery and create additional costs for the organizations in replacing the leavers (Sun and Wang, 2016).

There are two types of turnover, voluntary and involuntary turnover, which depends on whether an employee makes the decision to terminate the employment relationship (Sun and Wang, 2016). According to Shim (2009), labour turnover can also be classified into unpreventable turnover, which occurs due to factors such as retirement, illnesses, or death; desirable turnover, which is necessary as a result of companies weeding out underperforming staff (and does not harm the organisation); and undesirable turnover, which harms the organisation because it is as a result of employee dissatisfaction, and other factors mentioned earlier.

Most factors that affect employee retention and turnover are related to human resource management (Irshaad, 2012; Sun and Wang, 2016). The term “retention” includes the portfolio of human resource practices that organisations develop to reduce voluntary turnover rates (Kundu and Gahlawat, 2016). The role of management in maintaining and managing human resources in an organisation contributes to labour turnover or retention. These factors include compensation, job security, motivation, leadership, training and development as well as support and innovation culture. This suggests that organisations which tend to support creativity, as well as free and productive environments will have a lower percentage of employee turnover. In other words, an organisation’s culture and strategic alignment to innovation has an impact on employee retention or turnover.

## **2.5 Relationship between innovation, employee satisfaction and retention**

Innovation can be a catalyst for achieving success by providing a positive atmosphere and reforms that lead to retention of employees (Kesen, 2016). In Kesen’s (2016) view, employee turnover leads to innovation as new employees create additional learning and innovation opportunities, which improve employee abilities and eradicate monotony, and vice versa. On the other hand, negative innovation culture and resistance to change on the part of management may increase turnovers. Dynamism provided by an innovative environment can reset employees’ perceptions, old ideas and psychological environment in addition to reorganizing physical environment in an undesirable way. For instance, hostility and negative social

interactions, as well as suspicious and disparaging attitudes toward work situations may arise.

With regard to the relationship between innovative culture and employee satisfaction, Wei et al. (2012) opined that job satisfaction is one of the individual-level outcomes that stem from an innovative environment; others being organisational dynamism and improved firm performance. Organisations which favour innovation tend to value free environments, are open to creativity and unafraid of failure. This makes the environment a happy one to work in. As a result, employees tend to enjoy work more and thus there will be a low percentage of labour turnover (Park et al., 2016). Therefore, high labour turnover is therefore a function of unhappy employees and innovative employees tend to be happier. Organisations can therefore clear off the reasons that lead to turnover by providing innovative applications and opportunities in the firm and thus ensure happiness and satisfaction of employees.

### **3. METHODS**

A quantitative approach was used to conduct the study in order to achieve the objective, which was to establish a relationship between innovative culture and employee retention. The nature of the study therefore required obtaining measurable data for statistical evaluation. A field questionnaire survey was constructed from a detailed literature review. The questionnaire contained questions regarding the characteristics of an organisation with innovativeness, employee satisfaction and retention, in three separate sections. With regard to innovation, a number of questions were asked to characterise innovativeness and focused on creativity at work, the freedom to make decisions and errors and the tendency of the organisation to develop new products. With regard to employee satisfaction, respondents were asked question as which varied from how valued employees felt in their role, to the pride in the brand being sold by the organisation. Other questions related to the levels of stress experienced on a day to day basis. The questions on employee retention related to the extent to which employees would like to work at the company for a number of years (at least three years) or how often they seek employment in other establishments. The questionnaire was aimed at workers at all levels in an organisation. A separate email account was set up for the purpose of collecting the data. The surveys were then sent to a number of individuals within various organisations. These individuals also assisted in distributing the questionnaires. Including individuals at specific organisations ensured

that first-hand information was obtained from the respondents who worked for the organisations selected. Five different organisations were initially targeted because they displayed higher interest in the study and were accessible. The organisations included FMCG, Manufacturing and Construction, Retail, Banking and Services companies. These industries were selected because data was required from different sectors, in order to draw a comparison in the innovative nature and the employee retention, in each sector. However, two of the companies (Retail and Banking) declined participation and were subsequently not included in the study. Emails were used to distribute the questionnaire for ease of collection and anonymity. 500 questionnaires were administered. However, only 87 responses from three sectors (FMCG, Manufacturing and Construction, and Services) were received, despite numerous reminders to submit. The response rate from the three sectors is presented in Table 1. The 87 complete questionnaires were used in the analysis. Empirical data were analysed using the Statistical Package for Social Sciences (SPSS). Descriptive and inferential statistics were the outputs from the analysis. These outputs are presented as charts and tables in the findings section.

**Table 1:** Response rate from the sampled sectors

<b>Organisation</b>	<b>Distributed</b>	<b>Received</b>
FMCG	287	52
Manufacturing and Construction	150	9
Services	63	26
Total	500	87

#### **4. FINDINGS AND DISCUSSION**

##### **4.1 Demographic characteristics**

Out of a total of 87 respondents, 64.4% were male and 35.6% were female. 55.3% of the respondents had been with their relevant organisations for less than five years, and the remainder of the respondents had tenure of between five and forty years.

## 4.2 Relationship between innovative culture and employee satisfaction

### 4.2.1 Findings on innovative culture

Respondents were asked to rate the extent to which these were evident insofar as how innovative the organization was. Table 2 presents the findings on how respondents rated their organisations in terms of being innovative. It was found that all the organisations exhibited characteristics of an innovative organisation. Results showed more positive responses to the sixteen questions in this section as 55.6% agreed or strongly agreed to most of the questions. 26% of the respondents answered 'Neutral'. Equally, the recorded response mode on most questions was determined to be 4. The standard deviation values were determined to be less than 1.0, indicating that the answers were mostly concentrated around the mean. Therefore, most respondents had similar views.

**Table 2:** Findings on innovative culture

S/No	Element of innovative culture	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean Score	Mode	Std. Deviation
1	Employees in the organisation are an important source of information	0	2.3	4.6	40.2	52.9	4.44	5	.694
2	I am encouraged to ask questions when trying to perform a certain task	0	2.3	14.9	59.8	23	4.03	4	.690
3	I have control over my time management and how I carry out my functions at work	1.1	9.2	11.5	55.2	23	3.90	4	.903
4	The people in my department offer alternative solutions to problems/tasks	0	6.9	19.5	51.7	21.8	3.89	4	.827
5	I am allowed the opportunity to make decisions regarding specific tasks	4.6	11.5	10.3	59.8	13.8	3.67	4	1.008
6	I have an opportunity to be creative when solving problems in my current role	2.3	10.3	21.8	42.5	23	3.74	4	1.005
7	Management encourages me when I have problems carrying out certain tasks	4.6	6.9	19.5	63.2	5.7	3.59	4	.883
8	Innovative proposals are welcome in the	2.3	12.6	26.4	47.1	11.5	3.53	4	.938

	organisation								
9	We continuously improve old products and raise the quality of new products	1.1	12.6	35.6	36.8	11.5	3.46	4	.907
10	Management and staff are tolerant to new ideas and differing views	1.1	14.9	31	48.3	4.6	3.40	4	.842
11	In comparison to competitors, our company has introduced more innovative products over the last five years	5.7	10.3	39.1	26.4	16.1	3.38	3	1.069
12	The organisation is a safe environment for ideas and employees are not penalised for new ideas that do not work	3.4	14.9	33.3	40.2	8	3.34	4	.950
13	Management actively seeks innovative ideas	5.7	16.1	37.9	31	9.2	3.22	3	1.016
14	We take delight in being spontaneous and are not afraid to laugh at our mistakes	5.7	20.7	31	34.5	8	3.18	4	1.040
15	I am rewarded when I am successful	5.7	19.5	39.1	27.6	8	3.13	3	1.009
16	Our company is often first to market with new products and services	9.2	17.2	40.2	19.5	13.8	3.11	3	1.135

#### **4.2.2 Findings on employee satisfaction**

Findings from respondents regarding employee satisfaction indicated that most of them were fairly satisfied with the organisation. The mean values varied between 2 and 4; and modals scores were mostly 4 for all the questions. However, two questions dealing with time and stress were rated below the median value of 3. The respondents mostly disagreed to the statements "I have enough time to pursue new ideas" and "In a typical week, I rarely feel stressed out about my work" (Table 3).

The finding that "I have enough time available to pursue new ideas" scored the lowest is an indication that most employees, from all three industry groups, felt that there was insufficient time to pursue new ideas. This is relevant, because time is essential for an innovative organisation. Employees cannot innovate if there is insufficient time to do so.

