Association of Schools of Construction of Southern Africa

The Seventh Built Environment Conference
Cape Town, South Africa
28 - 30 July 2013

www.asocsa.org
PREFACE

The Seventh Built Environment conference provided in the aftermath of a global economic downturn an international forum for researchers and practitioners from developed, developing and underdeveloped nations to address fundamental problems and constraints that affect the Built Environment. The broad objectives of the conference were:

- To provide a forum for multi-disciplinary interaction between academic and practitioners;
- To provide an internationally recognized, accredited conference for the built environment;
- To disseminate innovative and cutting edge practices; and
- To contribute to the built environment body of knowledge (BEBOK).

The organizers brought together in a single forum researchers, academics, administrators and practitioners representing educational institutions, government agencies, contracting organizations, consulting enterprises, financial institutions, and other construction related organizations. The conference had a broad scope and topics were organized around the conference theme of Development and Sustainability of the Built Environment.

In particular, the conference sought responses to the following critical questions:

- What changes are necessary for improvements in construction policy, practice and outcomes?
- What is the potential contribution to improvement of alternative and traditional technologies?
- What are the barriers to change in industry policy, practices and products?
- Which economic levers can be used to achieve these changes?
- How can informal construction sector and construction SMME problems best be addressed?
- How can construction education, training, and professional development be improved?
- How can all construction industry participants be integrated into professional construction policies and practices?
- What policies, strategies and interventions will enhance diversity in the construction sector?
- How can the legislative and regulatory environment be made more effective?
- How responsive is the construction industry to sustainability and innovation imperatives?
- What is the role and contribution of government in construction industry development?

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 on sites not only in South Africa but everywhere that construction is being done.

Theo C Haupt/Ferdinand Fester
Cape Town, South Africa
July 28, 2013
ACKNOWLEDGEMENTS

The organizing committee of The Seventh Built Environment conference, held in Rondebosch, Cape Town, 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 the substantial financial support of the major conference sponsor, PPC Cement, 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 of the sponsors 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 (Pinnacle Research and Development Solutions) and Ferdinand Fester (University of Johannesburg) 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.

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 and her staff to the success of this conference is acknowledged in their capacity as conference organizers 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

Ferdinand Fester, University of Johannesburg, South Africa (ASOCSA President and overall Program Chair)
Prof Theo C Haupt, Pinnacle Research and Development Solutions, South Africa

Ms. Ferial Lombardo
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 Education, a rigorous two-stage system of peer review of each paper by no less than two acknowledged experts in the field has been followed. In terms of this process, each abstract received was blind reviewed in terms of:

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

Authors whose abstracts were accepted after the 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 blind reviewed again in terms of:

- Relevance to conference theme and objectives;
- 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 flashdrive and Table of Contents. Of the 67 abstracts originally received, only 30 papers were finally accepted for presentation at the conference and inclusion in these proceedings, representing a rejection rate of 55.2%. To be eligible for inclusion these papers were required to receive a minimum score of 5 out of 10 allocated by the peer reviewers during the final review process.
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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 where construction academics and practitioners can interact relative to practical experience and the findings of relevant research.

The Journal of Construction established in 2007 presently published twice per year is the official journal of ASOCSA and more than 5,000 complimentary copies are 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 facilitate 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.

**Meeting of Heads of Schools and Departments of Construction**

ASOCSA believes that meetings of Heads of School and Departments of Construction is a vital component of its functions and holds Heads meetings at the end of each conferences in addition to bi-annual Heads meetings.

[www.asocsa.org](http://www.asocsa.org)
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) and the Chartered Institute of Building (CIOB). 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 Heads of construction programs throughout the region, access to the Journal of Construction, reduced rates at all ASOCSA 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

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Past-president: Prof Didibhuku Thwala (University of Johannesburg) South Africa
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Henk Jacobs (University of Pretoria) South Africa

For more information on ASOCSA and its activities visit www.asocsa.org

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.
Established as the first cement plant in South Africa in 1892, Pretoria Portland Cement (PPC) Company Limited celebrated its centenary as the Johannesburg Stock Exchange (JSE) listed company on 24 February 2010.

Today, PPC is the leading supplier of cement in southern Africa with eight manufacturing facilities and three milling depots in South Africa, Botswana and Zimbabwe, producing almost eight million tons of cement products each year.

PPC is firmly committed to black economic empowerment in South Africa and recognises that meaningful participation by black people in the mainstream economy is essential to sustain the country's socioeconomic objectives.

**PPC The Brand**

The history of this iconic brand is closely linked to the growth and development of South Africa itself. PPC has produced cement for many of the country's most famous landmarks and construction projects - including the Union Buildings, Gariep Dam, Van Stadens River Bridge, the Gautrain, Medupi Power Station, and some of the newly built stadiums around the country.

The PPC cement brands include the market-leading SureBuild brand, Botswana's Botcem, Zimbabwe's Unicem and PMC as well as OPC, a special-purpose, rapid-hardening cement and guarantees strength and consistency, giving the assurance of successful building results.
A Company With A Conscience

In keeping with its brand vision of helping to build a strong country for future generations, PPC has been socially and environmentally aware many years before it became a global trend and has invested significantly in community upliftment.

To ensure long-term sustainability, we believe in partnering with beneficiaries for three to five years. Being a good corporate citizen is not just about giving money; it is important that beneficiaries are assisted in achieving financial independence and becoming productive members of society and this takes time. Job creation and skills development are vital in the context of high national unemployment and a number of our initiatives seek to address this issue.

“Everything that PPC does as a brand is about building a strong country for the future. It is founded on the bedrock of this country’s past, and its growth is a mirror of its strong economic advancement and development.” Concludes Richard Tomes, PPC Customer Executive: Cement Sales and Marketing.
Introduction

CIB is the acronym of the abbreviated French (former) name: "Conseil International du Bâtiment" (in English this is: International Council for Building). In the course of 1998, the abbreviation has been kept but the full name changed into:

INTERNATIONAL COUNCIL FOR RESEARCH AND INNOVATION IN BUILDING AND CONSTRUCTION

CIB was established in 1953 as an Association whose objectives were to stimulate and facilitate international cooperation and information exchange between governmental research institutes in the building and construction sector, with an emphasis on those institutes engaged in technical fields of research.

CIB has since developed into a world wide network of over 5000 experts from about 500 member organisations active in the research community, in industry or in education, who cooperate and exchange information in over 50 CIB Commissions covering all fields in building and construction related research and innovation.

CIB Members are institutes, companies and other types of organisations involved in research or in the transfer or application of research results. Member organisations appoint experts to participate in CIB Commissions. An individual also can be a member and participate in a Commission. CIB Commissions initiate projects for R&D and information exchange, organise meetings and produce publications. These meetings can be Commission meetings for members only or international symposia and congresses open to all. Publications can be proceedings, scientific or technical analyses and international state of the art reports.
CIB Past and Present

CIB was established in 1953 with the support of the United Nations, as an association whose objectives were to stimulate and facilitate international collaboration and information exchange between governmental research institutes in the building and construction sector. At that time an implicit objective also was to help rebuild the European infrastructure for building and construction research following the ravages of the second World War.

At the start 43 research institutes were members of CIB and by far the majority of these were European. And just as in the programmes of these institutes at that time, so in the CIB programme there was a strong emphasis on technical topics.

For selected topics CIB Commissions were established to which member organisations appointed experts from their staff to participate.

Along with all types of less visible activities, this collective participation resulted in many important international symposia and congresses and in a large number of publications acknowledged as of global standing. Indeed many of these formed the factual basis for developing international standards or were themselves used as such. Others were international state-of-the-art reports that for a long time provided an indispensable input to programming new research by the participating institutes and countries.

However, CIB has come a long way since 1953.

At present about 500 organisations are members of CIB from whom about 5000 individual experts participate in over 50 CIB Commissions. These extend over the whole area of building and construction research and innovation.

Amongst the CIB member organisations we can now find almost all the major national building research institutes in the world, as well as many other types of organisations in the building and construction sector who have joined us since. And although within the CIB programme considerable attention is still given to technical topics, there are now also activities focused on topics like organisation and management, economics of building, legal and procurement practices, architecture, urban planning and human aspects.

It is no exaggeration to say that at present CIB is the world's foremost platform for international cooperation and information exchange in the area of building and construction research and innovation. And we continue to increase our membership, to expand our scope, to initiate new activities while constantly striving to improve the quality of our products and services.
28 July 2013

Dear Author

PEER REVIEW PROCESS: 7TH BUILT ENVIRONMENT CONFERENCE: CAPE TOWN, SOUTH AFRICA 2013

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

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Regards

Ms Ferial Lombardo
Conference Organizer
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Implementation of green measures for South African affordable housing. A methodological framework related to international best practices

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ABSTRACT AND KEYWORDS

Purpose of this paper: This paper aims to provide a methodological framework that can be applied to support the implementation of green measures for South African affordable housing initiatives.

Design/methodology/approach: The perspective is created through a comparative study with international best practices using green rating criteria, followed by a scenario analysis that expanded on this by assessing selected green implementations, which were intended to improve the green rating of a local case study.

Findings: The application of the proposed framework showed that it can support design choices in terms of selecting green implementation strategies oriented to an environmentally friendly and economically feasible development, at the same time validating Green Star rating upgrades.

Research implications: This study increases the awareness of potential green implementation for affordable housing in South Africa and identifies possible areas for further developments when compared with international best practices.

Practical implications: The proposed methodological framework can be applied to pre-development and design phase of housing programmes to assess and implement green measures.

Originality/value: This research investigates the green quality of current South African affordable housing initiatives, providing a replicable methodological framework that combines qualitative and quantitative assessments, based on the local green residential buildings rating tool and sustainability indicators (CO₂, electricity consumption, cost).

Keywords: Green buildings, sustainable housing, green building rating system, energy efficiency
1 INTRODUCTION

The implementation of green initiatives in the building sector is one of the main challenges for the developing countries attempting a transition to sustainable development principles and advancing local green economy.

In South Africa, the operational phase of buildings accounts for 23% of total greenhouse gas emissions (13% from the residential sector = 45 millions of tonnes of CO$_2$ per year), while the manufacture of building materials causes approximately 4% of total CO$_2$ emissions (Milford, 2009).

The lack of national compulsory regulations and voluntary codes on the sustainability of buildings has only recently been addressed. In 2011 South Africa implemented the new national regulation on energy efficiency in buildings. Previously, in 2008, the Green Building Council of South Africa adopted a national rating system (Green Star SA) to assess the sustainability and the environmental quality of South African buildings. The rating systems are voluntary codes aimed at developing common metrics that help international stakeholders compare buildings in different contexts using an ‘international language’ (Kennett, 2009). This validates the use of the Green Star SA as a guideline to compare the green quality of current South African building design practices on an international scale.

In 2011, the Green Building Council of South Africa launched the rating tool for the multi-unit residential sector. Housing represents a crucial part of the South African building market. Data from 2007 show that investment in the residential sector is about 62% of the total investment in buildings (CIDB, 2007). Therefore, the environmental quality and energy efficiency of the residential sector, and their related affordability, are critical aspects for the sustainable development of the whole building sector.

With these premises, the rationale for this study is to provide a methodological framework that could support the implementation of green measures in South African affordable housing initiatives, through comparative analyses with international green design best practices using green rating criteria. The framework is oriented to firstly establish whether international best practices are applicable to the South African context, which is an acknowledged gap identified, and subsequently conduct a scenario analysis which gives a fact-based reasoning for the implementations selected in terms of cost, energy savings and CO$_2$ emissions reduction.

In this research, the term “affordable housing” was assessed in an international context due to the nature of the study being an international based comparison with the local context. The concept of “affordable housing” in international context has a broader meaning and scheme than the South African context, and hence for the purpose of the study is taken to include current advances in green “low-income” housing developments. As a consequence, also the Green Star SA multi residential rating tool was used in a broader application for this study.

Starting from a literature review on energy efficiency of the South African residential sector, related policies and green building rating system, this paper investigates then local and international best practices by comparative analysis and finally evaluates a local case study based on a...
scenario analysis using sustainability indicators. The consequent results are discussed, and the conclusion and recommendations are presented for future green development of the South African housing sector.

2 BACKGROUND AND LITERATURE REVIEW

Globally, the built environment is responsible for about 40% of solid waste produced, 12% of the fresh water resources consumed, 40% of energy consumption, and 33% of the CO$_2$ emissions (Ayres et al., 2011).

Data from 2006 show that in South Africa building sector accounts for 16% (= 375.509 Terajoules) of total energy use and 31% (= 246.613 TJ) of total electricity use. The residential sector, in particular, is responsible for 18% (= 142.815 TJ) of total electricity consumption, which represents about 70% of the total housing energy consumption (DME, 2006; Milford, 2009). In developing countries, the residential sector is thought to have the highest growth potential especially for electricity usage, due to the currently large numbers of un-electrified households (Davis, 2011). The potential is particularly large in areas with increased levels of urbanisation, where there is a demand for electricity provision along with formal housing development.

The total residential building stock in South Africa amounted to about 12.5 million units in 2006 of which 8.5 million are formal units and 4 million units are backyard properties, informal and squatter units, and traditional housing (BMI-BRSCU, StatsSA, 2007). The information on the delivery of formal dwelling units, based on the building plans completed for the major municipalities in 2007, show a trend towards higher density units with flats and townhouses accounting for about 29% of the number of units being built. Low-income housing accounts for about 43% of the floor space and 36% of the number of units being delivered (Milford, 2009; StatsSA, 2007).

Although residential consumption accounts for only 10-15% of the country’s national energy demand, it is estimated to constitute about 75% of the national variable load during peak demand (DME, 2007). Thus, improving the sustainability and increasing the energy efficiency in the housing sector could contribute not only to reduce energy supply demand, but also to stabilise the power grid, reduce the dependence on fossil resources and imported energy, and to enable a more feasible transition to energy self-efficient green infrastructures and decentralised districts based on renewable sources. With the current best practices in green building design, it is observed (Milford, 2009) that in South Africa energy efficiency savings around 40% to 50% could be obtained in new buildings in the commercial sector and around 30% to 40% in the residential sector.

The recent national policies have attempted to align the energy standards for buildings to the current international best practices, through the adoption of the new regulation on energy efficiency in buildings, SANS 204 and SANS 10400-XA, which came into effect in late 2011. The new regulation is oriented to meeting the goals of the National Energy Efficiency Strategy of the Republic of South Africa aimed at 20% reduction by 2015 of energy use for the commercial and public buildings, and 10% reduction for...
the residential sector (DME, 2008). The new policies define specific energy requirements in terms of performance of building components and systems, architectural design solutions, whole building consumption and demand.

The new South African regulation assesses only the energy performance of building during the operational phase. In 2008, the Green Building Council of South Africa launched the first Green Star SA rating tool (office v1), aimed at a wider concept of sustainability, concerning many green attributes related to eight environmental categories: Management, Indoor Environmental Quality, Energy, Transport, Water, Materials, Land Use and Ecology, Emissions. Another category, Innovation, is assessed separately. Each category includes several credits that assess different green attributes, that vary from one rating tool to another one, depending on the occupancy group (office, retail, residential, etc.). Each credit has a number of points available, which are fully or partially allocated based on the degree of compliance of the credit criteria, and generate the category score (n. points achieved/n. points available). The category score is multiplied by a weighting factor to obtain a weighted category score. This factor is specific for each category and depends also on the rating tool/occupancy group, ensuring implementations that are expected to generate the greatest impact on sustainability of that occupancy group are given a greater weighting. The final single score, determining the rating, is the sum of all the category scores plus the Innovation points.

The final aim of rating systems like the Green Star SA is to promote a more sustainable, holistic and integrated building design, construction approach and building operation, and also to improve knowledge about the level of sustainability in the country’s building stock (Reed et al., 2009).

In 2011, the Green Building Council of South Africa adopted the rating tool for the multi-residential buildings, which customises credits, points available and categories weighting to the residential occupancy (GBC SA, 2011).

Currently, many national and local initiatives are attempting to include green strategies in affordable housing projects. For example, the eThekwini Municipality, Huletts Sugar Company and the Government of South Africa are currently involved with the Cornubia National priority project in Durban, for the development of over 24,000 low and middle income dwellings and relative infrastructure, which will accommodate 100,000 people. This ongoing development represents current local building design practice for this residential market, and could therefore be reasonably selected as a significant local case study to be compared with international references.