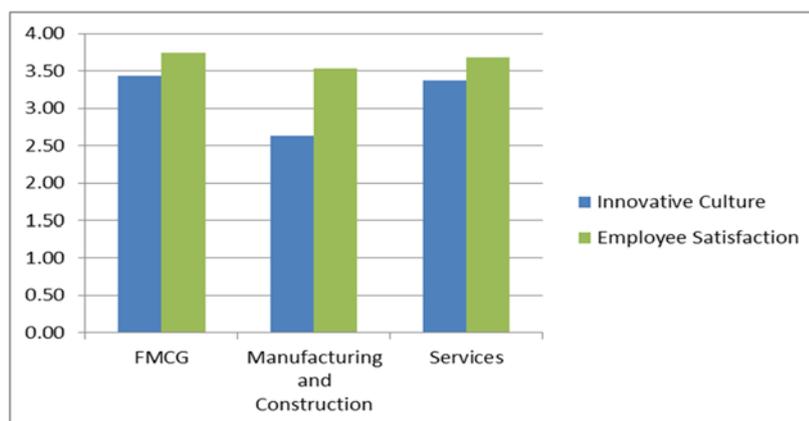
**Table 3:** Findings on employee satisfaction

	Elements of employee satisfaction	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean Score	Mode	Std. Deviation	Skewness
1	I am proud of my employer's brand	0	2.3	8	42.5	46	4.34	5	.729	-.995
2	I like my employer	0	2.3	14.9	58.6	23	4.03	4	.694	-.479
3	If I may choose again, I would choose to work for my current employer	1.1	4.6	23	51.7	18.4	3.83	4	.829	-.677
4	Tasks assigned to me help me grow professionally	1.1	9.2	19.5	51.7	18.4	3.77	4	.898	-.707
5	My work is meaningful and valued by the organisation	1.1	4.6	24.1	56.3	12.6	3.76	4	.781	-.752
6	My opinions about work are valued by my co-workers and manager	0	5.7	26.4	59.8	8	3.70	4	.701	-.547
7	I get enough supervision when I need it	2.3	9.2	18.4	59.8	10.3	3.67	4	.872	-1.015
8	I rarely have to carry out rework on a task due to it being completed incorrectly	1.1	12.6	12.6	64.4	8	3.66	4	.849	-1.060
9	I would advise other people to join this organisation	1.1	9.2	31	39.1	18.4	3.65	4	.930	-.320
10	My Supervisor's expectations are realistic	3.4	9.2	18.4	59.8	9.2	3.62	4	.905	-1.092
11	I look forward to coming to work each day	2.3	5.7	34.5	47.1	10.3	3.57	4	.844	-.597
12	I have time to think through a task before deciding on the path to follow	2.3	12.6	20.7	51.7	10.3	3.56	4	.932	-.736
13	Work methods are interesting and exciting	1.1	13.8	33.3	43.7	6.9	3.42	4	.860	-.366
14	My ideas are valued and I feel encouraged to express myself	1.1	9.2	42.5	41.4	4.6	3.40	3	.771	-.349
15	I enjoy putting in extra hours at work	1.1	13.8	33.3	47.1	3.4	3.38	4	.814	-.552

16	Employees are encouraged to perform well and morale is high	6.9	20.7	19.5	43.7	8	3.26	4	1.097	-.474
17	The people around me are positive about the organisation and where the organisation is heading	8	23	25.3	37.9	4.6	3.08	4	1.065	-.345
18	In a typical week, I rarely feel stressed out about my work	6.9	26.4	31	31	3.4	2.98	3	1.006	-.166
19	I have enough time available to pursue new ideas	4.6	36.8	32.2	24.1	1.1	2.80	2	.905	.113

#### 4.2.3 Findings on relationship between innovative culture and employee satisfaction

Figure 1 is a graphical representation of the relationship between innovative culture and employee satisfaction. As seen from the figure, there is a strong relationship between the two factors. In cases where the innovative culture was high (the FMCG and Services industries), the employee satisfaction was also high, except in the manufacturing and construction industry, where a low innovative culture did not result in a low employee satisfaction. The finding that the satisfaction of employees in the manufacturing and construction industry was not related to the innovative culture could be that organisations that lack innovation can still have satisfied employees because of other factors such as leadership, for instance (Azanza et al., 2013).



**Figure 1:** Relationship between innovativeness and employee satisfaction

### 4.3 Relationship between innovative culture and employee retention

The last section in the survey dealt with Employee Retention. Given the expected level of satisfaction based on innovativeness, it was expected that there should be a small percentage of employee turnover in each of the investigated industries. However, this was not the case. As can be seen from Table 3, it appears that many employees are leaving the organisations they work for. In this section, the mean varied between 2.04 and 3.6, indicating that answers varied between Disagree, Neutral and Agree. The skewness was positive for most questions. Therefore, the distribution was skewed to the right, indicating that responses were mostly negative. The standard deviation was also determined to be small between 0.9 and 1.1, indicating a minimal variability.

Therefore, it can be deemed that innovativeness in an organization does not necessarily lead to expected level of employee retention. This result could mean that innovativeness in an organization does not influence the level of retention or turnover or they could be inversely related (Kesen, 2016). It could also mean that employees could leave a job because of factors besides the level of satisfaction from the job or work environment such as leadership style of overall culture (not necessarily innovative in nature) (Azanza et al., 2013).

**Table 4:** Findings on employee retention

		Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean Score	Mode	Std. Deviation	Skewness
1	I plan to remain in the organisation for at least three years	8	6.9	26.4	32.2	25.3	3.60	4	1.181	-.673

2	More than half the employees have been with the organisation for more than 10 years	1.1	14.9	40.2	28.7	12.6	3.38	3	.938	.058
3	Workers tend to leave the organisation less often than expected	5.7	31	32.2	23	6.9	2.94	3	1.033	.184
4	As far as I know, my colleagues are not seeking employment elsewhere	11.5	32.2	18.4	29.9	5.7	2.86	2	1.156	.046
5	I rarely see new faces in the organisation	6.9	47.1	24.1	17.2	3.4	2.63	2	.971	.577

## 5. CONCLUSION

The study sought to establish relationships which exist among innovative culture of an organisation, employee satisfaction and retention in the organisation. The study objective has been met. It was found that innovative culture had a direct effect on employee satisfaction. The organisations with higher innovative culture had a higher employee satisfaction. Therefore, organisations should strive to increase the innovative culture. This will in turn increase satisfaction of the employees with regard to their work environment.

The outcome of the survey however, did not reveal a relationship between innovative culture and employee retention. The sampled organisations had a high level of employee turnover, despite the employees from all organisations being satisfied and two of the three organisations being innovative. It was concluded then that there may be other factors contributing to employee turnover in the sampled companies. Further studies could therefore explore other factors in the sampled companies or related establishments.

The limitations of the study are worth mentioning. Firstly, the small sample size used may limit generalisation of the results. In addition, the generalisation of the findings may be limited since respondents were drawn from three industrial sectors in South Africa. Future studies could engage a larger sample to determine if a different result could be obtained. Furthermore, the study did not employ sophisticated statistical techniques to establish the relations. Further studies could use correlation and/or multiple regression analysis to determine the relationships among the factors considered.

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## **The relevance of scope of work in corporate office projects – case studies**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The mission of this paper, as part of first author's master research, is to identify and analyze gaps during corporate project process.

#### **Design/methodology/approach**

The used methodology used is case studies through interview and then the comparison of interviewed cases processes, highlighting gaps on them. The cases chosen for this research were clients from a large Brazilian architecture firm, who recently contracted them for an office refurbishment, and they also must be large multinational companies since it is expected that they have project management culture implemented.

#### **Findings**

Findings of this paper include common development points for must-have-information in scope of work, such as the definition in scope of work of all project team responsibilities, avoiding rework along process.

#### **Research limitations/implications**

This study had limited access to all case's projects information, especially financial information, since it's considered confidential data.

**Practical implications**

The findings of this paper make project planning and client-architect relationship issues clearer and is a first step for scope of work improvement.

**What is original/ value of paper?**

This research identifies project planning and architect-client relationship issues for corporate office design projects.

**Keywords:** *Scope of work. Corporate office project. Design process evaluation. Project deliverable. Infrastructure design.*

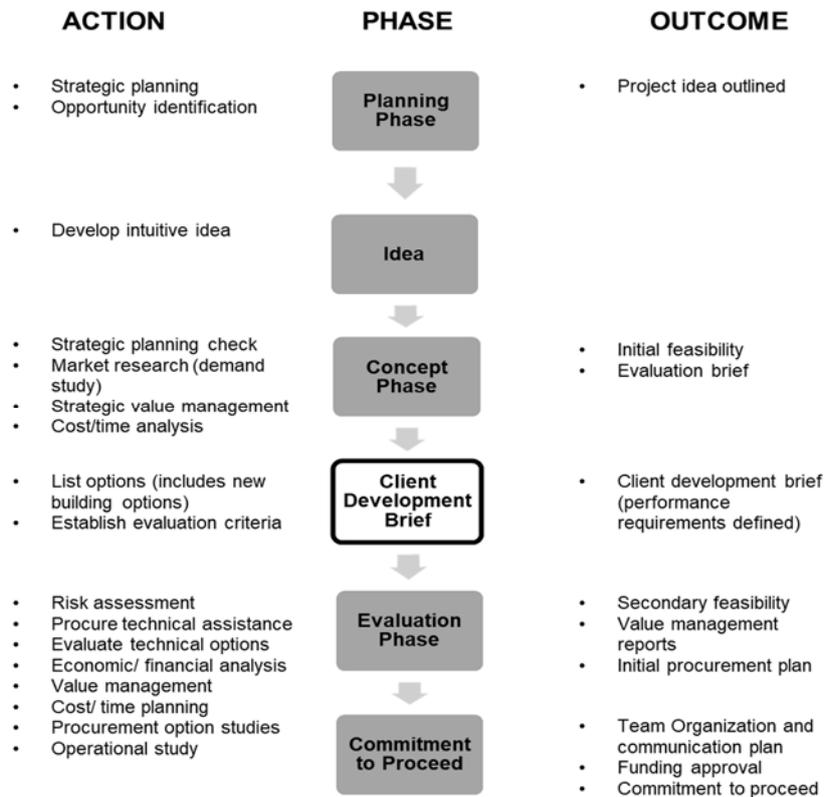
**1. INTRODUCTION**

Project process corresponds to four phases: planning/ project definition (or pre-design), design, construction and closing. A Project's life-cycle scope of work and client's needs program activities must be clearly defined by the beginning of the process (preferably before project conception phase).

"In the definition stage, the appropriate team member(s) determines what it may take to meet the client requirements and develops a plan for that purpose" (Mesa, Molenaar and Alarcon, 2016).

When project process plan isn't conducted efficiently, it may affect directly the design development:

"Through our case studies it was observed that an equally serious discontinuity inhibits the attainment of the best solution and performance for a proposed project. A number of authors have indicated that there is a gap between the pre-design activities and the design stages. This research confirms that such a gap exists in a tangible form" (Smith and Love, 2012).



**Figure 01** Building project life cycle: project initiation phases and stages. Reproduced here with permission of the Australian Institute of Project Management (AIPM, 1995. In. Finch, 2012)

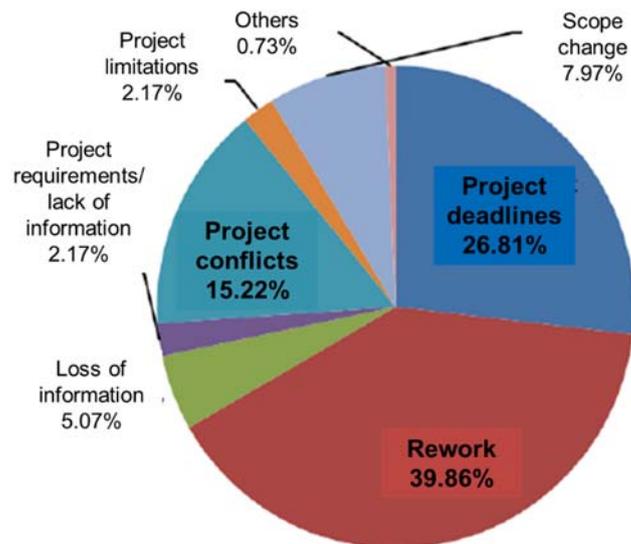
Closure between strategic project decision and the following design stages require management, in order to communicate stakeholder's criteria and decisions to the design team. The development brief, highlighted in light color in Figure 01, must identify project objectives, scope of work (SOW), standard of quality and services expected, time frame and target cost.

The SOW document must translate in a clear and objective way the client strategy (internal/ external problems that need solution; market expansion; technology innovation; product innovation; new company policies and strategies; etc.):

"This strategic brief, with an emphasis on the required performance of the project, needs to use a format, style and language all stakeholders and other groups can understand and use as a base for the development of the project" (Smith and Love, 2012).

When well conducted, clear definition of client's needs and project objectives compose scope of work and prevent gaps from the process,

such as delays, additional costs and client dissatisfaction, affecting project performance. However, in Brazilian reality, architects find difficulties during project process, as shown in the next Figure 02: a survey with nine architecture firms in Brazil show that 39.86% of them need to rework design and 26.81% struggle to accomplish project's deadlines.



**Figure 02** Graphic of Brazilian architecture firm's difficulties during project process (Leite and Barros Neto, 2014)

When stakeholders/ clients are not involved since the beginning in SOW development, there are bigger chances that scope change during design or execution phase, causing unforeseen costs and schedule delays.

Literature review and case interview methodologies were applied for this paper, in order to gather qualitative information over cases project processes. This study limitation regard the confidentiality of some project process information and the unfamiliarity of the interviewee with literature project processes.

## 2. SCOPE OF WORK – CLIENT BRIEF

Stakeholders' vision and strategic politics reflect on workspace, by changing technologies, facilities replacement and even change of the company strategy in market.

"The planning of all workspace should be a response to specific business needs. A key role of the facilities manager is the interpretation of business

data into a set of requirements for workspace and its infrastructure” (Then and Chau, 2012).

The facility manager, then, should gather business data and interpret it to provide workspace solutions to attend company’s needs. This interpretation must differentiate needs from wishes in order to achieve client’s long-term engineering solution and must be written down in a formal and objective document, accessible by all professionals involved in the project. The client’s demand is the main content of such document, SOW, which consists on determine the project’s objective to all professionals involved in the process, mainly the contracted architectural firm (Then and Chau, 2012).

The information gathered in the Table 01 is an input for the SOW and, therefore, the contracted architectural firm must follow it as project criteria for design development. It is one of the main documents that must be produced in the pre-design phase.

**Table 01** Information requirements for assessing demand (Then and Chau, 2012).

People	Workspace	Services
<ul style="list-style-type: none"> <li>• Types and numbers of people using the building and its facilities including other parties who are visitors for short and long duration.</li> <li>• Number of people to be engaged in each of the work processes of the business.</li> <li>• Anticipated occupancy of the premises in terms of number of people, timing and duration.</li> </ul>	<ul style="list-style-type: none"> <li>• Types and numbers of people using the building and its facilities including: <ul style="list-style-type: none"> <li>○ Types of workspace requires and its attributes;</li> <li>○ Types of workspace settings required, e.g. individual and collaborative workplaces, meetings, social, open and enclosed.</li> </ul> </li> <li>• Internal locations of workplace – aggregated or dispersed.</li> <li>• External locations of workplaces – CBD premises, satellite premises, customers and supplier premises, transit locations and staff homes.</li> <li>• Durations for which the various workspaces are required and by which workgroup.</li> <li>• Process operating environment and conditions, e.g. segregation, co-location.</li> </ul>	<ul style="list-style-type: none"> <li>• IT infrastructure: required to support the business, e.g. IT and communication systems, LANs and WANs, telephones, etc.</li> <li>• Support services: required for each work group and the business as a whole, such as security, reprographic, catering, cleaning, etc.</li> <li>• Operating hours: the hours of operation of the business and its constituent parts.</li> <li>• Equipment and machinery.</li> <li>• Information: types of information required to support business processes and its anticipated pattern of use.</li> <li>• Storage: e.g. document, records, raw materials, finished goods and consumables, in support of work processes and their anticipated pattern of use.</li> </ul>

Success in achieving quality satisfaction during project process depends on how understandable the SOW document is to client, designer and

construction vendor. Mesa, Molenaar and Alarcon (2016) analyze that “communication”, followed by “alignment of interest and objectives” and “team working” are the most sensitive variables to project process achieve such success. RIBA (2013) suggests the development of risk assessment plan, design responsibility matrix, agreement of schedule of services, project, technology and communication plans as key support tasks for defining client`s brief.

Souza (2016) classify client requirement in four categories:

- i. Expected: attendance of project characteristics expected by the client without much questioning. E.g. local legislation attendance.
- ii. Explicit: personal characteristics input by the client and clearly communicated. E.g. spatial requirements.
- iii. Implicit: personal characteristics input by the client but not clearly communicated. E.g. acoustic comfort.
- iv. Unexpected: undervalued characteristics gain value after be available to client use.

Client requirements arrange project scope when the project manager take them as project`s objectives. Stakeholders involved, together with the project manager, need to think over questions to clarify project`s objective present in SOW document. Meel, Martins and Ree (2013) point nine objectives, usually associated to corporate projects:

- i. Enhance productivity.
- ii. Cost reduction.
- iii. Flexible work environment.
- iv. Integration encouragement.
- v. Organization culture change.
- vi. Incite creativity.
- vii. Talent retention.
- viii. Branding.
- ix. Sustainability and environmental impact reduction.

Though these objectives are general and may allow several different interpretations, they would help guide the project to a more detailed scope. In addition, the authors observe as crucial decisions to be made at strategic level of the project:

- i. Location?
- ii. Fixed or shared workstations?
- iii. Open or enclosed office?
- iv. Office aspect: neutral or vibrant colors?
- v. Storage: digital environment or paper reports storage?
- vi. Layout standardization or customization?

Finally, yet importantly, the authors indicate another level of detail that should be considered in the pre-design phase, along with the previous presented, that will help the project implementation:

- i. Current and future situation analysis, considering strategy, organizational structure, culture, and workflow.
- ii. Employee communication plan.
- iii. Employee engagement plan.
- iv. Project team integration.

RIBA (2013) considers as objectives to Initial Project Brief:

- i. Project's spatial requirements.
- ii. Desired project outcomes, which may be derived following feedback from earlier and similar projects.
- iii. The site or context, by undertaking site appraisals and collating site information, including building surveys.
- iv. The budget.

Summarizing, the SOW must contain the minimum information:

- i. Location: If the office will keep the same site, or will change location – decision to build or refurbish.
- ii. Site population: how many people use the facility (employee, vendors, contractors, partners, clients, etc.). Must include estimate future growth.
- iii. Data of kinds of workspace each person in site use in their daily routine/ spatial requirements. Defines number of meeting rooms, collaborative areas, workstations, closed-offices, conference rooms, printer rooms, storage rooms, etc. Also, the working culture may influence his data: fixed or shared workstation and concept of open or closed office.
- iv. Branding: use of colors and/ or images that illustrates company's core.
- v. Implementation of new technologies: wireless internet, smart televisions in meeting rooms, etc.
- vi. Estimate project schedule.
- vii. Target cost/ budget.
- viii. Communication and engagement plan to all site's population.

### 3. CASE STUDIES

For this paper, interviewing is the research method adopted and applied, in order to gather qualitative data to compare and evaluate project processes adopted for corporate office design projects. Questions about recent corporate projects (concluded in 2017) were driven with key professionals, who intensively participated in the project. To obtain qualitative information, only one architecture firm and two of its clients were chosen to be studied in this research. The architecture firm need to be market-consolidated and had to have a corporate layout/ office architecture portfolio. The clients

need to be multinational companies (in Brazil, project management culture isn't common to most medium and small companies) and they had to have contracted a corporate architecture design in the last 5 year-time.