3 METHODOLOGY

The research methodology combines two approaches. A comparative study of local and international case studies based on the available literature used in conjunction with selected green rating tool criteria, provided a wide perspective of the contemporary practice on an international scale. The scenario analysis expanded on this by assessing selected green
implementations which were intended to improve the green rating of the local case study by virtue of the preceding comparative analysis.

The comparative study regards South African case studies and international best practices of housing developments selected from other developing and first world nations. Data was acquired from the available literature (books, journals, internet, reports), and also from the project's documentation for the local case study. The research method used in the comparative study is mainly qualitative in the assessment of the case studies cross examined utilising the Green Star SA Multi Unit residential tool and its categories and credits. The allocation of points followed the general rules described in the background section. The tool was used primarily as a guideline for assessing the green attributes of each project, with some assumptions and limitations motivated at the end of this section.

The subsequent scenario analysis derived from the outcome of the comparative study and is based on a quantitative investigation aimed at understanding the feasibility of potential green measures implementation in the representative South African case study of the Cornubia project, in terms of CO₂ reduction, energy and cost savings. The research process of the scenario analysis consists of two steps. Firstly, electricity demand, construction costs and embodied energy were modelled. The electricity model was created by assuming appliances and lighting requirements for a Cornubia building of 50m² and then selecting respective consumption rates from relevant literature (City of Cape Town, 2011). The embodied energy model was created by multiplying volume of materials by embodied energy rates extracted from WSP low-cost housing study (WSP, 2010). The cost model was based on rates extracted from the WSP low-cost housing study being applied to respective dimensions obtained from the project drawings.

The second step was to select and evaluate implementations to be applied to the scenario, based on the findings from the qualitative analysis and current development trends. For the case study of Cornubia, two low-cost initiatives were selected: solar water heating and green living management. Then, possible CO₂ reduction, energy and cost savings were applied to the respective models, and trends were noted and commented on. Finally, the savings were compared with the Green Star rating benefits achieved.

The assumptions and limitations for the study are as follows. Regarding the qualitative analysis and the application of the Green Star Multi Unit residential rating tool, the study concerns different typologies of buildings from different countries, hence not all the projects can fulfil all the eligibility criteria given by the rating tool technical manual, especially because of the different contexts from South Africa. Therefore, the rating tool was used with some assumptions of broader potential application than the limits given by the original eligibility criteria.

Other limitations are due to the lack of some information about the projects which did not allow all the categorical credits to be assessed, whose contribution was subsequently not considered for the calculation of the number of credit points available and the subsequent category score. This simplified application of the tool due to the mentioned limitations reflects its primary function as a qualitative guideline when data...
was not available and is aligned with the final aim of the study. The research is in fact firstly oriented to provide a methodological framework for improving the green quality of pre-development and design phase of housing projects, based on a better understanding of the most appropriate green measures implementable also through the comparison with best practices.

Finally, the Cornubia case study is part of an on-going housing development project which meant that some details may not have been available at the time of the investigation. Post-construction data assessments and post-occupancy surveys would lead to a more comprehensive outcome about the sustainability of the interventions.

4 CASE STUDIES

In order to compare green affordable housing local initiatives with current international practice, suitable case studies had to be selected from which quantifiable measures of sustainability could be applied and hence a comparison drawn. These case studies had to have implemented green initiatives and cater for a relative target group for each country relevant to the study in terms of the affordable housing segment.

In order to provide a comprehensive perspective on local versus international green practice and gain insight into the influence of variables such as hemisphere and the class of the country (first and developing nations) on implemented green initiatives, two local case studies (Cornubia and Elangani), one from another developing country (Brazil-Recife) and four from a first world countries (Australia-K2, UK-Sinclair Meadows, America-Los Vecinos and The Plaza) were selected.

The local case study of Cornubia was selected considering the typical high-density double-storey townhouse typology, usually constructed from clay or cement bricks with cement tile roofs. This is a common typology for middle-income housing in the South African stock (Milford, 2009), which in recent years has been also investigated and implemented in new low-income housing development initiatives (eThekwini, 2008). In comparison with the traditional low-income single-storey detached house unit, the higher-density double-storey multi-unit typology can meet the objectives of densification in low-income settlements, resulting in a positive outcome both for developers (reduced cost for construction, land purchase and infrastructures) and also for the occupants (improved quality of the living environment), especially if the development includes community areas that remove the closed environment usually created by increased density.

The phase 1A of the Cornubia development in Durban used a similar higher-density typology for the low-income housing programme, integrating communal courtyards for social interaction. This building typology can therefore represent both common middle-income housing initiatives and also current advances in recent low-income housing developments. For these reasons, the phase 1A of Cornubia housing programme and its building typology were selected as a representative case study of current
green South African initiatives. Cornubia incorporates transport facilities (BRT route), pedestrian friendly streets, cycle lanes, efficient lighting and electricity metering, social facilities and the use of natural materials.

Elangani social housing, a four building complex completed in Johannesburg in 2002, served as the local comparison to see if there was possibly a local standard of green initiatives based on rating category score correlations. With minimalist design, Elangani implemented some green measures, especially management protocols focused on sustainability.

The Reciffe development in Brazil was used to gauge South Africa’s position among other developing nations. It is a four-storey building, located near service facilities hence reducing the need for motorized transport, which incorporates steel frame design, passive cooling strategies and a temporary internal wall panel system which allows for spatial flexibility.

The first world cases indicated what the pinnacle of green design entails. This was compared to the local case studies to identify what first world measures could be applied locally and what benefits these measures grant for local application.

K2 social housing, completed in 2007 in Windsor (Australia), comprises 96 units and is designed to reduce energy consumption, gas emission, (through large use of recycled materials, passive cooling with shading balconies, cross ventilation and high thermal mass) and water consumption. A communal green courtyard houses water collection tanks.

Sinclair Meadows is a carbon negative social housing development located in South Shield (United Kingdom). Building shape maximises shading for houses whilst the orientation allows for the best sun exposure, coupled with triple glazing and recycled wood fibre insulation. 700 m$^2$ of photovoltaic panels power the development with surplus energy routed back into the power grid. Rainwater harvesting provide water for gardens and toilets, communal refuse and recycling area are provided.

In the Plaza social housing apartments, opened in 2006 in Loma Pietra in California, occupants are educated on sustainable management practices. By proving retail, medical and entertainment facilities, the need for residents to travel is reduced as well as vehicle emissions. A green courtyard with stormwater catchment is provided for social interaction.

Los Vecinos development (first Platinum LEED certified), completed in Phoenix in 2009, integrates passive design measures, water recycling and energy production from the 93kW photovoltaic power source. It also incorporates a tenant education programme on green design measures and social facilities to boost social sustainability.

As explained in the methodology, the Green star South African Multi Unit residential rating tool was selected as an appropriate measuring tool to provide a comparative analysis based on the South African context, with the assumptions and limitations already described. Credits were selected from the manual based on their applicability to the case studies selected. Thus, the category scores do not consider under the points available the credits that are not applicable for the target of this study or for which there was lack of information available. Due to this fact, the total score of some case studies, especially from the first world, could be a bit underestimated.
Following the process described in the methodology, from the outcome of the comparative analysis, a scenario analysis was developed for the local on-going Cornubia case study, in order to give a quantitative assessment, based on sustainability indicators (CO\textsubscript{2} reduction, energy and cost savings), of the potential implementation of green measures.

5 RESULTS AND DISCUSSION

This section describes and discusses the results of the comparative analysis of the case studies and the subsequent scenario analysis.

5.1 Comparative study

As expected, highest scores were obtained from first world case studies, especially in the categories Materials, IEQ, Energy, Management and Water. Australia’s K2 social housing had the highest scores in 3 of the 8 categories. Most cases scored high in the energy category and averaged low in the transport category, whilst Cornubia scored high for transport. This is probably due to Cornubia forming part of a mixed use development where all the necessary facilities are relatively near to the residences.

When comparing the rating for the different hemispheres, Northern scenarios did not promote land and ecology as much as the Southern hemisphere. This could be because the Northern hemisphere case studies analysed were located in central districts and highly urbanised areas and not much consideration was being paid to plant life and ecology. Roof gardens would be a recommended solution for such highly urbanised area.

There was a large disparity between the first and developing nations case studies with regards to sustainability, indicating that either the technology is not accessible or government funding for the implementations is not available. Third world countries did not emphasize management and material sustainability showing that recycled material production is not yet as popular and should be encouraged. The problem with management initiatives is that they are based on the residents commit to comply in order to be effective, and this fact may deter developing nations who may not want to spend a little extra on these implementations, due to the risk of them being not implemented effectively hence wasting money.

To conclude, based on the findings of the discussion relative to other countries of a similar economy such as Brazil, we are currently on par.

There are many potential steps to be taken towards sustainability in South Africa. Local affordable housing initiatives can especially improve in terms of utilizing recycled materials, implementing green practices aimed at energy and water saving, and suitable management programmes within housing developments to attain best international practices.

Moreover, the local transport sustainability approach should be integrated in a larger scale planning. Considering Cornubia, for example, the adopted approach encourages a shift towards implementing mixed-used residential developments, due to the close proximity to several...
facilities (resulting in high transportrating score) which some purely residential developments do not provide. On the other hand, the rating tool does not directly assess the distance from the main workplaces, central activities districts and the related transport facilities, that could cause high vehicle emissions and this should be factored into the transport score.

Figure 1.1 Weighted Category Scores distribution per category for the case studies

5.2 Scenario analysis

Starting from the outcome of the comparative study, a scenario analysis was conducted in order to evaluate the potential effects on the on-going project of Cornubia, of the implementation of green strategies. This analysis is a quantitative assessment that required firstly the modelling of buildings cost, energy demand and embodied CO$_2$.

The building typology from phase 1 of the Cornubia development was utilised. Energy was modelled using electricity consumption rates from relevant literature (City of Cape Town, 2011) assuming appliance usage. Appliances were selected and kilowatt-hours were totalled to obtain a monthly expected demand of 188 kWh. This was compared to an initial assumption of 260 kWh from the relevant literature (CSIR, 2005). To balance any uncertainty for the assumed model, the average of the two values was taken to be 224 kWh. Electricity cost was calculated using a rate of 75,41c/kWh from the eThekwini tariffs guide 2012-2013. The modelled cost of construction was done using dimensions based on the phase 1 double storey dwelling of 50 m$^2$ gross floor areas, split in two floors of 25 m$^2$ (dimensional data extracted from the project’s documentation) and applying rates from WSP low-cost housing study, resulting in a cost/m$^2$ of R1215/m$^2$ (excluding VAT). Embodied energy was calculated by volume of the main building envelope material, assuming 1330 kg/m$^3$ of concrete block density and a conversion factor of 0,4eqCO$_2$/kg from WSP study, resulting in 5094,43kg eqCO$_2$. 
Green implementations were then applied to achieve an improved level of sustainable rating. Two low-cost initiatives were deemed appropriate to achieve the desired points based on current implantation trends. Solar water heating was used to reduce electricity consumption, and residents would also be provided with a green living guide for homeowners, based on the qualitative analysis which showed green management was an area that could have been improved to aid the Green Star rating. The outcome is a quantification of sustainability in terms of energy, CO₂ and cost per m² related to the Green Star rating points gained.

Implementations of the green initiatives were researched and finally a total Green Star rating increase of 5.8 final score points was achieved.

Data on solar water heating were based on the available literature, Eskom website and data from manufacturers. System and installation costs for a 150 litres system with flat panel are assumed to be R 4815, including Eskom rebate. Energy savings result in an average 138 kWh/month from data from manufacturers. This energy was converted using a factor of 0.99 kg CO₂/kWh provided by Eskom, to obtain a value of 136.62 kg CO₂/month. The Energy Category Weighted Score increases for this implementation of 2.3 based on a point increase in the Maximum Electrical Demand Reduction credit. Operational cost savings were based on the rate of 75.41 c/kWh.

Management costs were based on the cost for an occupant users’ guide per a five person dwelling. The cost, energy and CO₂ savings are based on the behavioural response and could grant an increase of 3.5 weighted category score under Management category, assuming a better sustainable management of the building.

Energy savings, CO₂ reductions and operational cost savings were totalled and divided by the gross floor area to give respective indicators for the building (energy savings: 33.12 kWh/m² p.a.; operational cost savings: 24.97 R/m² p.a.; CO₂ savings: 32.79 kg CO₂/m² p.a.). Percentage saving and annual analysis were done and are explained as follows. From the scenario analysis carried out, it was discovered that, in order to obtain the star rating points achieved, an increase in construction cost/m² of around 10% would be incurred. This however also resulted in a saving in energy consumption of 138 kWh and 136.62 kg CO₂ per month which is substantial. A monthly saving in operational cost of R 104.07 was also realised, with a payback period for the recovery of the green implementation capital cost of around 5 years (considering rebate for solar heating, without considering inflation and assuming constant energy demand), after that savings would become effective. This result demonstrates that the interventions would be economically viable because of the 5 years period of recovery of capital cost implementation. Also, the environmental benefits realised are relevant, but would have been more significant using eco-friendly materials that can reduce the initial embodied energy.

Yearly savings percentage are very high for electricity as well as for related CO₂, due to the energy effectiveness of solar water heating. Regarding the total saving of CO₂ emissions, the yearly saving...
percentage is limited to around 27% principally due to the major contribution of embodied energy of building envelope.

The green implementations assumed for the case study result in significant increase of Green Star SA rating, of almost 6 points, that allow for a class upgrade (to 4 star) achievable with cost and environmental effective strategies.

Figure 1.2, 1.3 Incremental monthly savings projection for one year (left) and percentages of yearly savings related to energy demand, CO\(_2\) from electricity, total CO\(_2\) including embodied energy of envelope, implementation capital cost (right)

6 CONCLUSIONS AND RECOMMENDATIONS

This study provides a replicable methodological framework that can be applied to support the implementation of green measures in pre-development and design stage of South African affordable housing initiatives. Combining comparative analyses using the South African rating tool for the sustainability of buildings and scenario analyses based on simplified quantitative assessment of sustainability indicators (construction cost, energy savings, CO\(_2\) emissions), the framework offers a contribution to increase the awareness of the potential green targets for affordable housing in South Africa and to identify possible areas for further green developments when compared with best practices.

The proposed method, aimed at understanding the knowledge gap between the current South African initiatives and international best practices, and at investigating consequent potential green implementation, could also support future policies and planning actions on the sustainability of the residential built environment.

An application of the method to a local case study of an on-going housing development project in Durban was presented and discussed. The results showed that potential green implementation could be selected to achieve cost and environmental effectiveness and rating class improvement.

The proposed methodological framework could therefore support design choices in terms of selecting green implementation strategies oriented to an environmentally friendly and economically feasible development, at the same time validating Green Star rating upgrades.
7 REFERENCES


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The CBE as an effective tool for the development of the Built Environment.  
A focus on human resources.

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ABSTRACT

Purpose: This study explores the impact of the Council for the Built Environment (CBE) on human resources of the built environment professionals.

Research Design: The research design includes open-ended and closed ended questions in an email questionnaire, sent to members of the professions for which the CBE is responsible.

Research limitations/implications: The survey was done on as many professionals within the confines of the professions, willing to respond by email. Being unable to deliver the questionnaire and ensure that respondents responded was a limitation.

Findings: Participants felt that the CBE was lacking and needed to be more aggressive in promoting built environment professions.

Response to conference theme and outcomes: This study illuminates the need for an effective and well devised strategy for human resources in the built environment to effectively transfer skills over time.

Practical implications: This study highlights the need to look at the development of the human resources of the built environment as a holistic practice, taking into account the necessary factors to ensure success.
Originality/value: The study uncovers the necessity to address the deficit of interaction between the CBE and professionals.

Keywords: human resources, development, built environment professions

1. INTRODUCTION

Human resources are crucial to all learned professions and their survival. The Council for the Built Environment (CBE) among other things is mandated to promote ongoing human resources development in the built environment. Human resources management deals with the activities an organisation undertakes that relate to recruiting, selecting, designing work, training and developing, appraising and rewarding, directing, motivation and controlling workers (Wilton, 2011). Human resources development is a branch of human resources. This is where an organisation ensures their human resources have the skills, knowledge and competence required to perform their work now and in future (ibid). Ensuring that staff continually enhances their skills in a competitive market is an advantage, especially in construction where advances are continually being made.

In response to issues of mass joblessness and lack of infrastructure, the government of South Africa has laid out plans to expand infrastructure and create decent work (Economic Development Department, 2009). These plans place pressure on the built environment professions to be in a position to respond to the needs of the country (CBE, 2012). Documents produced by the CBE and other government institutions report strides have been made in this regard. However these strides are only effective if they impact the built environment and practicing professionals.