A 24-year-old architecture firm was chosen for this paper study. Their project portfolio is mostly composed by corporate projects and had large companies as clients. In addition, two of their clients were also interviewed, named Client 1 and Client 2, both located in Sao Paulo, Brazil, were interviewed to gather information about the way they manage pre-design and develop scope of work. The Architecture Firm (AF) was chosen following a profile of 20 years acting on corporate project market. Clients 1 and 2 were chosen following a profile of being large multinationals and because they ordered a corporate project in less than 5-year-time from the current year.

AF's organization consists in commercial team, pre-design team, design team and civil works team. The pre-design team is composed by 4 architects (1 senior and 3 juniors). The professional interviewed was the senior architect. When AF receive a demand of a corporate design service, the pre-design team, together with the commercial team, draw scope of work and contract terms up based on client's documentation and necessities. However, according to the interviewed, most of documentation received is just building drawings, sometimes not as built. Documents or records of client's culture or any formal letter of their objective and needs that occasioned the design demand aren't handed to the architect, who end up researching for information in the internet. Contract and scope of work vary depending on the complexity of the design requested, but there are some proposed standards:

- The pre-design team output will be a test-fit study, considering:
  - Square meters calculations.
  - Building architecture analysis.
  - Online surveys sent to managers (in order to gather all needs from different business of the client company).
  - Scenarios proposals.
- Determined up to 3 pre-design reviews.
- Use of BIM for designing (client usually receive .pdf format files only).

Client 1 is a 10.000+ employee American multinational which headquarters is located at Alphaville, Barueri. Client's 1 project team was composed by 9 professionals, one of them, the project manager, was a civil engineer. The project objective was the cafeteria renewal, replacing finishing and furniture, fitting HVAC ducts and electric infrastructure. The project objective and scope was discussed in formal meetings and through an RFP (Request For Proposal), developed by the client's project sponsors and

project manager. The following information were given to Contractor to develop contract:

- Cafeteria architecture, electric and HVAC drawings (none was as built of current state).
- Client Safety, Health and Environment politics and standards.

In client 01's project process was pointed out the following gaps:

- Need of longer period for planning (pre-design phase) before starting civil work execution phase.
- Fix scope of work: there were too many revisions and changes along design phase, affecting civil work schedule.
- Schedule was too tight to accomplish.
- There wasn't design suit between disciplines (architecture, electric, HVAC, etc.) projected in contract.
- Project team responsibilities were superposed and some activities were done twice while others weren't done.
- Professional fluctuation due to lack of engagement.

Client 02 is a 20-year-old Technology multinational which headquarters is now located at Osasco, São Paulo. Client's 2 interviewed professional was the Facilities supervisor, graduated in Business Administration. Their project objective was to move from their previous location (Alphaville, Barueri) to a more accessible one, specially by public transportation. The building program consisted on transparency and bringing people together. Also, sustainability must be considered. It was a R\$105MM (around USD33MM) capital project, 17.000 square meter building refurbishment, planned, designed and executed in total of 1,5-year-schedule. The following information were given to Contractor to develop contract:

- Location: a shed located in Osasco, close to a highway.
- Use of natural resources and technology to achieve sustainability.
- Program: building capacity for 2.000 employee; 200 people auditorium; 140 meeting rooms; 11 workshop rooms; cafeteria; gym; games room; bus stop.

In client 02's project process was pointed out the following gaps:

- Scope of work changes caused delay on design and civil works schedule and project's additional costs.
- Not all scope of work was concluded in project's schedule: some activities were postponed for later execution.
- There was no determined client's project manager during the process: both interviewed and site manager gave inputs to Contractor.
- Administrative and business professionals assumed project team responsibilities during some stages of the project.

**Table 02** SOW information requirement attendance by case studies (developed by the authors, 2018)

<b>SOW Information Requirements</b>	<b>Client 01</b>	<b>Client 02</b>
Location: decision to build or refurbish.	Refurbishment of old facilities.	Changed location to a new facility.
Site population: how many people use the facility, including future estimate growth.	Kept the same site population number.	Kept the same site population number.
Data of kinds of workspace each person in site use in their daily routine/spatial requirements.	Fully provided to design team during project meetings, but not to the execution team.	Provided to design team but changed during the execution works without the participation of design team.
Branding: use of colors and/ or images that illustrates company's core.	Rebrand occurred to make the space more modern and attractive.	Rebrand occurred to make the space more modern and sustainable.
Implementation of new technologies: wireless internet, smart televisions in meeting rooms, etc.	Not applicable.	Sustainable technologies were implemented, such as rainwater reuse.
Estimate project schedule.	2,5 months.	12 months.
Target cost/ budget.	Not provided information to AF.	USD 33MM.
Communication and engagement plan to all site's population.	Planned and executed by Client 01 team, with AF participation of the process.	Planned and executed by Client 02 team, with AF participation of the process.

Comparing both client's processes, it is visible that a subjective and not fully detailed scope of work caused reworks, professional work hour wastes, delays and unforeseen additional costs. In both cases, lack of definition of team members' responsibilities caused activities executed in duplicity (or were not executed), delivered with no good quality and demanding rework. Those poor design outputs that were not reviewed before design phase affected construction phase, causing delays and extra hour work.

Secondly, changing scope during design and execution phases caused additional costs and schedule delays to project process, affecting its success. Poor translation of client needs and expectations into project objectives may cause requirements to change along project course, leaving gaps in the whole process.

Analyzing Table 02, it is visible that none of them provided all information to AF, what impacted quality of the project's deliverables: Client 01 didn't get spatial requirements to be successfully understood by execution team and that, along with the tight schedule, brought additional and unplanned costs to the project. Client 02 had more time to develop and implement project but, since the SOW changed during execution activities, it impacted the project deliverables, causing some spatial requirements to be postponed to not impact project schedule.

#### **4. CONCLUSION**

Pre-design and planning phases have relevant role in project success, considering its main goal as accomplishing project objective, client's needs, schedule and costs compliance. If the client does not have much information about the building or the project or if responsibilities are not clearly distinguished between professionals, gaps between pre-design and design phase reflect on execution phase, enhance unforeseen additional costs e schedule delays. Also, not involving all participants since the beginning of the process, may cause loss of quality of the information along the process, especially in the execution phase.

The paper research shows that it is important to provide clear information to project manager and design team in order to avoid gaps and unsuccessful accomplishments, like schedule delays, additional costs and client dissatisfaction with final project quality. Mostly, it is critical that the Client in involved and participative from the beginning of the process, contributing to the development of project deliverables. The impact of it can be seen in Client 01's process by the confusion of tasks and responsibilities of all engaged and the fluctuation of team members, causing loss of interaction between them.

Both client and architect must work together since the beginning of the process to clear and quality information to the SOW, dividing responsibilities. Lack of information, or lack of quality information, may result in to accomplishment of project objectives and client's brief. It was assumed that this study has no significant ethical implication.

Future researches should consider practical application of a structured scope of work in the pre-design phase, check and analyze the savings it may provide to project process.

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## Threats to quantity surveying firms in South Africa: A Pilot Study

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### ABSTRACT AND KEYWORDS

#### Purpose of this paper

The purpose of this study is to analyse quantity surveying firms using a SWOT analysis to identify threats that the firm can overcome to achieve sustained growth and remain relevant.

#### Design/methodology/approach

This was a quantitative study. A questionnaire was randomly distributed to 30 quantity surveying firms in the Durban region.

#### Findings

The top three threats facing quantity surveying firms are fee cutting, lack of suitable and experienced quantity surveyors and competition among quantity surveying firms.

#### Research limitations/implications

This pilot study was limited to the Durban area. A study encompassing other geographical areas is currently being undertaken.

#### Practical implications

The findings ranked the threats that are currently hindering the performance of quantity surveying firms.

#### What is original/value of paper?

This study assists quantity surveyors with implementing the changes required to survive and remain relevant in the industry. Firms can try to overcome the identified threats in order to achieve sustained growth.

#### Response to the Conference Theme

Construction Industry Transformation and Development

**Keywords:** Quantity Surveying firms, Sustained growth, SWOT analysis, Threats

## 1. INTRODUCTION

In response to the ever-increasing changes in the global business environment, professions must evolve. Quantity surveyors are not invulnerable to these changes and therefore an array of challenges threatens the existence of the profession. Quantity surveying firms require urgent and far-reaching strategic transformation that will overcome their threats of the profession to ensure they survive and remain relevant in the ever-changing construction industry. This study identifies and quantifies threats to quantity surveying firms that can assist firms to achieve sustained growth by overcoming these threats.

## 2. QUANTITY SURVEYORS

Worldwide, South African quantity surveyors are recognised among the leaders in their profession representing the country on international bodies and serving as presidents of global organisations (Venter, 2009). Quantity surveyors measure and estimate the cost of resources for construction projects and therefore are the construction cost professionals. The main aim of a quantity surveyor is to keep the project on budget. The title 'quantity surveyor' was given due to the fact that they prepare a 'schedule of quantities' which is an estimate of the material and labour costs. There are many names that people employed with a quantity surveying qualification are known by such as cost engineer, cost planner or project coordinator (NZIQS, 2017).

The quantity surveyor is a member of the team of professional advisors in the construction industry but can also be found in the property development, government and finance spheres of the economy. As advisors, they estimate and monitor costs of a construction project from the feasibility stage through to the completion of the project. After construction they get involved with the final account and tax depreciation schedules and if necessary, adjudication, mediation and arbitration. Quantity surveyors work closely with engineers, architects and the rest of the members of the construction team on where construction work is carried out such as office blocks, schools, hospitals, factories, railways, shopping centres and so on (AIQS, 2017; Association of South African Quantity Surveyors, 2017).

It is important to know the strengths, weaknesses, opportunities and threats of a quantity surveying firm in order to ensure they take advantage of their strengths and opportunities while ensuring they overcome their weaknesses and threats. It is important to do a SWOT analysis of quantity surveying firms so that firms can actively take advantage of their strengths

and possible opportunities while developing strategies to overcome their weaknesses and threats.

### 3. SWOT ANALYSIS OF QUANTITY SURVEYING FIRMS

SWOT is an acronym for strengths, weaknesses, opportunities and threats. A SWOT analysis framework is therefore used to identify a firm's strengths, weaknesses, opportunities and threats. Strengths and weaknesses are controllable while opportunities and threats are factors that the firm does not have direct control over. Therefore, strengths and weaknesses are considered internal factors while opportunities and threats are considered external factors (Odubiyi and Oke, 2016). Table 1 depicts the SWOT analysis matrix.

Table 1: SWOT Analysis Matrix (Whally, 2010)

	STRENGTHS	WEAKNESSES
OPPORTUNITIES	How do I use these strengths to take advantage of these opportunities?	How do I overcome the weaknesses that prevent me from taking advantage of these opportunities?
THREATS	How do I use my strengths to reduce the impact of these threats?	How do I address the weaknesses that will make these threats a reality?

#### 3.1 Strengths of quantity surveying firms

Quantity surveying firms must plan strategically to cope with the dynamic construction environment. Strategic planning attempts to adjust a firm's strength in the most effective and efficient way relative to that of its competitors (Hassan, Rahmat and Ali, 2007). A strength of quantity surveying firms is a sense of leadership amongst their clients as they have to lead their clients in the right path much like a leader in a team project. A quantity surveyor acts honourably and with integrity as they can never put their own gain above the welfare of their clients. Quantity surveyors possess an innovative and creative approach to problem solving because they are required to ensure the client gets what they expect with the resources accessible (Towey, 2012). As a quantity surveyor, it is extremely important to have good communication skills to not only express your opinion verbally, but on paper as well. Language skills is also important as it is the quantity surveyor who writes clear and accurate reports that relate to complex information simply to a variety of different people (RICS, 2017). Quantity surveyors utilise their negotiation skills to put their point across while facilitating a solution that suits all stakeholders (RICS SBE, 2017). Quantity surveyors are also careful with calculations so as to avoid careless mistakes (Olanipekun, Abiola-Falemu and Aje, 2014). Another strength of quantity surveyors is that they are team players as they work

with not only the client but many other professionals involved on the project as well (Shafie, Khuzzan and Mohyin, 2014).

### **3.2 Weaknesses of quantity surveying firms**

Better jobs and salaries overseas are one the main reasons behind the burgeoning exit rates of quantity surveyors in South Africa. Most of the recently qualified quantity surveyors prefer job-hopping and using job offers and letters of appointment to negotiate better salaries (Venter, 2009). Another weakness is that many quantity surveyors have little work experience while few candidate quantity surveyors become professional quantity surveyors and therefore they do not grow in the career (van der Westhuizen, 2016). It is important that quantity surveyors possess the required competencies in order to succeed (Said, Shafiel and Omran, 2010) and should not cite lack of time, poor documentation and communication breakdowns as the primary causes of poor estimates (Crowley, 2013). The inability of quantity surveying firms to change and re-engineer their services to take advantage of the technological advances could drag the profession down (Smith, 2002). The only way to ensure survival as a quantity surveying firm is to actively educate and train quantity surveyors as the traditional means of working and providing services may soon become redundant (Crowley, 2013). A further weakness to firms of the quantity surveying profession is that it is fairly unknown to the public. Many people in the building industry only have a vague idea of what a quantity surveyor actually is (Venter, 2009).

### **3.3 Opportunities for quantity surveying firms**

Quantity surveyors are now keeping their traditional roles while moving on and adopting new roles (Seah, 2017). Good information technology and numeracy skills coupled with the ability to analyse complicated documents are important facets of being a quantity surveyor (Olanipekun, Abiola-Falemu and Aje, 2014). The quantity surveying profession must evolve with technology to keep up (Seah, 2017). Quantity surveyors can gain a significant amount of time by using Building Information Modelling (BIM) for the quantification and calculation thereby gaining additional time to carry out new and enhanced quantity surveyor's services such as life cycle and carbon costing (Crowley, 2013). Quantity surveyors have the potential to modify the process in which Public-Private Partnership (PPP) projects are being managed for economic growth (Mudi, 2016). Also, facilities management is considered as an opportunity for quantity surveyors as many buildings that have been built now requires maintenance management (Salleh, *et. al.*, 2014).

### **3.4 Threats to quantity surveying firms**

#### **3.4.1 Lack of Knowledge Management**

There are probable complications in the quantity surveying profession that are related to knowledge management such as the reluctance to change the current operating system, the confusion and difficulty to evaluate knowledge management and the reluctance of employees to share their knowledge (Abdul-Rahman, *et. al.*, 2011).

#### **3.4.2 Competition among quantity surveying firms**

The construction industry faces many changes in the workload, work mix and the way in which those changes are managed. Quantity surveying firms are therefore moving closer to clients who are becoming more sophisticated and are now the driving force for improvements in the services offered. This has led to increased competition amongst quantity surveying firms (Hassan, *et. al.*, 2007).

#### **3.4.3 Changes in technology**

New technologies and forms of innovative quantity surveying services such as BIM, the preparation of bills of quantities, estimates and feasibility studies are major threats to the industry as these technologies may one day make the quantity surveyor redundant (Hassan, *et. al.*, 2007).

#### **3.4.4 Changes in clients' demand**

Clients' demands change over time. The quantity surveyor's only duty was to prepare bill of quantities in the beginning. Presently, quantity surveyors are needed to do feasibility and viability studies, facility management, risk management etc. The change in the clients' demands can result in quantity surveyors who are not prepared to embrace changes, fail. Emphasis is now placed on speed, accuracy and value-based services from quantity surveyors as clients are becoming more involved in the building processes (Hassan, *et. al.*, 2007).

#### **3.4.5 Fee Cutting**

Bidding and fee cutting amongst firms is a major threat facing the industry. During the recession, firms became frantic for work and were therefore prepared to reduce their fees to often unmaintainable levels. This was not only in the quantity surveying profession but across the consultancy practices. The hangover from this period remains as clients became used to paying lower fees for services (Smith, 2002).

### **3.4.6 The use of Computer Aided Design (CAD)**

The progress of computer aided design (CAD) to automatically produce quantities is a major threat to firms especially in terms of the technical role of a quantity surveyor. However, it is important to note that the greatest threat is not embracing CAD and CAD measurement. If quantity surveyors evolve with and are integrally involved in the development of CAD it can pose as an opportunity rather than a threat. By clinging to the traditional method of measuring on paper, firms are putting themselves in a disadvantage. Professionals will need CAD capabilities and expertise just to be a participant (Smith, 2002).

### **3.4.7 Other Professions**

There are many other professionals carrying out some of the duties of quantity surveyors such as project cost managers with many other professionals with the potential to do so. The main threats to quantity surveying firms are project management firms as well as large accountancy firms. Some large companies also offer “one-stop shop” approach as well as more “in-house” services that are threats to quantity surveying firms (Smith, 2002).

### **3.4.8 The global financial crisis (GFC)**

The global financial crisis (GFC) has had major effects on the international construction market and on the quantity surveyors operating within it. There are many threats that exist because of the GFC (Frei, 2010).

#### **3.4.8.1 Internationalisation**

Local organisations are divesting themselves from their partners and re-evaluating themselves in international ties. However, quantity surveying firms should rethink internationalisation. As the organisations consider alternative locations, the relative cost differences in the new geographical regions should be considered. Seeking out local partners that are allied to a firm can assist by deflecting competition from multinational firms while the local partner benefits from international knowledge sharing (Frei, 2010).

#### **3.4.8.2 Human Resources**

Quantity surveyors are more susceptible to the effects of the crisis than their professional counterparts. Quantity surveying firms may operate with lower margins or may have higher sensitivity toward the economic forces. The response from firms has been to reduce exposure by downsizing the workforce (Frei, 2010)

### **3.4.8.3 Dispute resolution services**

The rise in insolvency and the tightening of credit led to an increase in disputes amongst contracting parties. Contractors are increasingly looking for more money in the form of recovery payments, claims of variations, latent conditions and delay costs from principal agents with limited cash (Frei, 2010).

### **3.4.9 Shortfalls in the quantity surveying qualifications offered at tertiary institutions**

The number of quantity surveying graduates from South Africa needs to quadruple in number to ensure a sufficient pool to draw from. Tertiary institutions offering quantity surveying are negatively impacted by the current economic conditions. Students who enter such programmes often lack preparedness and university resources in the form of staff and infrastructure. The ability of tertiary institutions to attract young academics, train them and keep them in the long run is almost impossible (Venter, 2009).

## **4. PURPOSE OF THE STUDY**

Identifying and overcoming a firm's threats is extremely critical in ensuring the sustained growth of a firm. This study therefore focuses on the external factors that hinder the performance of a firm. By recognising and classifying the threats that are faced by firms, firms can actively find ways to overcome these factors.