2. INFRASTRUCTURE EXPANSION IN SOUTH AFRICA.

Infrastructure as defined in the Infrastructure Development Bill of 2013 draft relates to the installations, structures, facilities, services or processes relating to: airports, communication and information technology installations, education institutions, health care facilities, mines, oil or gas refineries or other installations, ports and harbours, power stations or installations for harnessing any source of energy, public roads, railways, human settlement, sewage works, waste management and disposal, waterworks, water infrastructure and industrial facilities. Areas within South Africa (SA) are still deprived of functional infrastructure. The SA government in addressing the vast inequalities in infrastructure provision has cited development as one of its key areas of investment (Economic Development Department, 2009; Government of South Africa, 2012; National Planning Committee, 2011).

Infrastructure development is regarded as one of the areas that have great potential for creating employment on a large scale (Economic Development...
Department, 2009). Backed by a substantial financial commitment from the government of ZAR 872 billion, the planned massive drive to provide infrastructure is expected to have a multiplier effect. The construction process of providing infrastructure will realise most of its employment through housing and public works (ibid). The National Infrastructure Plan adopted in 2012 outlines 18 strategic integrated projects. Collectively these projects aim to change social and economic infrastructure over the nine provinces of the country. The Department of Public Works and entities within the built environment are fundamental in ensuring that the expansion of infrastructure is a goal that is realised (CBE, 2012). The CBE as part of its mandate is tasked with promoting the on-going human resources development in the built environment (Government of South Africa, 2000). Human resources have become increasingly vital as a result of the planned expansion in infrastructure.

3. THE CBE PLAN FOR HUMAN RESOURCES DEVELOPMENT.

The Council for the Built Environment (CBE) is a juristic person created by the Council for the Built Environment act 43 of 2000. The CBE Act recognises architecture, engineering, landscape architecture, project and construction management, property valuation and quantity surveying as the professions of the built environment. The organisation is meant to be a governing organisation for the Councils of the separate built environment professions. Each council is created by an Act governing each profession. The organisation has a vision to provide sustainable built environment professions, serving public and national interests. The mission of the CBE is through leadership of the built environment professions to; facilitate integrated development, while promoting efficiency and effectiveness.

As a development agency the CBE has aligned its strategic plan within the confines of the goals of the state (CBE, 2012). Development is a positive change that affects people differently aimed at addressing the needs of the poorest sectors of society, discourses about development occur from a variety of perspectives making it difficult to implement plans that suite all participants (Conyers and Hills, 1984; Stewart, 1997; Treurnicht, 1997). Authors in development studies agree that there is no recipe for development. To be effective development solutions need to be a collaboration between policy makers and the desired beneficiaries (Treurnicht, 1997; Conyers and Hills, 1984).

According to the Chairperson of the CBE in 2012, built environment professionals have a critical role in the delivery of infrastructure and are linked to job creation and skills transfer in the built environment (CBE, 2012). As an organisation mandated to serve as a liaison between the government and professional bodies, the CBE needs to ensure the ultimate goals of state are realised. This also includes ensuring policy decisions are reflective
of participation. The CBE is a critical organisation for sustainable development in the built environment.

In 2012 it was noted that the CBE was making strides in human resources in ensuring the application of norms and standards (Parliamentary Monitoring Group, 2012). The CBE Annual Report for the year 2011/2012 produced by the CBE outlined The Built Environment Skills Academy. This aimed to drive and facilitate human resources development in the built environment with the ultimate goal of transforming the built environment. The strategic objectives were:

- To provide funding support to deserving students to study towards built environment (BE) qualifications at tertiary institutions;
- To promote and facilitate the accreditation of BE programmes at tertiary institutions;
- To promote and facilitate skills development within the BE; and
- To promote a transformation agenda within the BE.

These objectives are further divided into strategic goals namely:

- Drive support and advise transformation in the built environment;
- Facilitate integrated development planning;
- Inform and influence government infrastructure spending; and professional practice to be responsive to public policy priorities.

At the end of the financial year ending March 2012 the CBE reported that it had achieved the goal of supporting and advising transformation in the built environment. The evidence of this was the participation of more individuals from previously disadvantaged backgrounds, the granting of bursaries to deserving students and the availability of an approved monitoring report on the accreditation of tertiary institutions. However this achievement does not seem to be enough to cope effectively with the need for more built environment professionals as a result of the proposed infrastructure investment.

4. RESEARCH OBJECTIVES AND APPROACH

Taking into consideration the goals and mandate of the CBE this study enquired through a questionnaire consisting of both open and closed ended questions of professionals about their knowledge of and overall feelings about the CBE. The objective of the survey was to:

- Enquire into the extent of interaction between the CBE and beneficiaries of its services;
- Determine whether professionals were aware that the CBE was well positioned to be a key tool in the implementation of government development goals; and
- Ascertain what could be done to ensure the CBE served its purpose effectively.
The questionnaire comprised of 16 questions, 8 of which were open ended. This gave respondents the opportunity to elaborate on their answers and provide their opinions. The remaining 8 questions ascertained basic facts such as the respondent’s profession, knowledge of the CBE mandate and knowledge of government infrastructure goals.

The questionnaire was sent to 120 professional consulting practices, ensuring that each of the professions recognised as built environment professions was represented equally. In order to ensure representation of all nine the provinces of the country a conscious attempt was made to ensure that the respondents were not all in the same geographic area.

Of the 120 professionals contacted 30 responded with completed questionnaires resulting in a 25% response rate which was deemed acceptable for the purposes of this phase of the study.

5. FINDINGS

The following is an analysis of the responses given by the respondents to the questionnaire. Within the professionals that responded the questionnaire, the bulk of respondents were Landscape Architects 40%, Architects 20% and Quantity Surveyors 40%.

![Responses by Profession](image)

Figure 1. Responses by professions

When asked what they knew about the CBE most of the respondents (60%) had some knowledge of the CBE relative to them overseeing professions in the construction and real estate industries. Only 20% were fully aware of the CBE and its role. Of concern are the remaining 20% who had no knowledge of the CBE at all.
Table 1 discusses on a question by question basis the knowledge of and the experience that respondents had with the CBE.

<table>
<thead>
<tr>
<th>Question</th>
<th>Number</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you know what the CBE is mandated for?</td>
<td>30</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Are you aware that the Council was established by an act of parliament with a mandate aimed at developing the built environment professions?</td>
<td>30</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Do you have any personal experience with the CBE?</td>
<td>30</td>
<td>20%</td>
<td>80%</td>
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</table>

The respondents who had a personal experience with the CBE noted that their interaction was not directly with the organisation but through associating with people who had served with the CBE. They mentioned that it was hard for the CBE to interact with the different professionals councils of the built environment professions.

The CBE is mandated to ensure the continual growth of human resources in the built environment. Of the 30 respondents, 80% were not aware of this element of the CBE’s mandate.

Table 2 indicated the awareness of the respondents of the CBE’s mandate.

<table>
<thead>
<tr>
<th>Mandate point</th>
<th>Number</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promote and protect the interests of the public in the built environment.</td>
<td>30</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Promote and maintain a sustainable environment and built environment.</td>
<td>30</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Promote the on-going human resources development in the built environment.</td>
<td>30</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Facilitate the participation by built environment professions in integrated development in the context of national goals.</td>
<td>30</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Promote appropriate standards of health, safety and environmental protection with in the built environment.</td>
<td>30</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Promote sound governance of the built environment professions.</td>
<td>30</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Promote liaison in the built environment in the field of training, both in the Republic and elsewhere, and to promote the standards of such training in the Republic.</td>
<td>30</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Serve as a forum where the representatives of the built environment professions may discuss the relevant:</td>
<td>30</td>
<td>20%</td>
<td>80%</td>
</tr>
</tbody>
</table>
When asked if they felt that these infrastructure goals would impact the built environment 80% of respondents agreed that the goals would affect built environment professions and the built environment. 20% of respondents however were unable to answer this question.

Respondents had strong views about the role the CBE should be fulfilling in terms of these infrastructure goals. Many respondents (50%) felt that the CBE should assume control and assist with the identification of work. Others felt that the councils should be more aggressive in promoting the built environment and the associated professions. The prevention of undercutting of fees was also a point raised by several respondents. There is also a feeling that the CBE should be in a position to scrutinise the credentials of individuals who tender to provide services and perhaps if individuals do not have the credentials that this should be a disqualifying factor.

Among the issues that respondents felt that the CBE should be concerned with was the undercutting of fees. Again it was presented as a major point of interest for the professionals and many felt that this led to poor quality work. Free and fair tendering was highlighted as professionals felt that this should be addressed by the CBE. Many of the respondents were in agreement that the CBE should make the knowledge of their work known as many people are unaware of them and their function. The improvement of education and training for both university and university of technology students was raised as an area in which the CBE should be concerned. One respondent raised the issue of standardised salaries to help the spread of professionals in the private and public sectors.

In response to the question as to what the CBE can do to ensure effective change in the built environment, respondents raised a variety of issues. The themes that seemed to reoccur were that the CBE should make a more aggressive attempt to communicate with professionals. Where possible respondents felt that practical training opportunities should be availed to students and that all constituent professions of the built environment should be recognised and acknowledged.

In order for the CBE to make itself more effective and available to stakeholders, respondents felt that transparency was one of the major themes. The proper management of built environment councils including voluntary associations was also mentioned. Many professionals felt that

| **Ensure the uniform application of norms and guidelines set by the councils for the professionals throughout the built environment.** | 30 | 40% | 60% |

- Required qualifications
- Standards of education
- Training and competence
- Promotion of professional status
- Legislation impacting the built environment
more bursaries should be granted to students to promote the professions. One respondent suggested that compliance with the CEB should be made part of a tender document like a check list to be complied to.

On the basis of what the respondents knew about the CBE they were asked to score their performance on a scale of 1-5, where 1 was extremely poor and 5 was excellent. The majority of the respondents 60% felt that the CBE was performing extremely poorly, 40% of respondents felt that the CBE was performing poorly.

In closing respondents offered some thoughts on the CBE. Some respondents choose not to answer this question however the respondents who answered voiced their opinions and general observations about the CBE. Other respondents felt that individuals in the CBE were serving the agendas of their discipline and that was a low point for the organisation. Many of the respondents agreed that the organisation needed more exposure so as to gain more support and aid in its ultimate success.

6. DISCUSSION OF FINDINGS

The questionnaire revealed that many practicing professionals are still unaware of the functions and mandate of the CBE. The professionals who knew of the CBE were still not informed to a level that would be satisfactory. The questionnaire also revealed that professionals felt that the CBE and its work were not as well-known as it should be. Respondents felt that the identification of work programme should be assisted as it affects all professionals. Although the CBE works through the different Built Environment Councils, according to the professionals the CBE still finds it difficult to interact with the different councils.

When asked what the CBE can do to make itself more available to stakeholders respondents called for transparency, proper management and more communication. A few participants went as far as adding that the CBE should circulate a newsletter reaching out to professionals.

7. OVERVIEW OF RESEARCH OBJECTIVES

This study opened with a discussion of human resources, planned infrastructure development and the plan for human resources development by the CBE. This set a premise upon which the research objectives were based which by answering would yield an answer to the research question if the CBE was an effective tool for development. The research objectives were investigated through the questionnaire and ultimately gave insight necessary to realise the research objectives.

Objective 1: Enquire the extent of interaction between the CBE and beneficiaries of its services.
The respondents who took part revealed that the interaction they had with the CBE was limited. Many of the respondents had not had a personal experience with the organisation at all. This highlighted how many of the desired beneficiaries have not had interaction with the council.

Objective 2: Uncover if professionals are aware the CBE is well positioned to be a key tool in the implementation of government development goals.

In making an enquiry into this research objective a combination of questions were posed. The responses of those questions uncovered that many of the professionals were unaware of the government's planned infrastructure expansion. Due to their lack of knowledge about the CBE and what it does many respondents felt that the CBE had performed poorly in its inception.

When asked what role the CBE should be playing in the implementation of infrastructure goals, respondents raised issues relating to the practice of their profession. For example assisting with the identification of work programmes, assuming control and scrutinizing credentials. Ultimately the professionals were aware that the CBE is in a position to help implement government infrastructure goals. Responses reflected that respondents believed the CBE can assist in creating a better working environment in which to practice.

Objective 3: Ascertain what can be done to ensure the CBE serves its purpose effectively.

The respondents felt that transparency within the CBE along with proper management would help the organisation be more available to stakeholders. Some respondents raised that there should be some way in which to comply with the CBE and that it doesn't have the exposure necessary for it to thrive and thus needs to be more visible to professionals.

8. CONCLUSION AND RECOMMENDATIONS

It is apparent that although the CBE has in place the right framework to achieve goals it has not reached the desired audience with great impact. Ultimately the study found that although the CBE had plans laid out their impact was not as far reaching as would have been thought. In this instant the CBE has not gained many positive reviews however from the comments of the respondents there is still hope for the CBE. Taking into consideration the opinions of the professionals the CBE still has the capability to impact change on the built environment and the associated professions.

At this juncture the CBE as a tool of development has not been effective. Evidence of this is that the professionals were not aware of the organisation, nor had they had personal experience with the organisation. Respondents felt that the organisation needed to avail practical training opportunities to students. The accomplishments of the CBE cannot be
understated the organisation has taken great strides to ensure there is an approved monitoring report on the accreditation of tertiary institutions. The awarded bursaries to deserving students as part of their mandate for transforming the Built environment must also be acknowledged.

A recommendation that could be made would be that the CBE should take a more aggressive stance on interaction with beneficiaries so that policies have a greater chance of success. The CBE is well positioned to impact change, however the backdrop against which it operates presents issues and challenges. With time and support from stakeholders the organisation can one day become an effective tool for development in the built environment.

9. REFERENCES


Proceedings 7th Built Environment Conference
The CBE as an effective tool for the development of the Built Environment
A focus on human resources
28 – 30 July 2013
Cape Town, South Africa
CONTRACTORS’ PERCEPTIONS OF CONTRACTOR DEVELOPMENT PROGRAMMES IN SOUTH AFRICA

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ABSTRACT

Purpose:
The prime objective of contractor development programmes (CDP) is to assist Small Medium and Micro Enterprises (SMMEs) to improve their management skills and performance levels to that of established firms. However, literature informs that some of these programmes have not achieved their intended objectives with one of the causes of this failure being the mismatch between contractors’ expectations and what is being offered as a development programme. Contractors have highlighted some gaps in the programmes which if addressed could assist in eliminating some of their concerns.

Design/Methodology:
A desktop study was conducted on contractors’ perceptions of some development programmes in other countries and the perceived gaps compared and ranked according to their presence in the countries.
Research limitations/implications:
This study presents findings from a review of literature and constitutes the first phase of an empirical research on contractors’ perceptions of contractor development programmes in South Africa.

Findings:
The study revealed that contractors generally perceive the programmes as being beneficial to their development however they need to be consulted in identifying the gaps in these programmes for their successful implementation.

Response to conference theme and outcomes:
This study raises awareness on the importance of involving contractors in the evaluation of contractor development programmes.

Practical implications:
The study evaluates how contractors’ perceive these CDPs and will assist in guiding stakeholders of the need to modify the programmes to meet their objectives. The findings of this study will be compared to an empirical study to be conducted in South Africa which will help in re-modelling of the contractor development programmes.

Originality/value:
The study will enable training stakeholders to improve the quality of the programmes for their successful implementation.

Keywords: Contractor development programme, Small Medium and Micro Enterprises, perceptions, gaps, South Africa

1.0 INTRODUCTION
Contractor Development Programmes (CDP) can be traced back to 1995 when the National Department of Public Works (NDPW) introduced programmes aimed at assisting contracting organisations owned by Previously Disadvantaged Individuals (PDI) develop their technical and managerial skills to enable them compete with established construction firms (NDPW,2004:3).

Subsequently, most provincial governments established contractor development programmes with the same objectives as that of the NDPW. The configuration and the implementation of some of these programmes have been widely researched such as the, Contractor Development Programme (CDP) (CIDB, 2011:1-35), South African Construction Excellence Model (SACEM) (Dlungwana, et al, 2002:1-8), Integrated Emerging Contractor Development Model (IECDM) (Hauptfleisch, et al, 2007:1-13).
However there appear not to be enough reports on the effectiveness of these CDPs and whether they are beneficial to the end users. And as Jacquet (2002:7) observed:

> the greatest challenge that exist today in South Africa lies at the fact that no data is available on how effective interventions are, whether they are achieving successes, and which sector require most assistance”.