This study therefore identifies and ranks the threats to quantity surveying firms to ensure these firms know the extent of each threat in order to find ways to overcome them. By knowing the potential threats and the impact it can have on a firm, firms can search for ways to defeat them. This will not only ensure that quantity surveying firms survive but it will also ensure they remain relevant and strive for success in this ever-changing construction industry.

## **5. RESEARCH METHOD**

This study adopted a quantitative research approach informed by the positivist paradigm (Creswell, 2014). A sample of 30 quantity surveyors who are members of the Association of South African Quantity Surveyors (ASAQS) were purposively selected in the Durban region for this study. The data was collected through questionnaires and analysed using SPSS version 25 using descriptive statistics. A 5-point Likert scale was used for the questionnaire. Questionnaires were used because the problem

statement can be stated in a clearly defined and precise manner, both the dependent and independent variables can be specified clearly and precisely, there are high levels of reliability gathered by the data and the subjectivity of judgement is eliminated or minimised.

## 6. ANALYSIS

Cronbach's alpha for this study was 0.76. This confirmed validity of the study as the acceptable range is between 0.70 and 0.90 (Bonett and Wright, 2014).

### 6.1 Background Information

Seventy percent (n=21) of the participants in the survey were male. Figure 1 below shows that the majority of the participants that took part in this study possess a honours degree.

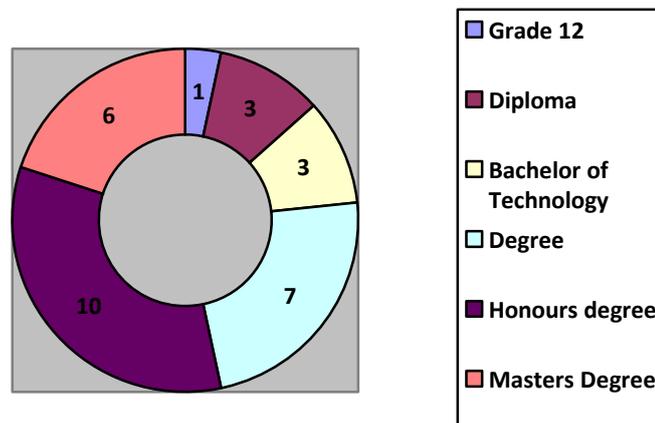


Figure 1: Education qualifications

### 6.2 Threats to quantity surveying firms

Table 2 focuses on the threats to quantity surveying firms. The results show that the respondents believe that 14 threats have a negative impact on quantity surveying firms. However, the use of computer aided design is not so much of a threat to the profession.

Table 2. Threats to quantity surveying firms

Threats to quantity surveying firms		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Lack of knowledge management	No.	0	3	10	14	3	3.57
	%	0.0	10.0	33.3	46.7	10.0	
Competition among quantity surveying firms	No.	1	2	5	11	11	3.97
	%	3.3	6.7	16.7	36.7	36.7	
Changes in technology	No.	0	6	6	16	2	3.47
	%	0.0	20.0	20.0	53.3	6.7	
Changes in Clients' Demand	No.	0	4	4	18	4	3.73
	%	0.0	13.3	13.3	60.0	13.3	
Fee cutting	No.	0	1	4	6	19	4.43
	%	0.0	3.3	13.3	20.0	63.3	
The use of computer aided design (CAD)	No.	1	9	13	6	1	2.90
	%	3.3	30.0	43.3	20.0	3.3	
Other professions performing quantity surveying services	No.	0	1	7	16	6	3.90
	%	0.0	3.3	23.3	53.3	20.0	
The global financial crises (GFC)	No.	0	5	7	12	6	3.63
	%	0.0	16.7	23.3	40.0	20.0	
Shortfalls in the quantity surveying qualifications offered at tertiary institutions	No.	0	4	5	12	9	3.87
	%	0.0	13.3	16.7	40.0	30.0	
Lack of suitably and experienced quantity surveyors	No.	0	3	2	17	8	4.00
	%	0.0	10.0	6.7	56.7	26.7	
The ageing workforce and the under supply of new entrants	No.	2	1	10	13	4	3.53
	%	6.7	3.3	33.3	43.3	13.3	
The profession's "lack of voice" due to relatively small number of practitioners compared to other professional groups.	No.	0	6	7	15	2	3.43
	%	0.0	20.0	23.3	50.0	6.7	
Lack of formal registration and chartered status	No.	1	10	5	11	3	3.17
	%	3.3	33.3	16.7	36.7	10.0	
Lack of marketing of the quantity surveying profession	No.	1	4	7	16	2	3.47
	%	3.3	13.3	23.3	53.3	6.7	
The perception that quantity surveyors are non-critical to project success.	No.	2	4	3	8	13	3.87
	%	6.7	13.3	10.0	26.7	43.3	

Table 3 below ranks the threats from the greatest threat to the smallest threat using the mean item score.

Table 3: Ranking of threats to quantity surveying firms

Threats of quantity surveying firms	Mean	MIS	Rank
Fee cutting	4.43	0.886	1
Lack of suitable and experienced quantity surveyors	4.00	0.800	2
Competition among quantity surveying firms	3.97	0.794	3
Other professions performing quantity surveying services	3.90	0.780	4
Shortfalls in the quantity surveying qualifications offered at tertiary institutions	3.87	0.774	5

The perception that quantity surveyors are non-critical to project success	3.87	0.774	5
Changes in Clients' Demand	3.73	0.746	6
The global financial crises (GFC)	3.63	0.726	7
Lack of knowledge management	3.57	0.714	8
The ageing workforce and the under supply of new entrants	3.53	0.706	9
Lack of marketing of the quantity surveying profession	3.47	0.694	10
Changes in technology	3.47	0.694	10
The profession's "lack of voice" due to relatively small number of practitioners compared to other professional groups.	3.43	0.686	11
Lack of formal registration and chartered status	3.17	0.634	12
The use of computer aided design (CAD)	2.90	0.580	13

From the table above, fee cutting is ranked first being the most serious threat with a mean of 4.43. This confirms the study by Smith (2002) who believes that during the recession in the late 2000's, firms reduced their fees to unsustainable levels as they were in desperate need of work. Several years later and fee cutting seems to still be a major problem.

According to the former president of the ASAQs, Qinisani Mbatha, one of the biggest challenges facing the South African quantity surveying profession is the lack of qualified and experienced quantity surveyors (Moodley, 2012). The participants also feel this way as this threat was ranked second.

According to Hassen, *et. al.* (2007), competition amongst quantity surveying firms has come about due to firms moving closer to clients who are becoming more sophisticated and are now the driving force for improvements in the services offered and according to the participants of the study this is true and very much a threat as it was ranked third.

Ranked fourth is other professions performing quantity surveying services which is considered a serious threat to the industry. The main threats are large companies offering "one-stop shop" and "in-house" services as well as project management firms and large accountancy firms (Smith, 2002).

Shortfalls in the quantity surveying qualifications offered at tertiary institutions and the perception that quantity surveyors are non-critical to project success were both ranked fifth.

The changes in the demands of clients is also a threat to quantity surveying firms. Quantity surveying firms who are not ready to embrace changes are more likely to fail in the profession (Hassan, *et. al.*, 2007). The participants ranked the changes in client's demand sixth.

The global financial crisis (GFC) has had major effects on the international construction market and in the quantity surveyors operating within it (Frei, 2010) and was ranked seventh.

Knowledge management is not a major threat to the industry as it was ranked eighth. Even though it is not a major threat, knowledge management still remains vital for the success of a quantity surveying firm.

The ageing workforce and the under supply of new entrants was ranked ninth. The former president of the ASAQs, Qinisani Mbatha believes that in order for a good supply of new entrants into the profession, applicants

must be screened at universities to ensure high-quality learners are entering the field (Moodley, 2012).

Changes in technology and the lack of marketing of the quantity surveying profession was ranked tenth. The inability of quantity surveying firms to change and re-engineer their services to take advantage of technological advances could drag the profession down (Smith, 2002). The quantity surveying profession is fairly unknown to the public with many people in the building industry only having a vague idea of what a quantity surveyor really is or what a quantity surveyor is responsible for (Venter, 2009).

The profession's "*lack of voice*" due to a relatively small number of practitioners compared to other professional groups was ranked eleventh. It is important for the profession to find ways to encourage and attract the next generation of quantity surveyors as well as other people into the profession (McGaw, 2007).

The lack of formal registration and chartered status was ranked twelfth. For a quantity surveyor, it is extremely important to get to register as a professional quantity surveyor in order to advance in their career (van der Westhuizen, 2016).

Lastly, the participants believe that the use of CAD is a relatively small threat ranking it thirteenth.

## 7. CONCLUSION

A firm needs to recognise and know their strengths, acknowledge their weaknesses and spot their opportunities. The firm should then use their strengths to minimise their threats and improve their weaknesses by taking advantage of potential opportunities. Once a firm works to eliminate their weaknesses, they will be able to avoid threats.

This study highlighted the threats to quantity surveying firms which they need to overcome in order to be successful and remain relevant in the industry. This study thereby aided quantity surveying firms by determining the threats faced by the profession along with the ranking of each. Firms that know what the threats are can actively overcome them to optimise their performance.

By knowing the potential threats of quantity surveying firms, firms can try to bridge the gap and overcome each threat. Firms may have known what the threats to them are but they now have an understanding of the impact of them. This gives firms the opportunity to find ways to actively counteract them. Firms can further do internal audits and have regular meetings to find new ways to not only overcome these threats but possibly turn them into opportunities and hence take advantage of them.

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## **Labour Challenges in the South African Construction Industry: A Dialectic Discourse**

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### **ABSTRACT AND KEYWORDS**

#### **Purpose of this paper**

The paper is a dialectic discourse on the challenges in the South African construction industry. It is written with a view to charting a sustainable course for labour productivity in the industry.

#### **Approach**

A thematic review of the literature is employed to establish the current state of knowledge. Both the requirements and major supply sources of the country's construction industry labour are highlighted. The challenges are identified, synthesized, characterized and classified. They are then exhaustively discussed.

#### **Findings**

The labour challenges in the South African construction industry fall under two broad headings: endogenous challenges or those that are internal to the industry and exogenous challenges or those that are external to the industry. The challenges have social, political and economic implications for the productivity and sustainability of the industry.

#### **Value of paper**

The paper prioritizes the enhanced productivity and sustainability of the South Africa's construction industry by proffering pragmatic policy

recommendations towards the head-on containment of the labour challenges.

**Keywords:** construction industry; construction labour; construction technologies; technical skills; skills acquisition; South Africa

## 1. INTRODUCTION

The construction industry is the barometer by which the health or ill-health of a nation's economy is assessed (Agbola, 1985). It is not surprising, therefore, that the South African construction industry wields significant economic influence. Its importance to the national economy is accentuated in that it is an important employer of labour in the country. Indeed, it is one of the largest employers in the country (Department of Labour, 2003). In 1999, the South African construction industry contributed approximately 35% of the total gross domestic fixed investment and employed 230,000 employees; then, in 2005, it employed up to two-thirds of all craft-related workers (Mukora, 2008) and by 2011, it employed well over a million people (Mayekiso, 2011). According to the Construction Industry Development Board (cidb) (2015), it accounts for around 8% of total formal employment and around 17% of total informal employment. Consequently, it is understandable why KH Plant (2018) remarks that the South Africa's construction industry contributes a large part of GNP, plays a key role in development, contributes substantially to the country's GDP and employs more than 1.4 million people.

Construction is a labour-intensive activity (Agapiou *et al.*, 1995; Odesola and Idoro, 2014), even when mechanised or automated. Thus, construction labour challenges bear directly on the construction industry as labour costs approximately between 25 and 35% of the total project costs; it can even be up to 40% of direct cost in large projects (Kazaz *et al.*, 2008). According to Building Momentum (2018), a significant factor influencing construction costs is the wages of construction labour, including additional expenses such as travel costs, insurance, pensions and other benefits of employment. In addition, the productivity of the labourers directly influences the construction period and costs. This realisation substantiates the need for the investigation of construction labour productivity (Odesola and Idoro, 2014), as its importance in national economies is such that cannot be ignored.

Against the foregoing background, the aim of this paper is to examine the labour challenges in the South African construction industry with a view to identifying practicable measures capable of addressing them towards charting a sustainable course.

## 2. THE TYPOLOGY OF LABOUR AND CONSTRUCTION METHODS IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

Construction labour comprises all persons involved in physical construction work, including skilled and unskilled labour, which form the core labour component for the physical completion of the construction process (cidb, 2007). Going by this definition, it is obvious that the construction industry relies heavily on the skills of its workforce (Agapiou *et al.*, 1995). Two major labour types are obtainable in the South African construction industry: skilled and unskilled labour. Whereas skilled labour requires a high level of formal training and in most cases registration with regulatory bodies, unskilled labour is informal and unclearly defined. According to Shah and Burke (2005), unskilled labour comprises labourers who lack relevant qualifications and various forms of education and learning.

Labour requirements in the South African construction industry are determined by the two predominant construction methods in the country, viz. the in-situ concrete construction method and the hybrid concrete construction method. Whereas in-situ construction takes place on the site of construction, hybrid concrete construction combines precast concrete elements which are used in conjunction with the conventional cast-in-place (in-situ) construction (Elliott, 2002). These two construction methods require labourers with different types of skills and with different levels of labour-intensiveness. Apparently, this is due to the different environments and the *modi operandi* employed by them. The understanding of these techniques is important when looking at their labour requirements.

There are two main sources of training for construction labour supply to the South African construction industry. These are formal sources (universities and technical colleges) and informal sources (e.g. apprentices and internships). The Construction Education and Training Authority (CETA) is one of several Sector Education and Training Authorities (SETAs) that were recertified by the government with various changes in 2011. CETA aims to influence training and skills development throughout the construction industry and ensure that the requirements of the construction sector are met in terms of the way learners are trained and educated. Even though CETA does not directly establish college courses, its influence is considerable (SETA, nd).

According to Makhene and Thwala (2009), quality standards for all apprenticeship programmes registered with the federal government are set by the Office of Apprenticeship Training, Employer and Labour Services (OATELS) which requires that all registered apprenticeship programmes include a minimum of one year of 2,000 work hours of on-the-job training and at least 144 hours of formal instruction. Upon completion, the apprentice receives a certificate. If the apprentice receives a certificate for completing the training, he can also receive a journeyman card from his national union organization with which he can be employed anywhere in the nation in that particular occupation.

### **3. PROFILING THE LABOUR CHALLENGES IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY**

The South African construction industry is beset by various labour challenges. Profiling these challenges would aid our understanding of them. Generally, the labour challenges of the South African construction industry can be classified into endogenous and exogenous challenges. The endogenous challenges are those that are intrinsic or internal to the industry. They are challenges for which workers, contractors and the industry as a whole can, and should, take responsibility. Exogenous challenges, on the other hand, are those that are brought about by forces that are beyond the workers, contractors and the industry. They are conditions, situations and circumstances brought about by forces external to the industry. Thus, while the endogenous challenges come from within the industry, the exogenous ones emanate from out of the industry. Meanwhile, more often than not, these challenges, irrespective of the category, form a continuum. Therefore, it can be challenging to characterise them by categorisation in absolute terms.

#### **3.1 The Endogenous Challenges**

The endogenous challenges in the South African construction industry are many and diverse with some of them overlapping on one another. They include acute shortage of technical skills, aging workforce, low pay, poor image and lowly career paths, diminishing skilled training programme, the cyclical nature of construction, labour brokerage, and high-risk or unsafe work environment. These are now discussed briefly.

##### **3.1.1 Shortage of Technical Skills, Aging Workforce and Low Pay**

A dearth in the required skilled labour in the South African construction industry has been discussed extensively (see, for example, Ademeso *et al.*, 2011; Brier, 2009; cidb, 2007, 2015; Makhene and Thwala, 2009; Mukora, 2008; Windapo, 2016). About 70% of the labour employed in the industry is semi-skilled and unskilled (cidb, 2015) and there exists an extremely high rate of technical skilled labour shortage with 75% of the contractors and owners experiencing this shortage that costs them significant time and money (Makhene and Thwala, 2009). Contractors in the country have difficulty in sourcing skilled workmen (Windapo, 2016). Aging workforce contributes to this (Department of Labour, 2003; Makhene and Thwala, 2009; Mukora, 2008; Windapo, 2016). According to Mukora (2008), while approximately 30% of skilled artisans are leaving the construction industry, a far less percentage is entering. Meanwhile, it is arguable that principal among the factors responsible for the failure of the South African construction industry to attract and retain skilled labourers is the regime of low wages (Makhene and Thwala, 2009; cidb, 2015).

### 3.1.2 Poor Image and Lowly Career Paths

According to Haas *et al.* (1999), the construction industry lacks appeal to young, potentially skilled workers who do not see it as a viable career path. In a survey of high school students, construction work ranked 247 of 250 as an attractive career option (Makhene and Thwala, 2009). Similar results were obtained by Haupt and Harinarain (2016). It is not unlikely that many construction workers are in the trade owing to frustration or the failure to secure a more desirable job. The construction job is perceived as of low social standing and lacking in attractiveness for variety of reasons, including being dirty, dangerous, physically taxing, physically demanding, time-consuming, remote work sites and nomadic lifestyle (cidb, 2007; Makhene and Thwala, 2009). In addition, career artisanship requires people with hands-on experience rather than just supervisory experience. Mukora (2008) aptly puts it that today's youth have no preference for hands-on labour and would rather work with computers.

### 3.1.3 Diminishing Skills Training Programme

There has been a significant decrease in craftsperson skills training by the unions. Makhene and Thwala (2009) argued that the unions have moved their efforts from improving their training programmes and identifying the difference in performance to having owners specify labour agreements where craftspeople used by contractors are union trained. Meanwhile, the tradition was that job training was handled by the trade unions in the construction industry. Windapo (2016) also corroborated this stance by contending that the dwindling supply of skilled tradesmen in the South African construction industry is attributed to the lack of continuing craftsperson skilled training programme. This has gone a long way in adversely affecting the quality and relevance of the training received by artisans in the industry.

### 3.1.4 The Cyclical Nature of Construction

Agapiou *et al.* (1995), Drucker and White (1996), Gruneberg (1997), Hurst *et al.* (2007), Allan *et al.* (2008) and Ademeso *et al.* (2011) have expatiated on this cyclical nature of the construction industry as driven by the demand for its products and services. By several standards, construction is evidently one of the most cyclical industries. Its unemployment rate goes up and down in response to seasonality and a high amount of temporary labour, among other factors. The construction industry is tied to the supply and demand of real estate property which can hit the bottom very quickly. The natural consequences of this characteristic manifest in fluctuations in potential output, employment and training levels (Agapiou *et al.*, 1995; Drucker and White, 1996; Gruneberg, 1997), which have direct consequences on the industry's labour force.