Literature reviewed, seems to indicate that there are not much assessments done on the outcomes of these training programmes in South Africa although much need to be done (CIDB, 2009, i). This problem does not affect developing countries alone, in a study conducted by the Organisation for Economic Co-operation and Development (OECD) in 2002, it was found that only the United Kingdom (UK) and Japan had evaluated the outcomes of their training programmes (OECD, 2002:17), though this process is very important as it informs future improvements to the programmes. This study therefore seeks to investigate contractors’ perceptions of programmes.

2.0 THE STUDY

A desktop study on contractors’ perceptions of development programmes in other countries was conducted, their perceived gaps identified, compared and ranked as per their occurrences. The study also constitutes the first phase of an empirical research on contractors’ perceptions of contractor development programmes in South Africa.

3.0 CONTRACTOR DEVELOPMENT PROGRAMME

3.1 Why train SMME contractors?

The importances of Small Medium and Microenterprises (SMMEs) have been well researched all over the world. The World Bank (2003:3-4) observed that SMMEs are important as they contribute to economic growth of countries, are essential for a competitive and efficient market, are critical to poverty reduction and playing a particularly important role in developing nations. According to the World Bank (2003) Russia’s SMMEs accounted for 90% of the total number of firms, 45% of total employment and 40% of total sales in the economy. The Chinese economy was not different according to the report, as SMMEs accounted for 99.9% of the total firms, 84% of the total employment and 71% of total sales of the economy (World Bank 2003:6-8).

SMMEs in the construction industry are equally significant to most economies. For instance in Sri Lanka, the construction industry contributed almost 8% to the Gross Domestic Product (GDP) (Chamber of Construction Industry Sri Lanka, No date: 2), whereas in South Africa, the construction industry contributed almost 4% to the GDP in 2012 (Industry Insight, 2012:17), in Palestine, the construction industry contributed about 26% to...
the country’s economy in 2000 (Mahamid, 2011:1) and in Ghana the industry contributed about 10% to the GDP (Mhango, 2010:2).

Generally, the construction industry contributes about 5 to 10% of GDP in all countries, employs up to 10% of the working population and is responsible for about half of the gross fixed capital formation (Ofori, 2012:5).

However, these SMMEs are very fragile especially at their start-up stage and are likely to “die” before there maturity stage (OECD, 2002:7). OECD (2002) observed that smallest firms in the OECD hardly survive beyond five years of their existence and in Malaysia only 10% of start-up businesses survive beyond the tenth year (Sin et al, 2010:14).

Training programmes have been proven to assist the survival of firms as “the balance of evidence indicates that formal training and development cuts failure rate by half in the UK – all other things being equal” (OECD,2002:8).

CIDB (2009:1) reiterated that “there are several instances where contractors have increased their CIDB grading by three or four grades during or subsequent to their participation in the CDPs”.

3.2 Challenges facing SMME contractors

With all the benefits and the importance of SMMEs in the construction industry as observed in the previous section, there still remain several challenges facing this sector of the industry. The Construction Industry Development Board (CIDB) South Africa (2011:5-8) identified a number of challenges impacting on SMMEs which include inter alia:

- Lack of business and financial skills;
- Financial constraints and limited access to funding, trade credit and performance bonds;
- Late payment by clients impacting on contractor cash-flows, causing delays in the completion of projects and eroding their profits margins. This also ties up working capital, and encourages corruption;
- High turnover among skilled workers owing to uncertainties in job opportunities;
- The fragmentation of the construction process has an adverse effect on the overall performance of the industry;
- Short term nature of the work which makes it hard to develop and implement long-term strategies and growth plans;
- Officious or overly complicated contract award and contract administration procedures;
- Intense competition, especially in lower scales of construction enterprise, and difficulty in competing with larger construction firms;
- Insufficient resources to provide a safe and decent working environment such as protection, equipment and attire;
• Lack of professional advisors and consultants, and where these were available the reluctance to use them due to perceived expensive fees, a lack of finance or awareness;
• Lack of capital equipment such as vehicles, heavy machinery or scaffolding;
• Uncertainties in supplies and prices of materials, allied with generally non-existent or poor relationships with suppliers;

These challenges may lead to low productivity, poor quality workmanship, and low delivery of construction projects in the South African construction industry (CIDB, 2011.6 - 8).

3.3 Objectives of development programmes

Different countries have different objectives for the design and implementation of their development programmes. Malaysia's development programme according to Ofori (2012:10) is to develop the country's construction industry into a world-class, innovative, knowledgeable global solution provider.

While Singapore's Construction 21 initiative was designed to improve the productivity of the industry by reinventing its processes, procedures and practices (Ofori, 2012:8) The development programme designed by the Contractors Registration Board (CRB) in Tanzania was targeted at curbing the skills and knowledge gap between local and international contracting firms and thereby also improve the ability of local contractors to perform at optimum levels (Uriyo and Jere, no date: 1).

The CDP training objectives in South Africa as recorded by CIDB (2011:5-6) includes among others, the improvement of the contractors’ overall performance in the economy, to empower local contracting firms to compete with their international counterparts, to provide opportunity for emerging contractors’ to develop their firms, to improve and sustain the performance of rural contractors and to encourage and empower contracting firms owned by people with disabilities, women and youth.

4.0 FINDINGS

4.1 Development Programme - Tanzania

The Tanzanian Construction Registration Boards (CRB) as stated by Uriyo and Jere (No date: 2-15), introduced a Sustainable Structured Training Programme (SSTP) in 2001 with the aim of assisting local contractors bridge the skills and knowledge gap and to increase the capacity of local contractors participating in infrastructure development, refurbishment and maintenance. The programme was initiated when 38% of potential clients and 42% of contractors surveyed requested for training programmes (Uriyo and Jere, No date: 2). The training’s objectives were to address contractors’ low technical and managerial capabilities, inability to breakthrough into high
grades, failure to acquire modern tools, and their inability to access credit facilities.

Uriyo and Jere (No date) further explained that the training comprised of a 5 day period modules covering, pre-contract practise, contract management, construction planning, plant and equipment maintenance and health and safety where contractors’ were required to complete six modules per year. The cost of training was highly subsidised with the CRB taking about 70% and the participating contractor paying about 30%.

4.1.1 Outcome of the programme

Assessing the outputs of the SSTP, Uriyo and Jere noted that, within 7 years of its inception, 2,071 contractors were trained as compared to the budgeted 1,620 contractors.

Further, the annual client feedback report indicated a decline in complaints of contractors’ lack of knowledge and skills within the period of the SSTP and there was also a reduction in the complaints related to the use of unqualified persons on projects.

The contractors’ generally perceived the training as a success. However they noted some shortfalls of the programme which needed to be addressed (Uriyo and Jere, No date: 4).

4.1.2 Perceived gaps of the programme

The following were the gaps that contractors suggested to be attended to; (i) that the training be made mandatory to all contractors, (ii) contractors must go through Continues Professional Development (CPD) - (continues mentoring), (iii) more emphasis must be on addressing artisans and technicians skills gap, (iv) training should be relevant and responsive to industrial needs, (v) contractors require more training in Rate-build-up, (vi) mentorship and apprenticeship must be encourage to enhance competency (vii) continues monitoring of programmes to ensure effectiveness, (viii) there must be different training programmes for different levels of firms and (ix) there must be a sufficient pool of resource persons to sustain knowledge transfer, (Uriyo and Jere, No date: 5-15).

4.2 Development Programme - Palestine

Enshassi and Shaath (2007) in evaluating the International Labour Organisation’s (ILO) Arabic version of the Improve Your Construction Business (IYCB) methodology in the Gaza Strip, noted that the aims of the programme was to assist smaller construction firms to improve their managerial skills in areas such pricing, submitting tenders, financial management, contract administration and marketing of construction work (Enshassi and Shaath, 2007:43). It was also indicated that, the IYCB programme consisted of a three handbooks and workshop series that...
tackled topics such as (i) pricing and bidding (ii) site management and (iii) business management.

The implementation was in two phases; with phase one being the training of the Trainers (TOT) and phase 2 the training of selected construction companies’ managers and owners, with each training model lasting for about three months.

4.2.1 Outcome of the programme

Enshassi and Shaath, (2007:52) observed that majority of the contractors have benefitted greatly from the IYCB handbooks and workshops and were content with the models as they were able to implement some of the new methods taught.

4.2.2 Perceived gaps of the programme

The contractors noticed some of the following as the gaps of the programme that needed the attention of the implementing stakeholders; (i) that the duration of the training programme is too long and be shorten, (ii) that the Arabic translation needs to be reviewed (iii) that the books be made more practical than theoretical (iv) there should be different training for different levels of contractors (v) that the books be adjusted to suit the conditions of the Gaza Strip and the West Bank.

4.3 Development Programme – Sri Lanka

Gamage (2003:145) mentioned that a formal training intervention termed “how to begin an industry” which was aimed at developing entrepreneurs in Sri Lanka commenced in 1987. It was further elaborated that the programme consisted of a 12 day model that was spread over a period of 6 weeks by the Chamber of Commerce and Industry. The programme was financed by the Asian foundation with a focused on providing knowledge of business and development linkages with institutions and individuals, and was implemented by several governmental, non-governmental and private sector agencies.

4.3.1 Outcome of the programme

Gamage (2003) identified that even though they performed better than their untrained counterparts; the performance of the trained entrepreneurs is not satisfactory enough. It was nonetheless observed that the few trainees who have entrepreneurial qualities and took the initiative succeeded in their businesses.

He concluded that the attempts made to improve the entrepreneurial skills did not produce the right results (Gamage, 2003:146).
4.3.2 Perceived gaps of the programme

The following were noted by the trainees as being the hindrance to the success of the programme; (i) there should be a systemic follow up action after training, (ii) there must be a continues mentoring of trainees on graduation, (iii) training had longer durations, (iv) training had high theoretical content and must be made practical (v) training modules be based on local expertise, (vi) indigenous entrepreneurship experience be integrated in the training and (vii) there must be different training programmes for different levels of entrepreneurship (Gamage, 2003:147-149).

4.4 Development Programme – OECD Countries

OECD (2002:5) indicated that in a study conducted by the Organisation for Economic Co-operation and Development (OECD) countries which comprises of the United Kingdom (UK), United States (US), Germany, Japan, Canada and Finland to assess their various training programmes, it was only the UK and Japan that did evaluate their training outcomes.

United Kingdom (UK)

According to OECD (2002) three Small-scale schemes were adopted by the UK to provide public funds to support schemes that provided training to small enterprises.

The Small Firms Training Loan Schemes (SFTL) established by the Department of Education allowed authorised banks to provide loans to SMMEs to pay for the training of their workforce and managers. A low interest rate of about 2% was levied on this loan which saw 346 Small Firm Training Loans being made between 1994 to1998. (OECD, 2002:15).

(OECD, 2002:15) again stated that the Golden Key Package was established with the aim of promoting the financial management skills of small businesses through a training programme around the Norwich area, after a research revealed that about 80% of firms in the area failed. Loans were provided to graduates of the programme at a discounted interest rate and also served as financial incentives for the small firms to attend the five “Three-hour” evening sessions spanning two and half weeks.

The Small Firms Enterprise Development Initiative (SFEDI) was established as a set of National common standards for SMME managerial competencies and a National Vocational Qualification (NVQ) in small business planning was awarded to participants. The qualifications were at different levels with start-ups and established business both targeted (OECD, 2002:16).
4.4.1 Outcome of the UK programme

The evaluation of the Golden Key scheme demonstrated that the excitement of clients was high and they believed their managerial skills have been promoted.

The trainees also rated the programme 4 out of 5, the presenters were rated almost 5 out of 5, 90% indicated that they will recommend the programme to others and 74% having their growth plan affected (OECD, 2002:18).

Japan

Japan has a long history of SMME development programmes (OECD, 2002); these are implemented through local governments or the Japan Small Business Corporation (JSBC). Advice on business management are provided through an evaluation system (“SHINDAN”) where production and technology analysis were done on the performance of SMME to introduce them to the improvement of the business environment. Consultants are employed to provide these training programmes to SMME firms, with the responsibility of selecting a consultant resting on the national government (OECD, 2002:14).

4.4.2 Outcome of the Japan programme

According to OECD (2002:18), Japan evaluated two of its programmes by questioning the participants about the rate of satisfaction of the training provided.

It was found that the trainees were highly satisfied and further shows that all the aspects of the training are highly regarded.

4.4.2 Perceived gaps of the programme

The following are some of the challenges emanated from the evaluation of the training programmes; (i) training programmes for start-up business must be separated from established SMEs, (ii) skills for current business be taught, (iii) training be targeted to those who need it, (iv) target training to specific groups, (iv) provide training at local levels, (v) reasonable times should be assigned to training, (vi) make greater use of electronic transfer in training, (vii) foster entrepreneurship through general education system (OECD, 2002:19-21).

5.0 ANALYSIS

The perceived gaps of the programmes studied are analysed in the table below.
<table>
<thead>
<tr>
<th>Item</th>
<th>Contractors' perceived Gaps</th>
<th>Tanzania</th>
<th>Palestine</th>
<th>Sri Lanka</th>
<th>OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Continuous Professional Development (CPD) – Mentoring of contractors after graduation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ii.</td>
<td>Bridging the skill shortage gap between start-ups and established firms</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>iii.</td>
<td>Training to be adopted to specific area</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>iv.</td>
<td>Different training requirements to be adopted to different levels of contractors</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>v.</td>
<td>Training cost must reasonable</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>vi.</td>
<td>Training should be relevant and responsive to industrial needs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>vii.</td>
<td>Duration of the training programme should not be too long</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>viii.</td>
<td>Training to be more practical</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ix.</td>
<td>Graduates must be assisted even after graduation in acquiring services</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>x.</td>
<td>Training should be Electronically delivered</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xi.</td>
<td>Prompt payment to contractors should be encourage</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The result of the analysis portrays the common factors contractors perceived as lacking in the various training programmes that requires the attention of all stakeholders. It should be observed that most of the gaps emerged in most of the study areas as per items (i),(iii),(iv),(vi),(vii),(viii) and (ix), with items (ii) and (v) emerging in three areas while items (xi) and (x) show up only once.
6.0 CONCLUSION

It is relevant to note that contractors have their own perception and expectation as to how contractor development training programmes should be designed, structured and implemented.

It can be deduced from the study that contractors do not see these training programmes as waste of time but as being beneficial to their businesses. However they would like certain aspects of training to be revised to ensure its successful implementation. These factors as depicted in Table 1 include:

- The adaptation of the programmes to suit the geographic areas of its implementation.
- The adaptation of different training objectives for different levels of contractors.
- Training should be relevant and responsive to industrial needs.
- Training programmes must have shorter durations.
- Training to be more practically oriented.
- Graduates to be mentored even after graduation.
- A continuous contractor development programmes must be inculcated.
- The cost of training should not be too high.
- And training programme to be delivered electronically.

It is consequently recommended that assessments of the outcomes of these development programmes be undertaken regularly to ascertain the extent to which contractors perceive them, and whether they have assimilated what the training was set out to achieve.

Finally, it should be noted that this study is only a desktop study which constitutes the first part of a pragmatic research on contractors' perceptions of contractor development programmes in South Africa.

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The Paradox of Time and Cost Overruns: A Review of Literature in Developing Countries

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ABSTRACT

Purpose: This paper reports on the preliminary findings into the problem of time and cost overruns on construction projects to provide an understanding of the extent of the problem, research done and the solutions proposed. It concludes with suggestions for research on the recurring problem of time and cost over-runs.

Design: Review of literature on the problem of time and cost over-runs in developing countries.

Findings: Completion of projects beyond budgets and scheduled times remains a challenge to many projects today in developing countries in spite of recommendations from previous studies. This paper suggests this may be due to a combination of research methods adopted and the recommendations made.

Research Limitations/Implications: The research is limited to literature that was found on over-runs on construction projects in developing countries.

Practical Implications: This study is intended to contribute to the BEBOK on the management of construction projects in developing countries.

What is original/Value of paper: The study explored the extent of the problem of time and cost over-runs in developing countries to provide a fresh insight into a recurring problem and give suggestions on research approach to be able to identify the root causes.

Keywords: construction projects; cost and time overruns.
1. INTRODUCTION

One of the biggest challenges to managing construction projects today is the problem of time and cost overruns. Many attempts have been made to solve this problem, but we still appear not to have found the solution (AlSehaimi et al, 2012, Flyvbjerg et al, 2011). The paradox is that in spite of the many studies carried out on the problem over the years, projects still continue to experience time and cost overruns (Steyn, 2009). These overruns have been found to affect diverse industries, public and private projects whether small or large, but large projects are the worst affected (Morris and Hough, 1987; Whittaker, 1995; Merrow, 2011). It is reported that nine out of ten large projects have cost overruns (Flyvbjerg et al, 2011).

This paper reports on preliminary findings from a research project on the investigation of the management of large projects in developing countries. The aim of the paper was to review literature on time and cost overruns in developing countries to explore the extent, causes and solutions proposed in an attempt to address the paradox between the amount of research carried out and the lack of progress in reducing them over time and then suggest a possible methodology to investigate the recurring problem. The literature review method was used being a method that would enable a critical review of previous research in over-runs.

2. GEOGRAPHICAL EXTENT OF TIME AND COST OVER-RUNS

Results from previous research show clearly that the problem of over-runs is evident in various parts of the world (Toor and Ogunlana, 2008; Long et al, 2004). In our investigation of over-runs in the developing countries, we found that studies have been carried out in the Middle East, Asia and Africa. Most of these studies were investigating the causes of delay in construction projects. Due to space limitations, only studies in Africa are shown in this paper in Table 1 below.

A total of 25 studies were found with the majority studied in Nigeria followed by South Africa, Libya, Egypt, Ghana and Zambia. Table 1 shows that, 12 studies were investigating successful project management, 8 time and cost over-runs and 5 delay studies.

Table 1: Time and cost over-run studies in Africa

<table>
<thead>
<tr>
<th>Type of Research</th>
<th>Researcher</th>
<th>No of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay Studies/Time over-runs</td>
<td>Aevinu &amp; Jagboro, 2002</td>
<td>5</td>
</tr>
<tr>
<td>1 Effects of delays</td>
<td>Hatunsh et al, 2005</td>
<td></td>
</tr>
<tr>
<td>2 During design</td>
<td>Aevinu &amp; Odeyinka, 2006</td>
<td></td>
</tr>
<tr>
<td>3 In general construction</td>
<td>Challal &amp; TMIoukat, 2012</td>
<td></td>
</tr>
<tr>
<td>4 In water and utility projects</td>
<td>El-Razek et al, 2008</td>
<td></td>
</tr>
<tr>
<td>5 In building projects</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Proceedings 7th Built Environment Conference
The Paradox of time and cost overruns. A Review of literature in Developing Countries
Cape Town, South Africa
### 3. EXTENT OF TIME AND COST OVER-RUNS

An overrun is a situation where a planned event actually takes longer or costs more than it was planned (Assaf and Al-Hejji, 2006; Kaliba et al., 2008). The lack of uniformity in the reporting on over-runs by scholars makes it difficult to know the extent of over-runs. Some refer to the numbers of projects affected and others to percentage of over-runs suffered on projects. Another factor is that most scholars focussed on identifying the causes and effects of over-runs and not the extent. Therefore, there was scant information on the statistics on percentage of projects or the number of projects affected.

In Europe and USA, based on studies of large projects by Morris and Hough (1987), Flyvbjerg et al (2003, 2011) and Merrow, (2011) 18–90% of projects experienced over-runs. Cost over-runs ranged from 25–200% of the planned budgets.

| 6 | In road, civil projects | -- |
| 7 | Time over-run quantification model | -- |
| B | Cost over-runs/Time delay | -- |
| C | Time and cost over-runs | 8 |
| 1 | In road, civil projects | Kaliba et al, 2009 | Mansfield et al., 1994 |
| 2 | Causes of over-runs in large projects | Baloyi & Bekker, 2011 |
| 3 | Causes of over-runs in construction in general | Elinwa & Joshua, 2001 | Steyn, 2009; |
| 4 | Causes of over-runs in building projects | -- |
| 5 | Time, cost performance public projects | Okuwoga, 1998 |
| 6 | Over-runs in public projects | Dlakwa & Culpin, 1990 |
| 7 | Over-runs in water/utility projects | Frimpong et al, 2003 |
| D | Successful project management | 12 |
| 1 | Factors hindering successful project performance | Mbachu & Nkado, 2007 |
| 3 | Project planning | Abubaker et al, 2008 |
| 4 | Factors hindering client satisfaction | Nkado & Mbachu, 2008 |
| 5 | Client assessment of consultants | Oyodele & Tham, 2005 | Oyodele & Tham, 2009 |
| 6 | Status of project management | Bary & Uys, 2011 |
| 7 | Relationship, leadership and teamwork on project performance | Odusami et al, 2003 |
| 8 | Problems of project implementation | Ndiritu & Crawford, 2003 | Olima & K’akumu, 1999 |
| E | Site Management | Ogunlana & Olomolaiye, 1989 |
In the developing countries, the statistics are similar. In the Middle East, Al-Khalil and Al-Ghaflly (1999) investigating causes of delay in public utility projects report that 37-84% of the projects were delayed with the average time over-run of about 39% of the original duration. They also reported that 70% of the public projects in Saudi Arabia had time over-runs whilst Al-Momani (1999), investigating a quantitative approach to construction delays in Jordan, reported that 82% of projects investigated had time over-runs.

In Asia, we did not find latest statistics on projects affected apart from the work by Morris (1990). He reported that 186 out of 290 large public projects in India in 1989 had cost over-runs ranging 0–961% above the planned contract value. 162 projects had time over-runs whose range of over-run was 0–204%.

In Africa, from six studies found with over-runs statistics on projects, not necessarily investigating large projects, the number of projects with over-runs ranged from 80–100% and time over-runs from 63–90% of planned time. The number of projects with cost over-runs ranged from 63–100% with cost over-runs of 0–342% (Mansfield et al, 1994; Elinwa and Joshua, 2001; Aibinu et al, 2006; Frimpong et al, 2006; Hatush et al, 2005; Kaliba et al, 2009).

4. CAUSES OF TIME AND COST OVER-RUNS

Various reasons have been cited in literature as the causes of time and cost over-runs. These are mostly based on the actions and inactions of the project members whether the project was large or not.

In the Middle East, the client is seen in literature to be the major contributor to time and cost over-runs through numerous change orders, poor/delayed payments to contractors and late approvals/slow decision making on project matters. The contractor is seen to be a contributor through their poor planning and scheduling of projects, poor site management and supervision and general poor productivity evidenced through poor workmanship and presence of unskilled labour. The region also has difficulties with acquisition of both professional and skilled artisans. These all indicate that the problems could be emanating from the poor preparation during concept design and feasibility studies in the client’s organisation as well as poor planning in the contractor’s organisation during tendering and planning before construction commencement.

In Asia, like in the Middle East, the problem appears to be incompetence in the procurement system as a whole starting with the clients and their inexperience, poor preparation for projects, unclear objectives resulting in many change orders; the consultants lack of
preparation for the task of design and document preparation resulting in several scope changes due to constructability problems and difficulties of supervision and; the contractor’s poor site management, estimates and financial difficulties possibly from ill-preparation for the task. These are all human and management related causes as observed by Long et al (2004). Again, like in the Middle East, these problems seem to stem from poor pre-project planning sometimes called front-end loading as well as contract tendering and planning by the contractor.

In Africa, the causes mentioned in literature are similar to those in the other two regions, but with the primary cause being the delayed payments to the contractor followed by the financial difficulties of the contractor. The client is also seen to affect the over-runs through frequent change orders; incomplete designs; use of a procurement system which results in poor contract management as well as the bureaucracies in the client organisations where public projects are concerned. The contractor is also blamed for an inefficient materials, contract and labour management system. Cost over-runs are seen to result mostly from time over-runs, increase in cost of resources, projects complexity and inaccuracies in estimates (Baloyi and Bekker, 2011).

5. SOLUTIONS PROPOSED

Various recommendations have been made over the years as shown in the summaries in Table 2 below. The paradox is that in spite of all these studies and recommendations, projects still experience over-runs. This may mean, either the recommendations have been read or have not been read. If they have been read, they have either been acted upon or not acted upon. If acted upon, they have not helped or been ineffective. It could also be that they have been difficult to implement.

Table 2: Solutions to time and cost over-runs in developing countries

<table>
<thead>
<tr>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Client</strong></td>
</tr>
<tr>
<td>Involve or court other players such as contractors in financing projects</td>
</tr>
<tr>
<td>Use other methods of financing projects such as BOOT</td>
</tr>
<tr>
<td>Increase leadership role in projects</td>
</tr>
<tr>
<td>Improve planning and control of projects</td>
</tr>
<tr>
<td>Determine appropriate funding levels at project planning stage</td>
</tr>
<tr>
<td>Minimise design changes/change orders</td>
</tr>
<tr>
<td>Improve payments to contractors</td>
</tr>
<tr>
<td>Improve decision making</td>
</tr>
<tr>
<td>Improve or adopt better procurement process</td>
</tr>
<tr>
<td>Use integrated procurement</td>
</tr>
<tr>
<td><strong>Consultant</strong></td>
</tr>
<tr>
<td>Improve document preparation and production</td>
</tr>
<tr>
<td>Improve communication and coordination of projects</td>
</tr>
<tr>
<td>Minimise design changes</td>
</tr>
<tr>
<td>Improve supervision and assistance/decision making/approvals</td>
</tr>
<tr>
<td>Contractor</td>
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<tr>
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<tr>
<td>Other</td>
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</tbody>
</table>

**Develop human resources in the construction industry:**
- Provide incentives e.g. tax deduction on money spent on training
- Authorise bodies e.g. CIDB to regulate; follow up on training and classify trades
- Develop managerial skills of engineers by offering training/short courses:
  - Finance management
  - Scheduling
  - Time control
  - Information systems
  - Human resource management

Try other contracting approaches such as design and construct which reduce delays by:
- Limiting owner interference
- Improving the design management
- Improving contractual relationships amongst parties

From our review, we found a few scholars who carried out recent reviews of literature on the persistent problem to try to determine why it was still prevalent. AlSehaimi et al (2012) contend that this state of affairs may be due to the descriptive and explanatory type of research. They noted that such a method would not help identify the root causes of the problem. They specifically pointed out three issues. These were that the recommendations made may not be practical, do not address the planning and control which is typically found to be ineffective and lastly that where few studies make recommendations, they did not identify the necessary tools for improvement. They proposed the use of approaches where researchers participate and influence practice whilst creating knowledge.

Ramanathan et al (2011) found that most research used opinion surveys and concluded that there was need for a different research approach from opinion surveys to generate meaningful answers and that there was a strong case against opinion surveys. They recommended the use of statistics on the actual projects as opposed to what the respondents said in the surveys. Eizakshiri et al (2011) in their review of literature on delays confirmed that the problem was still unresolved. They noted that previous studies placed primacy on what contractors could do to manage and eradicate delays and took it for granted that the planned programme was accurate. They made a case that the intentions of the stakeholders potentially affected the project time and proposed that the self-perception questionnaire surveys only went a small way in explaining individual intentions. They proposed that a more interpretive, qualitative technique
could provide a wholistic picture of the dynamics of individual and collective intentions of stakeholders over time.

Steyn (2009) was of the view that the problem has persisted due to the complexity of the problem and the nature of the research that was typically carried out. He explained that the problem is complex as various factors are involved which include the hard and soft issues with numerous causal relationships and interactions amongst them and the fact that several industries are usually involved. He observed that interactions and interrelationships amongst the causes have not been studied to provide a comprehensive view of what is driving projects to overspend and deliver late. He recommended a review of the causes and their relationships and effects and then formulation of a framework to address the problem.

Whilst we found it true that most studies did not investigate the root causes or the factors behind the factors, we noticed that this may have been due to the intent of the research. Most sought to identify the list of factors leading to over-runs to know how they ranked as viewed by project team members. This was particularly true with the self-perception survey method. We also found that where case studies were used, singly or in combination with other methods, hints on the root causes of over-runs were identified.

6. RESEARCH METHODS USED

The predominant research method used in the previous studies has been the use of the questionnaire or opinion survey. In a few instances, case studies have been used. Sometimes there would be a preliminary interview with a few respondents and then the questionnaire survey would be carried out.

In the questionnaire based method, the researchers would use a list of causes from previous studies, validate them with a pilot survey using interviews and then send them out in questionnaire form asking their respondents to rank or confirm that these were the problems faced in their projects or that these were the major causes of over-runs in projects in general. In some cases, the researcher sought to find whether there was consensus amongst the different project management players on the causes of over-runs.

This method has helped enrich project management in identifying the various factors responsible for over-runs over the years. Current research now needs to identify the root causes and possibly the interactions amongst the factors to build on the work that has been done over the years.
7. CONCLUSIONS ON PREVIOUS STUDIES

Most of the studies sought to determine or confirm the causes of over-runs observed in previous studies using surveys where respondents ticked from a list of causes. There are few studies with actual information on the proportion of projects with overruns and the amount or extent of over-runs on the projects which Flyvbjerg et al (2003) calls lack of project data on the issue of over-runs and the projects concerned. There are fewer still who conducted studies to determine the extent of the over-runs and whether the problem was growing or reducing in developing countries over a period of time.

Another significant factor worthy of note is that over-runs are seen to be a result of actors failing to meet the time and cost plan conceived at tender or project conception stage. However, there is a possibility that the plan could be faulty itself, inaccurate or that the intentions of the stakeholders may affect the plan as observed by Eizakshiri et al (2011) has observed that

From the review carried out, the major causes of overruns were the inefficiencies in the client’s organisation resulting into delayed payments, poor procurement method, and frequent changes in the design; inefficiencies in the contractor’s organisation resulting into poor site management and supervision, poor material procurement and supply, reworks and financial difficulties. In the consultant’s organisation, the problems are seen to result from incomplete drawings and documents and poor coordination of projects.

These factors appear to indicate a problem of preparation for projects by the parties involved, particularly the client and the contractor. What could be causing this poor preparation? We wish to speculate that it could stem from the actions of the principal players in the micro-project environment as well as those of players in the macro-project environment. This will require empirical verification of which the self-perception survey may not be the best or only method.

8. THE WAY FORWARD

The problem of over-runs appears to be rooted in the management of the process of project management which is divided into design and construction. These two processes are affected by the actions of project management players within as revealed in the previous studies. However, they are also affected by other players outside the project process who include suppliers, personnel trainers and government in the macro-project environment, especially for large projects. These later factors have sparingly been dealt with in previous research.

Finding a way to harmonise and integrate these players could be one way of beginning to solve the problems of over-runs. Current research
has provided us with the factors which cause over-runs giving us a foothold which we can use to investigate the root causes. We now need to identify the root causes which may be in the micro-environment and the macro-environment. We could then move to the next step which is to formulate a framework of how to address or manage the factors. Therefore, our recommendation is a two way process: investigate the root causes of the over-runs, see how the actions of various players and institutions affect over-runs and then formulate an integrated process for managing projects.

This paper contributes knowledge to the project performance and improvement theme.
An Investigation into the Challenges and Potentials of Delivering Mega Construction Projects in Developing Countries

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ABSTRACT

Purpose
This paper aims to investigate the challenges and potentials of delivering Mega Construction Projects (MCPs) in developing countries.

Design/methodology/approach
To achieve this aim, a research methodology, consists of literature review and case studies, was designed to accomplish three objectives.

- Firstly, building a comprehensive background of the research topic through (1) reviewing the characteristics of developing countries and (MCPs), (2) identifying, validating and classifying the challenges of delivering (MCPs) in developing countries and (3) establishing the necessity of (MCPs) in developing countries.
- Secondly, developing a 4-dimensional model to overcome the challenges of (MCPs) in developing countries.
Finally, outlining research conclusions and recommendations useful for delivering successful (MCPs) in developing countries.

Findings
(MCPs) play significant role towards achieving sustainable development plans in developing countries. These projects have been characterized with poor delivery record, inappropriate design, over budget and beyond schedule. On one hand, these projects require large financial investment, high technical capabilities, professional management skills and competent human resources. On the other hand, developing countries suffer from having limited resources and shortage in these skills which ultimately hinders the development of (MCPs) in these countries.

Research Limitations
This research focused on (MCPs) in developing countries.

Practical Implications
Adopting the model developed by this research will facilitate overcoming the challenges of delivering (MCPs) in developing countries.

Originality / Value
Although the paper highlighted the need to develop (MCPs) in developing countries, it identified the challenges that hinder the delivery of such projects in developing countries. In addition, the value of the study stems from the scant attention paid to study this topic in construction literature, especially in developing countries. Moreover, the developed model represents a synthesis that is novel in thought, adds value to the original body of knowledge and enables governments, decision makers and construction professionals overcome the challenges of delivering (MCPs) in developing countries.