### 3.1.5 Labour Brokerage

Labour brokerage is the arrangement by which an intermediary comes in between the skilled construction workman and the contractor, thereby negotiating the terms for its own profit. Through it a construction company outsources its skilled labour rather than directly employing such. Ordinarily, this works in the interest of the company as its liabilities and obligations towards the skilled workman, are limited. However, it does not augur well for the labourer who has much to lose in terms of job security, retirement benefits, life assurance and other benefits. However, it is difficult to finalise on the effects of labour brokerage on the South African construction industry as there tends to be no glaring consensus in previous research concerning the subject. Whereas Kennelly and Schmitz (2000) favoured a strong demand for brokered labour in the construction industry, cidb (2015) concluded that the use of labour brokers in the South African construction industry was negligible.

### 3.1.6 High-risk or Unsafe Work Environment

Dozzi and Abourizk (1993) argue that the construction industry has a high-risk or unsafe work environment. The safety performance of the industry continues to be a source of concern even in spite of government's efforts to deal with the problem through legislations and regulations (Agumba *et al.*, 2013; Murie, 2007). Although a decline has been recorded in the number of fatal injuries in the recent past, statistics still report very high rates of accidents, injuries and fatalities (Bureau of Labour Statistics, 2013). The industry has the highest rates of fatalities and injuries. It is responsible for up to 30%-40% of all the world's fatal injuries and accounts for one in every six work-related fatal accidents globally (cidb, nd; Murie, 2007).

## 3.2 Exogenous Challenges in the South African Construction Industry

The exogenous challenges in the South African construction industry are those that are external to the industry. They range from macroeconomic and environmental to institutional and socio-political ones. They include unfavourable macroeconomic conditions, low income and poverty, stringent certification and high-quality basic education requirements, government interference and technology, as discussed below.

### 3.2.1 Unfavourable Macroeconomic Conditions

The country's slow economic growth makes for a sluggish construction sector. In 2015, South Africa was hit by serious knocks to the rand in relation to the dollar (KH Plant, 2018). Meanwhile, the struggle of the rand endures still. As of 3rd August 2018, a US dollar exchanged for 13.36 rand. The implication of this is that as the value of the rand decreases, project

costs and the prices of construction materials rise. This adversely affects commodity markets and the construction industry as the demand for construction work goes down. Thus, unfavorable macroeconomic conditions are bad news for the construction industry labour.

### **3.2.2 Low Income and Poverty**

Housing affordability is a real issue with households in South Africa as with other nations. When households cannot afford housing, the effective demand for the products and services of the construction industry dwindles. Meanwhile, statistics have shown a prevalence of low household income in the country. For instance, while the average taxable income for Johannesburg in Gauteng Province was R318,533 in 2013, the average annual household income for the metro was just R29,400. Meanwhile, Gauteng Province houses most of South Africa's wealthy individuals. While the metro accounts for 23% of the country's wealthiest households, the wealthy comprise less than 1% of the total number of households in the metro (Schreuder, 2015). These figures are pointers to the level of households' housing affordability in the country.

### **3.2.3 Stringent Certification and High-Quality Education Requirements**

South Africa puts a premium on formal certification, even in her construction industry. Thus, the certification of tradesmen is compulsory. However, sailing through the process can be a real issue. Indeed, the need for trade certification significantly contributes to the perceived level of skills shortages in the construction industry (Awe, 2004). In some cases, workers have the necessary skills but need a certificate to prove it. Meanwhile, the training that occurs in the informal sector is seldom certifiable because it is not a pre-requisite for obtaining employment in the informal sector. According to Brier (2009), there is a skills crisis in the industry because it takes a very long time to source skilled workers in the event of a surge in the demand for skills resulting from various infrastructure and large-scale projects. Windapo (2016) also found a significant relationship between skilled labour shortages and the requirement that labour be certified.

### **3.2.4 Government Interference**

As an institutional factor, government intervention often constitutes a real challenge to the construction industry in South Africa. Windapo (2016) found that there are procurement targets requirements in government contracts as government often requires a certain percentile of labour to be employed from the project location area. Specifically, Broad-Based Black Economic Empowerment sub-contractors and suppliers must be hired, and a certain amount of money must be put aside for training some of the workers. This affects the amount of skilled labour construction companies

can choose to have, as they have to employ local labour and Broad-Based Black Economic Empowerment sub-contractors. This stifles productivity.

### 3.2.5 Technology

Construction technologies are dynamic as new methods evolve every time. There are three divergent views on the relationship between technology and construction labour. The first argues that when new technologies are employed in the construction industry, they are often labour- and cost-effective (Perfect Hire, 2016). This is especially true of Alternative Building Technologies (ABTs). Thus, improved building technologies can effectively replace even highly skilful construction workmen (Beaver, 2017; Makhene and Thwala, 2009). The second view advances the claim that the construction industry can be made less capital-intensive, with workers replacing machinery. However, this model applies in countries where cheap labour is available. For instance, in Saudi Arabia, importing Indian and Pakistani construction workers is cheaper than acquiring machinery (*The Economist*, 2017). In such a country employment policies more often than not favour labour intensiveness in the construction industry (Windapo and Cattell, 2013). The third school postulates that new technologies complement construction labour (World Trade Report, 2017). For instance, ABTs usually have the ability to effectively utilize low-skilled/semi-skilled labour, and they prove to be more labour-friendly, with easier and more effective management of labourers. Furthermore, it is noted that changes in technological advancements in construction have resulted in changes in the demand for various types of skilled labour and the redefinition of the industry's skill requirements (Clarke and Wall, 1998).

## 4. IMPLICATIONS OF THE SOUTH AFRICAN CONSTRUCTION LABOUR CHALLENGES

Construction labour challenges are not abnormal. However, when they are not timely and properly contained, they degenerate and escalate into high-magnitude, intractable problems that are capable of wreaking a full-scale industrial havoc that could wreck the entire industry. The implications of the construction industry challenges in South Africa are many and diverse. There are social, political and economic dimensions to them. The social, implications appear to be most physically evident and they are so pervasive. For instance, it is easy to quickly perceive the effects of unemployment and/or underemployment in the construction sector, the depopulation of the construction of workforce, low pay and poor social image. All these would be non-negotiable if the challenges in the country's construction industry persist. Meanwhile, the problem goes beyond just that. There is a real issue with the future of the industry, in terms of its sustainability.

There are political implications as well. It is difficult to prove that a government is successful when it fails to meet the housing need of the citizens, especially when it is claimed that housing delivery is principal among the priority areas of such a government. Arguably, some policies, particularly those that have to do with certification and education requirements, if not pragmatically handled, could adversely affect the construction labour lower the productivity of the construction industry.

The economic dimensions of the challenges are obvious. Indeed, every social and political challenge can be explained in economic terms. Employment problems, poor income and the inability to be gainfully employed, among other challenges that obtain in the construction industry, have direct economic ramifications that have the capability of trickling down. The adverse multiplier effect can be very devastating, given the pride of place the construction industry occupies in the South African economy.

## **5. RECOMMENDATIONS AND CONCLUSION**

The South African construction labour challenges cannot be allowed to continue unfettered. Consequently, it is expedient that practical steps are taken towards containing the challenges. First, the political will to save the construction industry should be very evident. When this is seen as a primary objective, others become easy to achieve.

With a view to fixing skilled labour shortages, pragmatic modifications in construction education programmes, training and recruitment are necessary. Specifically, some measure of informality should be encouraged for certain scarce skills to be easily acquired, especially through apprenticeship. This is important because it can be made a reliable framework for evaluating the on-the-job expertise acquired by workers informally. However, for highly technical trades in which details and accuracy are crucial (e.g. plumbing, wiring and fitting), the basic educational system should rather be strengthened to ensure standard, quality and safety. In addition, the government should establish subsidised technical and vocational schools where tradesmen are trained. Secondary education should also be improved with a view to increasing the likelihood that capable individuals will attend further education and training colleges.

Furthermore, there should be an upward review of wages in the industry. This could prove to be an efficacious incentive that could significantly undercut the exodus of skilled hands from the industry. It can also draw young people into the industry and help in capacity building. For instance, highly proficient scarce skills expatriates can be enticed by attractive packages and benefits. This approach is arguably a lot better and cheaper than permanently employing foreign construction labour or outsourcing construction work to foreign sources all the time. A time-bound plan should be evolved for this. So far, it is proving efficacious in the

education sector where postdoctoral research fellows are maximally engaged in research activities and outputs.

Moreover, being practically unavoidable, labour brokerage should be regulated to protect the interest of construction workers. They should not feel used or unfairly treated. Then, efforts should be made to ensure compliance with established safety standards and practices on hazard-prone construction sites. Also, the government should be less overbearing in the area of confining construction companies to particular labour pools.

While there is a limit to what the government can do on the cyclical nature of construction, technology and industrial action, much can be done to address unfavourable macroeconomic conditions and poverty. Improved macroeconomic conditions, increased income and other forms of intervention can help in cushioning the effect of these in some ways.

In addition, comprehensive empirical studies into all the identified construction labour challenges herein and elsewhere should be conducted. New empirical studies will unearth several other issues. Besides, the exact dimensions to the problems could be determined more accurately. Thus, it would be easier to apply practicable mitigating measures. A conscientious consideration of these recommendations can go a long way in fixing most of the challenges that beset labour in the country's construction industry.

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