Keywords: Mega Construction Projects, Challenges, Sustainable development, Developing Countries.

1 INTRODUCTION

About 85.4% of the world’s population lives in developing countries. These countries are characterised with (1) low standard of education and vocational training as well as out flow of best brains, (2) corruption and political instability, dearth of capital, outdated technology and low levels of production, (3) poor health care, low life expectancy and high growth rate of population, and (4) difficulties related to social, demographic and culture.
Governments in developing countries construct (MCPs) as an approach for achieving sustainable social and economic development objectives (Zeybek and Kaynak, 2006; Cohen, 2006; Human Development Report, 2011). These objectives include constructing education and training institutions, infrastructure facilities, housing projects, Health care services, business centres, a few to name (Othman, 2012; Khan, 2008; Mthalane et al, 2007; Field and Ofori, 1988). On the one hand, these projects are characterised with the need for high design knowledge and technical skills; competent human resources and managerial capabilities as well as excessive cost investment (Sturup, 2009; Frick, 2006; Flyvbjerg, et al., 2003). On the other hand, developing countries experience shortage of many of these requirements, which obstruct the development of (MCPs). This paper aims to develop a 4-dimensional model to overcome the challenges of developing (MCPs) in developing countries.

2 Research Objectives and Methodology

To achieve this aim, a research methodology consists of literature review and case studies, is designed to accomplish a number of objectives.

- Firstly, building an in-depth understanding of the research topic through (1) reviewing the characteristics of developing countries and (MCPs), (2) identifying, validating and classifying the challenges of delivering (MCPs) in developing countries and (3) establishing the necessity of (MCPs) in developing countries. This objective was achieved through literature review and analysis of 36 case studies of (MCPs) (developed, underdevelopment, on hold or cancelled) in developing countries worldwide. These projects covered a wide range of projects, see figure (1).

- Secondly, developing a 4-dimensional model to overcome the challenges of (MCPs) in developing countries.

- Finally, outlining research conclusions and recommendations useful for delivering successful (MCPs) in developing countries.

![Figure (1) Types and Numbers of (MCPs) Surveyed in Developing Countries](image)
Developing Countries

**Characteristics of Developing Countries**

Generally, the classification of a country as “developed” or “developing” is based on certain measures such as (1) economic development, (2) education and training provision, (3) political stability, technological development, infrastructure and production rate, (4) healthcare, life expectancy and growth rate of population, and (5) society, demography and culture issues. Economically, the World Bank (2012) classified countries into four income groups based on their Gross National Income (GNI) per capita. All low (GNI ≤ US$ 1,025), lower (GNI = US$ 1,026 - US$ 4,035), and upper middle-income countries (GNI= US$ 4,036 - US$ 12,475) are classified as developing countries. In 2011, the United Nations developed the **Human Development Index** (HDI) as a measure to gauge the level of human development of countries. The index showed that 18% the world's population lives in low human development countries (HDI below 0.500), while 52% populate countries falling in the medium human development category (HDI = 0.500 – 0.799), all of which represent developing countries (Human Development Report, 2011). Table (1) summarises the remaining characteristics of developing countries.

<table>
<thead>
<tr>
<th>Table (1) Characteristics of Developing Countries</th>
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</thead>
<tbody>
<tr>
<td>Characteristics related to Education, Training &amp; Brain Drain</td>
</tr>
<tr>
<td>1. Low standard of education and vocational training</td>
</tr>
<tr>
<td>Characteristics related to Policy, Economy, Technology, Infrastructure and Production</td>
</tr>
<tr>
<td>3. Corruption and political instability</td>
</tr>
<tr>
<td>4. Lack of capital and technology</td>
</tr>
<tr>
<td>5. Dualistic economy</td>
</tr>
<tr>
<td>6. Vicious Circle of Poverty</td>
</tr>
</tbody>
</table>
7. Low levels of productivity
8. Inequalities of national income distribution
9. Inadequate infrastructure
10. Heavy dependence on agricultural production
11. External resources dependence
12. Lack of industries and enterprises
13. Underutilized natural resources
14. High and rising levels of unemployment and under-employment (Economic Concepts, 2013; Connexions, 2012; Kumar, 2012; Economics, 2010; Bobrova and Kalvina, 2004; Fry, 1998)

Characteristics related to Health Care, Life Expectancy and Growth Rate of Population

15. Poor health care
16. Low life expectancy

Characteristics related to Society, Demography and Culture

18. General and social backwardness
19. Demographic characteristics

3.2 Characteristics of (MCPs)

Different terms are used in to describe what large projects such as complex projects, major projects, giant projects, new animals and megaprojects (Ruuska et al., 2009; Grun, 2004; Flyvbjerg, et al., 2003). (MCPs) are massive investment projects aimed at supporting governments achieving
their social and economic development objectives. They attract public and political attention due to their significant impacts on communities, environment and budgets (Capka, 2004; Van Marrewijk et al., 2008). In addition, (MCPs) are owned by governments and executed by large construction firms. Furthermore, (MCPs) are risky undertakings which consume large amount of time, cost and require competent design and construction professionals as well as skilled managerial team. Table (2) summarises the characteristics of (MCPs).

<table>
<thead>
<tr>
<th>Table (2) Characteristics of (MCPs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics related to Project Nature, Objective, Location, Time, Cost, and Risk</td>
</tr>
<tr>
<td>1. Colossal in size and scope physical infrastructure / capital asset with a life span measured in decades in order to plan, design, finance and build (Sanderson, 2012; Sturup, 2009; Frick, 2006; Bruzelius et al., 2002)</td>
</tr>
<tr>
<td>2. Located in remote and/or inhospitable areas (Flyvbjerg, et al., 2003; Haynes, 2002).</td>
</tr>
<tr>
<td>3. Costly and often under estimated projects that require high investment expenditures of:</td>
</tr>
<tr>
<td>• US$1 billion or more (Sturup, 2009; Frick, 2006; Flyvbjerg, et al., 2003; Bruzelius et al., 2002)</td>
</tr>
<tr>
<td>• £150 million as a bench mark cost (Sturup, 2009)</td>
</tr>
<tr>
<td>• EUR 0.5 billion and more (Megaproject Cost Action, 2012)</td>
</tr>
<tr>
<td>4. Controversial and often have financing difficulties (Sturup, 2009; Frick, 2006; Haynes, 2002)</td>
</tr>
<tr>
<td>5. Risky undertakings, especially when:</td>
</tr>
<tr>
<td>• project priorities and objectives changed (Ruuska et al., 2009)</td>
</tr>
<tr>
<td>• project extends over its economic cycles (Jia et al., 2011; Little, 2011)</td>
</tr>
<tr>
<td>• shortage of labour and suppliers (Haynes, 2002)</td>
</tr>
</tbody>
</table>
- lack of planning and cost estimate (Keegan, 2004; Bruzelius et al., 2002)
- poor technology and traditional delivery methods (Jia et al., 2011; Little, 2011)

**Characteristics related to Client(s) and Performing Organisation Structure**

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>6.</td>
<td>The client is often a government or public sector organisation</td>
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<tr>
<td>7.</td>
<td>The main contractor or consortium of contractors are usually privately owned, financed and</td>
</tr>
<tr>
<td></td>
<td>often from various countries with variety of cultural differences, backgrounds, political</td>
</tr>
<tr>
<td></td>
<td>systems, and languages, seeking success with different objectives (Kardes, et al., 2013;</td>
</tr>
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<td></td>
<td>Sanderson, 2012; Ruuska et al., 2009; Shore and Cross, 2005; Haynes, 2002)</td>
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<tr>
<td>8.</td>
<td>Complex management structure and the matrix and project organisational forms are used</td>
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<td></td>
<td>interchangeably (Kerzner, 2003; Stoddart-Stones, 1988)</td>
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<tr>
<td>9.</td>
<td>Insufficient experience of performing organisation in managing complex undertakings</td>
</tr>
<tr>
<td></td>
<td>(Keegan, 2004; Haynes, 2002)</td>
</tr>
<tr>
<td>10.</td>
<td>Continuous organizational restructuring may be necessary as each project goes through a</td>
</tr>
<tr>
<td></td>
<td>different life-cycle phase (Kerzner, 2003)</td>
</tr>
<tr>
<td>11.</td>
<td>The performing company often retains an ownership stake in the project after completing</td>
</tr>
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<td></td>
<td>the construction phase in a special purpose vehicle and is paid by the client for the</td>
</tr>
<tr>
<td></td>
<td>service that flows from the asset’s operation or use over a number of years (Sanderson,</td>
</tr>
<tr>
<td></td>
<td>2012)</td>
</tr>
</tbody>
</table>

**Characteristics related to Engineering Design and Technical Requirements**
|
|---|
|12. Complex projects that demand high design knowledge, professional technological skills and logistical support |
|13. Necessitates multidisciplinary contributions from various organizations (Sturup, 2009; Frick, 2006; Flyvbjerg, et al., 2003) |
|14. Long term projects that require program planning, control and highly trained employees especially in the field of Project Management |
|15. Requires clearly defines rules and procedures as well as effective communication at all levels |
|16. Requires quality front-planning (Sturup, 2009; Kerzner, 2003) |
|17. Projects’ captivation due to their size, engineering achievements and aesthetic design call for virtual enterprise for the implementation of the project through exploiting fast-changing opportunities and confronting problems as early as possible (Sturup, 2009; Frick, 2006; Flyvbjerg, et al., 2003) |

### Characteristics related to Environment, Society, Economy and Policy

18. Public acceptance / opposition due to the social, economic, political and environmental impacts (Ruuska et al., 2009; Haynes, 2002) |
19. Politics are playing an important role in how senior management appointments and activities are defined (Haynes, 2002; Stoddart-Stones, 1988) |
20. Poor risk analysis and inappropriate identification of the project consequences (Hopkinson, 2007) |

### 3 Identification, Validation and Classification of Challenges of delivering (MCPs) in developing countries

Towards assisting governments of developing countries achieving their sustainable development objectives and overcoming the challenges that hinder the development of (MCPs), these challenges have to be identified, validated and classified. Firstly, literature review was used to identify to identify these challenges based on textbooks, academic journals and professional magazines, conference and seminar proceedings,
dissertations and theses, organisations and government publications as well as Internet and related websites. Secondly 36 case studies of (MCPs) (either developed, under development, on hold or cancelled) were collected and analysed to validate the challenges identified from literature review. The use of case studies confirmed the identified challenges and added new ones, which were not covered by current literature. These new challenges were specific to the culture of the analysed projects and their societies. By using more than one source of evidence (literature review and case studies), it was possible to improve the validity of the collected challenges and increase background knowledge (Yin 1989; MacPherson et. al 1993). Literature review and case studies resulted in the identification of 65 challenges. The work was reviewed and refined by the author on regular basis to omit repeated challenges and merge similar ones. The result was 45 challenges. Finally, identified and validated challenges were classified based on their nature into four categories, namely Engineering Challenges (EC), Human Development Challenges (HDC), Managerial and Political Challenges (M&PC), and Sustainability Challenges (SC), see table (3).

<table>
<thead>
<tr>
<th>No.</th>
<th>Challenges of Developing Megaprojects in Developing Countries</th>
<th>EC</th>
<th>HDC</th>
<th>M&amp;PC</th>
<th>SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lack of design knowledge and experience related to (MCPs) (Georgieva, 2012; Deputy, 2011).</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Lack of professional expertise and full consideration of technical requirements (Georgieva, 2012; Deputy, 2011).</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Misunderstanding and partial achievement of project objectives (Georgieva, 2012)</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>Lack of financial resources, cost control and venture capital (Al-Maghraby, 2012; Georgieva, 2012; Jia et al., 2011; Witular, 2009)</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>5</td>
<td>Lack of research capacity and business innovation (Georgieva, 2012)</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td>Missing Intermediary bodies (Georgieva, 2012)</td>
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<td>X X</td>
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<td>Description</td>
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<tr>
<td>7</td>
<td>Unfavourable regulatory framework (Georgieva, 2012)</td>
<td>X</td>
<td></td>
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<td>8</td>
<td>Lack of providing and managing high-qualified human resources</td>
<td>X</td>
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<td></td>
<td>(Georgieva, 2012; Baloyi and Bekker, 2011; Koen and Theron, 2008)</td>
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<td>9</td>
<td>Bureaucracy and corruption practices (Al-Maghraby, 2012; Georgieva, 2012)</td>
<td>X</td>
<td></td>
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<tr>
<td>10</td>
<td>Lack of political support and inefficiency (Merco Press, 2013; Al-Maghraby, 2012; Georgieva, 2012)</td>
<td>X</td>
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<td>11</td>
<td>Difficulty resourcing the right skills and matching with project demands and geography</td>
<td>X</td>
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<td></td>
<td>(Procaccini et al., 2012; Baloyi and Bekker, 2011).</td>
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<td>12</td>
<td>Lack of experienced staff to accept critical roles which they are not prepared for (Procaccini et al., 2012; Koen and Theron, 2008)</td>
<td>X X</td>
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<td>13</td>
<td>Governance decisions fail to strike a balance between short- and long-term objectives and effective risk mitigation (Procaccini et al., 2012)</td>
<td>X</td>
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<td>14</td>
<td>Improper identification and engagement of various stakeholder groups in the early project phases (Procaccini et al., 2012)</td>
<td>X X</td>
<td></td>
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<td>15</td>
<td>Tight service market and lack of internal capacity (Procaccini et al., 2012)</td>
<td>X X</td>
<td></td>
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<td>16</td>
<td>Improper implementation of project management processes and training of key project staff (Procaccini et al., 2012; Hussein and Karimin, 2006)</td>
<td>X</td>
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<td>No.</td>
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<td>17</td>
<td>Lack of available on-site skilled workers or local labour forces (Baloyi and Bekker, 2011; Kerzner, 2003)</td>
<td>X</td>
<td></td>
<td></td>
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<td>18</td>
<td>Lack of properly trained on-site supervisors (Koen and Theron, 2008; Kerzner, 2003;)</td>
<td>X X X</td>
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<td>19</td>
<td>Huge numbers of people and organisations of different specialties involved in mega projects development (Kerzner, 2003)</td>
<td>X X</td>
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<td>20</td>
<td>Ill-defined rules and procedures as well as inappropriate use of prior experience to review contingencies (Kerzner, 2003)</td>
<td>X</td>
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<td>21</td>
<td>Inadequate communication at all levels and poor coordination interface management between project stakeholders (Kerzner, 2003; Toor and Ogunlana, 2006)</td>
<td>X X</td>
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<td>22</td>
<td>Lack of quality front-end planning (Kerzner, 2003)</td>
<td>X X</td>
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<tr>
<td>23</td>
<td>Improper decision making and overlooking specialists and stakeholders consultation during the decision making process (Jia et al., 2011; Kerzner, 2003; Toor and Ogunlana, 2006)</td>
<td>X X</td>
<td></td>
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<td>24</td>
<td>Lack of construction material availability (Tenah, 1985)</td>
<td>X</td>
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<td>25</td>
<td>Ignorance of health and safety considerations as well as the absence of activating health and safety acts (Othman, 2012)</td>
<td>X X</td>
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<td>26</td>
<td>Weak governance of project management (Hopkinson, 2007; Hussein and Karimin, 2006)</td>
<td>X</td>
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<td>27</td>
<td>Political imperatives and authority misuse (Hopkinson, 2007; Toor and Ogunlana, 2006)</td>
<td>X</td>
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<td>28</td>
<td>Lack of exploiting uncertainties (Hopkinson, 2007)</td>
<td>X</td>
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<td>29</td>
<td>Project authorisation pressures on individuals (Hopkinson, 2007)</td>
<td>X</td>
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<td>30</td>
<td>Failure to invest sufficiently before the project’s main authorisation point (Hopkinson, 2007)</td>
<td>X</td>
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<td>31</td>
<td>Unachievable targets cause sub-optimal project outcomes (Hopkinson, 2007)</td>
<td>X</td>
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<td>32</td>
<td>Lack of efficiency and effectiveness of the Project Management process</td>
<td>X</td>
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<td>33</td>
<td>Naïve risk analysis and inappropriate identification of the project consequences (CBC News, 2012; Hopkinson, 2007)</td>
<td>X</td>
<td>X</td>
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<td>34</td>
<td>Inappropriate behaviour of the client organisation (Altman, 2005) and absence of national policy to resettlement of affected people</td>
<td>X</td>
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<td>35</td>
<td>Lack of considering environmental requirements, preserving historical sites, and natural reserve (Walta info, 2013; UNESCO, 2012; Hernandez, 2012; Fearnside, 2006; Best and De Valence, 1999)</td>
<td>X</td>
<td>X</td>
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<td>36</td>
<td>Ineffective project management and poor use of experience and competency of client and contractor organisations (Hussein and Karimin, 2006)</td>
<td>X</td>
<td>X</td>
<td></td>
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<td>37</td>
<td>Lack in managing complexities of work content and work processes (Hussein and Karimin, 2006)</td>
<td>X</td>
<td>X</td>
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<td>38</td>
<td>Lack of strategic project planning and ineffective leadership (Hussein and Karimin, 2006)</td>
<td>X</td>
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<td>40</td>
<td>Lack of managing social project complexity (Brockmann and Girmschied, 2007)</td>
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<td>41</td>
<td>Lack of managing cultural project complexity (Brockmann and Girmschied, 2007; Othman et al., 2004)</td>
<td></td>
<td>X</td>
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<td></td>
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<tr>
<td>42</td>
<td>Inappropriate level of scientific and technological knowledge and application required (Jia et al., 2011; Deputy, 2011)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>43</td>
<td>Lack of providing quality education and professional training programmes (Baloyi and Bekker, 2011; Naidoo et al., 2009)</td>
<td>X</td>
<td>X</td>
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<td>44</td>
<td>Political tension between countries (GAP, 2011)</td>
<td></td>
<td>X</td>
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<tr>
<td>45</td>
<td>Stakeholders change project requirements at later stages of the project life cycle (Othman et al., 2004)</td>
<td>X</td>
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5 A 4-DIMENSIONAL MODEL FOR OVERCOMING CHALLENGES OF DELIVERING (MCPs) IN DEVELOPING COUNTRIES.

5.1 Model rationale and components

Analysis of literature review and case studies confirmed the need to develop (MCPs) in developing countries as an approach for achieving sustainable development objectives. This could be accomplished through developing a model to overcome the challenges of (MCPs) development. The proposed model consists of four improvement dimensions namely: Education and training, Human resources, Policy and management and Sustainability, see figure (2). Towards achieving these dimensions, a number of steps have to be implemented:

- Diagnosing current challenge
- Identifying improvement opportunities and strategies
- Planning and implementing improvement opportunities
- Monitoring and evaluating obtained results
5.1.1 Diagnosing current challenge
This step aims to investigate the current challenges that obstruct the development of (MCPs) in developing countries. Within this the step, the current status of (MCPs) in developing countries is studied. This includes investigating developed, under development, on hold or cancelled projects and their environmental, social, economic impacts on achieving sustainable development objectives. A list of all challenges has to be compiled from literature review, survey questionnaires and interviews with project managers and involved parties. In order to complete challenges diagnose, these challenges have to be validated through case studies and classified as Engineering Challenges, Human Development Challenges, Managerial and Political Challenges or Sustainability Challenges. It is essential to have an orientation meeting prior to the study to establish strategic issues such as: study objectives, information required, team structure, study duration and location. Gaining government, decision makers and top management support and approval will facilitate gaining the needed resources, accepting and implementing study decisions, see figure (3).

5.1.2 Identifying improvement opportunities and strategies
This step aims to identify improvement opportunities and strategies towards overcoming the challenges of (MCPs) in developing countries. Identifying improvement opportunities have to be done through brainstorming and
team consensus techniques which will help generating and evaluating creative improvement ideas. Areas of improvement could include: education and training; human resources; policy and management; and sustainability. This necessitate developing technical, economic, social and time feasibility studies as well as costs and benefits of improvement. Ensuring government, decision makers and top management support and approval on improvement opportunities will allow the team members to continue the study with confidence and adopting study recommendations. Within this step, improvement strategies and actions to be taken for implementation have to be established and evaluated, see figure (3).

5.1.3 Planning and implementing improvement opportunities
Within this step, the improvement strategies and actions resulted from the previous step will be planned and implemented. The planning process includes activities such as securing government, decision makers and senior management support, developing management plan (i.e. time, cost, quality, resources, etc.). In addition, the implementation process may require that employees involved in the improvement opportunities be trained and equipped with all tools and technologies required to guarantee the successful execution of plans. Furthermore, team work and offering required facilities will help overcoming the challenges of (MCPs) in developing countries. To ensure the quality of the work performed, the implementation step should use the work authorization system, which verifies predecessor activities and permits the successor activity to begin as well as performance measurement system, see figure (3).

5.1.4 Monitoring and evaluating obtained results
The aim of this step is to monitor and evaluate the results obtained from the planning and implementation step. Within this step, results have to be measured against the performance measures developed earlier, causes of failure and issues that caused deviation from original plans have to be studied and evaluated, see figure (3).

5.1.5 Implementing corrective actions and feedback
Within this step of the model, corrective actions which have been gathered in the previous step have to be implemented. In addition, lessons learned have to be gathered and shared with government authorities, decision makers and team members. Providing government, decision makers, and team members with feedback will help improving the performance in overcoming other challenges of (MCPs) in developing countries, see figure (3).
6 CONCLUSIONS AND RECOMMENDATIONS

Governments in developing countries develop (MCPs) as an approach for achieving sustainable development objectives. On the one hand, these projects are characterised with the need of high design knowledge and technical skills, competent human resources, professional managerial capabilities and large financial investment. On the other hand, developing countries suffer from having shortage in meeting these requirements, which hinders the development of such essential projects in developing countries. This paper aimed to investigate the challenges and potentials of delivering (MCPs) in developing countries. Literature review and case studies identified and validated 45 challenges and classified them into four categories as Engineering challenges, Human Development challenges, Political and managerial challenges and sustainability challenges. In addition, the paper proposed a 4-dimensional model to assist governments and decision makers in developing countries overcoming these challenges. The paper recommends that governments and decision makers pay more attention and offer needed facilities towards:

- Creating national capacity to investigate the topic of (MCPs) from different perspectives such as delivery methods suitable to developing countries, potentials of collaboration between public and private sectors, etc.
- Learning from other countries that developed (MCPs) successfully and maintaining collaboration at different dimensions.
- Adopting the proposed model as an approach towards overcoming the challenges of delivering (MCPs) in developing countries.
Figure (3) Steps, Activities and Tools & Techniques of the 4-Dimensional Model for Overcoming Challenges of Delivering (MCPs) in Developing Countries
7. REFERENCES


Economic Concepts. (2013). Common Characteristics of


Incentives as an activation agent for construction and consultant team members to enhance a successful construction project delivery

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ABSTRACT

Purpose:
The aim of this paper is to determine which incentives motivate each of construction and consultant team members to achieve a successful project delivery.

Design:
This is study designed based on a deductive approach whereby the problem (hypothesis) under investigation is developed from established theories; and in this instance, motivational incentives. A theoretical framework of the study was outlined to guide the focus of the literature. The literature on types of incentives, goals of incentives in organisations, and incentives to team members has been reviewed.

Findings:
The literature suggested that both monetary and non-monetary incentives can be used to stimulate people to work. Therefore, incentives can be designed to achieve specific goals aligned with project requirements. However, it was argued that an incentive mechanism that motivates a contractor may not necessarily be applicable to a designer. It was suggested that knowing what motivates each team member may provide the project manager with the ability to connect with team members to environments, assignments, and responsibilities that foster personal motivation.
Research limitations:
While desktop study findings reported here do not represent any specific professional entity, it is anticipated that the analysis of field data will reveal some motivational incentive patterns specific to each of the construction and consultant team members.

Practical implications:
By understanding incentives as activation tool for a successful infrastructure delivery, this will compel project managers to design incentive driven contracts streamlined to stimulate project participants’ commitment to higher performance as a team.

Value:
Given the delivery challenges faced with the South African construction industry, the consideration of incentives that motivate each construction and consultant team member would create conducive project environment to achieve a successful project delivery.

Keywords: construction and consultant team, monetary incentive, successful project delivery

1. INTRODUCTION

Traditionally, it has been believed that project success can be measured in terms of cost, quality and time. However, Saqib, Farooqui and Lodi (2008) argue that the success criteria often change from project to project, depending on the participants, the scope of the services offered, the project size, the sophistication of the client in relation to the design of the facilities and the technological implications. A project’s success depends on the performance of the participants entrusted to execute the project (Oyedele, 2010) and motivation in meeting project goals (Peterson, 2007). Previous studies have revealed that reward or incentives can motivate construction project participants to put extra effort to perform better (Bower, Ashby, Gerald, Smyk & 2002:37; Rose & Manley, 2011:765; Rose & Manley, 2010:253). Yavuz (2004:9) indicates that the concepts of ‘incentive’, ‘reward’, and recognition are quite interrelated and complementary in the context of employee motivation.

Barbour (2005) asserts that the economic rationale for incentives seeks to correct, for example, market failures including, information asymmetries, the public good nature of investment in research and development, and infant industry protection. In the South African
construction industry context, incentives may be used as an activation agent to compel various professional participants in construction project to achieve project objectives.

While there are many types of activation agents that compel construction and consultant team members towards achieving project objective, this paper will discuss monetary and non-monetary incentives offered towards a successful project delivery. The objective of the study is to identify the most important motivational incentive construction and consultant team members are willing to adopt in procurement of construction projects. In other words, the gap in knowledge or problem area to be addressed is that “the most important motivational incentive that motivates construction and consultant team members in project success is not evident”.

2. RESEARCH METHODOLOGY

This research follows a deductive approach as depicted in Figure 2. In fact, Walliman (2005) advises that depending on the subject and position in the debate about the research, the main argument may be based on inductive or deductive reasoning. Deductive reasoning is a theory testing process which commences with an established theory or generalisation, and seeks to see if the theory applies to specific instances (Hyde, 2000).

![Figure 2 Distinction between deductive and inductive approach Adapted from Burney (2008:6)]
Mouton (2001) indicates that the most common forms of deductive reasoning in science are the following:

- Deriving the hypothesis from theories and models; and
- Conceptual explications: when the meaning of a concept is clarified through the deductive derivation of its constructive meaning.

In fact, given the deductive reasoning approach adopted for this study, the theoretical concepts on motivation which have been limited to individual employees will be replicated to the construction and the consultant team members rendering services to the clients. However, the study is confined to the literature review.

3. LITERATURE REVIEW

3.1 Types of incentives

3.1.1 Monetary incentives

It should be noted that incentives are provided following two categories: monetary incentives and non-monetary incentives (MSG, 2012: online). Monetary incentives involve granting reward in terms of money such as commissions, bonus (Yavuz, 2004:9). MSG (2012: online) refers to monetary incentives as those incentives which satisfy the subordinates by providing them rewards in terms of money. Money has been recognized as a chief source of satisfying the needs of people. Money is also helpful to satisfy the social needs by possessing various material items. Therefore, money not only satisfies psychological needs but also the security and social needs. Therefore, in many factories, various wage plans and bonus schemes are introduced to motivate and stimulate the people to work.

3.1.2 Non-monetary incentives

Non-monetary incentives do not involve direct cash payment (Yavuz, 2004:9). Management Study Guide (2012: online) indicates that besides the monetary incentives, there are certain non-financial incentives which can satisfy the ego and self-actualization needs of employees. The incentives which cannot be measured in terms of money are under the category of “non-monetary incentives”. Whenever a manager has to satisfy the psychological needs of the subordinates, he makes use of non-financial incentives. Some examples of non-monetary incentives are: encouraging employees by providing them with autonomy in their job and participation in decision making, assigning challenging duties, improving working conditions, recognising good work through small gifts, letters of appreciation.
Management Study Guide (2012: online) adds that non-monetary incentives can be of the following types:

- **Security of service** - Job security is an incentive which provides great motivation to employees. If his job is secured, he will put maximum efforts to achieve the objectives of the enterprise. This also helps since he is very far off from mental tension and he can give his best to the enterprise.

- **Praise or recognition** - The praise or recognition is another non-financial incentive which satisfies the ego needs of the employees. Sometimes praise becomes more effective than any other incentive. The employees will respond more to praise and try to give the best of their abilities to a concern.

- **Suggestion scheme** - The organization should look forward to taking suggestions and inviting suggestion schemes from the subordinates. This inculcates a spirit of participation in the employees. This can be done by publishing various articles written by employees to improve the work environment which can be published in various magazines of the company. This also is helpful to motivate the employees to feel important and they can also be in search for innovative methods which can be applied for better work methods. This ultimately helps in growing a concern and adapting new methods of operations.

- **Job enrichment** - Job enrichment is another non-monetary incentive in which the job of a worker can be enriched. This can be done by increasing his responsibilities, giving him an important designation, increasing the content and nature of the work. This way efficient worker can get challenging jobs in which they can prove their worth. This also helps in the greatest motivation of the efficient employees.

- **Promotion opportunities** - Promotion is an effective tool to increase the spirit to work in a concern. If the employees are provided opportunities for the advancement and growth, they feel satisfied and contented and they become more committed to the organization.

### 3.1 Goal of incentives in organisations

Content theories of motivation go back as the turn of the 20th century, when pioneering scientific managers such as Frederick W. Taylor, Frank Gilbreth, and Henry L. Gantt proposed sophisticated wage incentive models to motivate workers (Luthans, 2005:239). According to Management Study
Guide (2012: online) incentives are referred to as something which is given in addition to wage; which means additional remuneration or benefit to an employee in recognition of achievement or better work. Incentives provide a spur or zeal in the employees for better performance. It is a natural thing that nobody acts without a purpose behind. Therefore, a hope for a reward is a powerful incentive to motivate employees. Besides monetary incentive, there are some other stimuli which can drive a person to better; this will include job satisfaction, job security, job promotion, and pride for accomplishment (Management Study Guide, 2012: online). Management Study Guide (2012: online) establishes that incentives can work to accomplish following goals:

- To increase productivity,
- To drive or arouse a stimulus work,
- To enhance commitment in work performance,
- To psychologically satisfy a person which leads to job satisfaction,
- To shape the behavior or outlook of subordinate towards work,
- To inculcate zeal and enthusiasm towards work, and
- To get the maximum of their capabilities so that they are exploited and utilised maximally.

It is evident that organisations have benefit of exploiting benefits derived from incentive provisions.

3.3 Incentives to team members

Incentives can be used in a construction project context so as stimulate construction and consultant team members achieve a successful project delivery. According to Rose and Manley (2011:765), the use of incentives is seen as a key means of improving built environment outcomes. Rose and Manley (2011:765) indicate that financial incentives are necessary not only to enhance motivation at personal and organisation levels; but also, to promote unified motivation across highly interdependent and contractually fragmented project teams. Tang, Qiang, Duffield, Young and Lu (2010:465) stipulate that there is a consensus among all parties involved in any construction project that the use of incentives is effective in providing motivation for participants to perform better.

Obviously, incentive packages are designed to achieve specific goals aligned with the project requirements. The spirit in which the incentives are designed is to attempt to align the interests of the contractor with those of the client by basing compensation, to some degree, on the
Incentives as an activation agent for construction and consultant team members to enhance a successful construction project delivery

results that are important to the client (Howard, 1996:112). In other words, the more the rewards from the client, the more the contribution of the consultant team member to a successful project delivery. Incentives are used to increase the effort of construction and design teams in voluntary performance goals beyond the contractual specifications (Rose & Manley, 2010:253). This can potentially be achieved by having the construction and consultant team members share in the client's success by means of a wide range of performance areas, such as cost containment, schedule performance and quality of workmanship (Rose & Manley, 2010:253).

However, an incentive mechanism that motivates a contractor to achieve a successful project delivery may not necessarily be applicable or desirable to a designer. For example, a contractor's driving factor in project delivery may be early project completion to avoid penalties for delays while designers' driving factor may be to show-off their ability to produce state-of-the-art designs. Oyedele (2010:181) indicates that motivation is a multi-faceted concept and has no single answer of what best motivates people at work. Peterson (2007:65) suggests that knowing what motivates each team member may provide the project manager with the ability to connect team members to environments, assignments and responsibilities that foster personal motivation. In a case study, Rose (2008:232) revealed that all consultant representatives involved in the project were suspicious of the monetary incentive intention and they felt the monetary incentive implied they would not perform better without it. However, this was in contrast with the managing contractor and subcontractors' views; they valued the opportunities inherent in the financial incentives (Rose, 2008:232). It is evident that one contracting party may be motivated by monetary incentives while the other may be motivated by non-monetary incentives. Given such an example, there is no agreement between the construction and the consultant teams on whether either monetary or non-monetary incentives would necessarily motivate them to achieve a successful project delivery.

4. CONCLUSION AND FURTHER RESEARCH

The study postulated that both monetary and non-monetary incentives constitute a tool for compelling employees for a better performance. In the construction context, incentives were anticipated as useful to improve built environment outcomes. However, it was contended that an incentive mechanism that motivates a contractor to achieve a successful project delivery may not necessarily be applicable or desirable to a designer. For example, a contractor's driving factor in project delivery may be early project completion to avoid penalties for delays while designers' driving factor may be to show-off their ability to produce state-of-the-art designs. Oyedele (2010:181) indicates that motivation is a multi-faceted concept and has no
single answer of what best motivates people at work. Peterson (2007:65) suggests that knowing what motivates each team member may provide the project manager with the ability to connect team members to environments, assignments and responsibilities that foster personal motivation. In a case study, Rose (2008:232) revealed that all consultant representatives involved in the project were suspicious of the financial incentive intention and they felt the financial incentive implied they would not perform better without it. However, this was in contrast with the managing contractor and subcontractors’ views; they valued the opportunities inherent in the financial incentives (Rose, 2008:232). Given such an example, there is no agreement between the construction and the consultant teams on whether either monetary incentives or non-monetary incentives would necessarily motivate them to achieve a successful project delivery. Therefore, an empirical study is deemed necessary to find what kind of incentive would be suitable for each of the construction and consultant team members. Given the delivery challenges faced with the South African construction industry, a further study on incentives would create conducive project environment to achieve a successful project delivery. By understanding incentives as activation tool for a successful project delivery, this will compel construction industry stakeholders to design incentive driven contracts streamlined to stimulate project participants’ commitment to higher performance as a team.

Acknowledgement

The financial assistance provided by the Cape Peninsula University towards this research project under Staff Development Programme and University Research Fund is acknowledged.

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Dominant Factors Hampering Full Participation of Female Contractors In The South African Construction Industry

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ABSTRACT

Purpose of this paper
This paper analyses the experiences of female contractors in the South African construction industry in order to identify dominant factors hampering their meaningful participation in the industry.

Design/methodology/approach
Structured questionnaires and focus groups were used as the main data collection instruments. A purposive sample of 2,145 grade 2 – 6 female contractors was drawn from women-owned construction entities of Gauteng, Eastern Cape and Mpumalanga provinces that are registered on the Construction Industry Development Board (CIDB) database.

Findings
The findings identified various factors that hamper development and meaningful participation of female contractors in the construction industry in South Africa. Participation of female contractors in the industry remains...
limited. Current legislation, strategies and programmatic interventions utilized by government entities to facilitate transformation of the industry to embrace and accept participation of women; has not yielded the desired results.

**Research Limitations**
A purposive sample of 2 145 women-owned construction companies was obtained from the CIDB register of contractors in categories 2-6, selected from three provinces only, namely; Gauteng, Eastern Cape and Mpumalanga.

As this research was restricted to experiences of female contractors, further surveys need to be conducted with women in built-environment professions and women in construction trades to provide information for a more comprehensive and comparative analysis of the status of female participants in the construction industry.

**Practical implications**
According to the 2011 statistics from the CIDB register of contractors, women-owned construction entities constituted 48% of the total number of registered construction companies. This study has drawn attention to the fact that participation of women in this industry is hampered by factors that can no longer be ignored. Political-will is not enough. A more rigorous approach is required to effect meaningful change.

**The value of the paper**
The study has highlighted that empowerment legislation, programmes and strategic intervention designed to empower women in the construction industry in South Africa must be backed up with industry-specific legislation to bring about meaningful transformation in this traditionally male-dominated industry. Women empowerment must be institutionalized in order to be effective.

**Keywords:** Construction, Women Empowerment, Transformation, Gender Policy, South Africa
1. INTRODUCTION

The South African government’s vision for the country is that of an adaptive economy characterised by growth, employment and equity. To meet the needs of all people and their enterprises in a sustainable manner, the South African economy must build on the full potential of all persons and communities across the length and breadth of its country. However, vast racial and gender inequalities in the distribution of and access to wealth, income, skills and employment persist. As a consequence, our economy continues to perform below its full potential (Department of Trade and Industry (SA), 2007).

Like other progressive countries of the world, South Africa recognises that no economy can grow without providing opportunities for all its citizens to participate actively in the mainstream of its economy. Historical disparities in this country made it necessary for the government to introduce legislation that would facilitate transformation and thereby create an enabling environment for participation by previously disadvantaged individuals (pdls), including women (the historically disadvantaged - hdi’s).

In traditionally male-dominated industries such as construction, special programmes and strategic interventions were introduced to empower those that are already participating and to encourage entry of new participants. In fact, the Commission for Gender Equality commented in 1999 that mining and construction were two industries with little prospects to offer to the empowerment path of women. At the time there were apparently only 84 women (7%) participating in the construction sector, mostly involved in cleaning, horticulture and catering services. The comment presented such a challenge to the Minister of Public Works, Ms Stella Sigcau, that in 2001, she launched a “Strategic Empowerment Initiative” for Women in Construction - with a 30% participation goal (Sigcau, 2001). By 2003, there were 330 (10%) female-owned emerging construction enterprises on the department’s database. Currently (2011), the CIDB database boasts 48% (4 839) female-owned enterprises, an increase of almost 1 366% in eight (8) years. Efforts introduced by the Minister in 2001 to facilitate entry of female contractors into the industry yielded extraordinary results.
However, the CIDB register of contractors shows that the majority of these entities are still in the lower grades. According to Table A (CIDB) below, 45% (2 190) of registered women-owned entities are still in grade 2, 52% (2 500) in grades 3-6 and 3% (149) in grades 7-9. A registered contractor's grading designation (indicated in the first column below), means that the contractor is considered capable of undertaking a contract less than or equal to the value indicated in the second column - within the contractor's registered class of works.

**Table A: Tender Value Range**

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>Less than or equal to</th>
<th>Women-owned entities (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>1.</td>
<td>Involved in EPWP</td>
<td>2 190</td>
</tr>
<tr>
<td>2.</td>
<td>650 000</td>
<td>650</td>
</tr>
<tr>
<td>3.</td>
<td>2 000 000</td>
<td>853</td>
</tr>
<tr>
<td>4.</td>
<td>4 000 000</td>
<td>567</td>
</tr>
<tr>
<td>5.</td>
<td>6 500 000</td>
<td>430</td>
</tr>
<tr>
<td>6.</td>
<td>13 000 000</td>
<td>130</td>
</tr>
<tr>
<td>7.</td>
<td>40 000 000</td>
<td>17</td>
</tr>
<tr>
<td>8.</td>
<td>130 000 000</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>No limit</td>
<td>4 839</td>
</tr>
</tbody>
</table>

The above table shows that less than 50% (a mere 130 to be precise) of the 330 women-owned construction companies that were registered on the department's database in 2003 are capable of undertaking contracts from R 13 to R 40 million. This constitutes only 2.69% of the registered women-owned entities! According to Menches and Abraham (2007) the reason why women encounter problems in construction vary from difficulty in balancing family and career life to slow career progression and attitude barriers caused by male dominance. This is supported by Madikizela (2008) who asserts that the industry is under-utilizing the full range of skills and talents in the population because of continuing unequal opportunities for some groups within society.
Current evidence suggests that there are still discrimination challenges that women face on a daily basis, but expressed in less visible ways. A series of studies revealed that many women in high-level positions in corporations and firms believe that social exclusion, not just overt discrimination, is a barrier to women’s career advancement (Welle & Heilman, 2005). In order to minimize or cope with this problem, attitudinal change by both men and women is strongly recommended Enshassi, A, Ihsen, S, Al Hallaq. (2008).

Barrier to entry into the South African construction industry is no longer an issue, as corroborated by the number of female-owned entities registered with the CIDB. Transformation of the construction industry to provide opportunities for full participation by female is considered painstakingly slow. Sex-disaggregated data and gender-responsive analysis continue to reflect imbalances and multiple barriers to the empowerment of women, gender equality and equity. Legislative reforms introduced to empower women seem to have yielded subminimum results on the empowerment of female contractors. Despite well-documented economic successes and the availability of a broad range of state policy, strategy and programme interventions aimed at overcoming economic disparities; entrenched inequalities continue to characterise the South African economy and act as a deterrent to growth, economic development, employment creation and poverty eradication (DTI)(SA), 2007).

Thus, this study seeks to identify obstacles to meaningful participation of female contractors in the South African construction industry.

2. **Research Method**

The study combined both quantitative and qualitative methods. Structured questionnaires coupled with focus groups were used to collect data. The respondents to the questionnaires included female owners and directors of construction organisations. Focus group meetings where held with the questionnaire respondents in order to obtain more complementary information on the subject.

The questionnaires comprised both closed and open-ended questions, designed to establish the profile of respondents, types of operation, skills levels, experiences, bottlenecks and problems as well as availability and effectiveness of support structures available in the construction industry for female owned contractors.

The questionnaires were piloted prior to being distributed in order to check the respondents’ understanding and ability to answer questions. These
were then distributed electronically to e-mail addresses provided through the CIDB database of Registered Contractors.

The survey was delimited to the Eastern Cape, Mpumalanga and Gauteng provinces. A purposive sample of 2,145 grade 2-6 female owned contractors was drawn from the CIDB database.

The Eastern Cape, Mpumalanga and Gauteng Provinces were selected for the study because they have a higher population density per square kilometre than the national average. Of the population density for South Africa is 39 persons per square kilometre while that of Gauteng, Mpumalanga and Eastern Cape is over 39 persons per square kilometre (Answers.com. accessed 17 November 2010). Therefore it was considered that the research would provide a general picture of the country. However, the results may not be generalised to all the regions of South Africa as conditions may differ.

A total of 301 female contractors out of 2,145 responded to the survey, representing 14% of the target population. The low response may be attributed to the fact that emails were sent to all organisations that appeared on the CIDB register and some organisations may have stopped operating. The CIDB register is not updated regularly. Considering the rate of business closures in South Africa, it is estimated that at least 50% of firms on the CIDB register, may not have been actively involved in the industry and would therefore not have had an interest to participate in the survey. Consequently the percentage of those who participated in the survey may actually be as high as 30%.

Data from the survey was analysed using SPSS to output descriptive statistics. The results are presented as means, standard deviations, frequencies and rankings in the findings sections.

3. FINDINGS

Data analysis involved inspecting, cleaning, organising, transforming and analysing the data quantitatively, using the Statistical Package for Social Sciences (SPSS).
3.1. Profile of respondents

The analysis revealed that the majority of the respondents (56%) did not have formal construction education, but wanted to be economically independent and felt a passion for hard work and for construction. 62% operated from home, 76% owned a computer but only 36% was found to be computer-literate. The survey further found that an astounding 56% of respondents had never been employed in a construction company before while only 20% had been employed for longer than 5 years before starting their own business. The range of experience of the respondents varied from 1 year to 19 years. Rightfully, Women speak, (2010) believe that women deserve a visionary educational and training framework that enhances their participation in the professional or vocational sectors of their choice. This needs one to conclude that challenging the norms of gender associated with ‘feminized’ or ‘masculinised’ careers, occupations and industries, and opening doors to women to access relevant and affordable training is linked to real employment prospects.

Due to the high percentage of women who have never worked in the construction arena or a construction company before, an average number of years in the industry were not calculated.

3.2. Experiences, bottlenecks and problems

All respondents indicated that they were highly dependent on sourcing work from government, but that access to opportunities offered was limited due to sexual harassment, discrimination, nepotism and unfairness that are so prevalent in procurement procedures. These practices made it extremely difficult for them to secure work. Davis, (2006) correctly asserts that since the democratic elections in 1994 in South Africa, the constitution and a further series of laws has banned discrimination and demanded employment equity - this includes a prohibition on gender discrimination and the promotion of gender equity in the workplace. But for many women there has been little change.

Haupt & Fester, 2012 cited bureaucratic systems and procedures within the public sector as a definite hindrance to female contractors achieving their goals of being economically independent. This was exacerbated by their lack of requisite marketing skills to solicit work from the private sector.
Other major constraints to participation were found to be exploitation by main contractors, which mostly took the form of not being informed when contracts are awarded even though they participated in the tendering processes. Sometimes these contractors would find reasons to exclude female contractors from being part of the project/s. What was most disheartening was the lack of support from industry role-players such as government and state-owned entities, who would turn a blind eye to such practices. It was also found that female contractors employed more male than female workers, confirming the stereotype that male workers were much suited for hard-core construction work than their female counterparts. The ratio was found to be 2:1. This is in line with a study conducted by Haupt & Fester in 2012.

When asked about factors that affect their performance, the respondents strongly indicated that access to finance and working capital were major hindrances, resulting in lack of continuity of work and poorly trained workers. Although the industry is inundated with various training programmes, these were generally found to be ineffective as most of the respondents still indicated a dire need for training in the areas of technical, business, financial and marketing skills. Apparently, needs assessments are generally not carried out and as a result, most of the programmes are not designed to meet the needs of the beneficiaries. They are a ‘one size fits all’.

Lastly, organisations that purport to represent women were viewed as having an agenda which benefited only office bearers.

4. CONCLUSIONS AND RECOMMENDATIONS

This research concluded that indeed the current status of female contractors in the construction industry in South Africa is not representative of what the country desires. Although the well-known and well-documented issues of discrimination, harassment, lack of finance, lack of opportunities and lack of technical-managerial-business skills were cited as major factors hampering active participation of female contractors in the industry, these are merely the result of the construction industry’s non-compliance with the country’s transformation agenda. Although Cabinet adopted South Africa’s
National Policy Framework on Women’s Empowerment and Gender Equality (NPFGW) in December 2000, there is no evidence of its utilization by the industry. In fact, a survey report by the National Department of Public Works (SA), 2007 revealed that all provincial departments of public works utilised legislative reforms and programmatic interventions for empowerment of female contractors and that this was ineffective and was not achieving the desired results. Most construction industry role-players also confirmed that they did not have a women-empowerment and gender policies within their organisations. The objective of the NPFGW was and still is to urge national departments and other relevant industry role-players to develop sectoral gender policy guidelines that would translate national imperatives for women’s empowerment and gender equality into their sector policies, programmes and activities; a deliberate strategy designed to ensure that industry role-players prioritise the government’s agenda on gender empowerment, equality and equity. These policies would address gender-specific issues such as stereotypes, attitudes and incorrect perceptions that the generic legislative reforms were not designed to deal with.

One report concluded that non-compliance with Millennium Development Goal 7 – Target 9, constitutes a serious omission which may seem to endorse discriminatory practices. MDG7 – Target 9 addresses the elimination of all forms of discrimination against women. Establishment of appropriate enabling sector policies is essential to moving towards equity. A random search for sectoral Gender Policies in South Africa revealed that only the Department of Justice complied with the requirements of the NPFGW by creating a comprehensive departmental gender policy in 2001.

There is therefore an urgent need to advocate actions that will bring about a meaningful change to this lamentable state of affairs. Women empowerment needs to be institutionalized and not be treated as “something at the end-of-the-day” business (Office of the Status of Women 2002). This will provide a strong basis for equality and equity for women in the construction industry. Women will no longer negotiate or participate from a position of weakness, but will be empowered to participate at an equal level with their male counter-parts.

The National Department of Public Works should therefore be urged not only to create and operate a relevant comprehensive gender policy, but to also ensure that all construction industry role-players comply with this
imperative. These policies must be coupled with comprehensive monitoring and evaluation systems that would feed into a rigorous reporting mechanism to be designed by the Ministry of Women-Children-and-the-Disabled.

**In addition, the Department would need to:**

i. Investigate the possibility of developing a Construction Bank. Investigating existing models such as the Chinese Construction Bank and the model of the previous Agricultural bank of SA (prior to 1994)

ii. Facilitate the development of relevant training programmes designed to empower women in the industry

iii. Facilitate the development of training programmes designed to expedite acceptance and solicit support for women empowerment in the industry.

iv. Re-examine its procurement processes and procedures to ensure compliance with best-practice

v. Set up systems to address prejudices and stereotypes within internal tender adjudication processes.

vi. Apply set-asides for projects to be executed by female contractors and professional services rendered by female professionals.

**References**

Davis, S. (2006) Gender equality in the workplace: Available at: <http://sharondavis.co.za> accessed 02/05/2010


An Investigation about the Technical Concerns on the Use of Beam and Block Slab Systems

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ABSTRACT AND KEYWORDS

Purpose of this paper
This study investigates concerns of the industry of the use of beam and block slab systems with regard to the following attributes: Thermal resistance to increased temperature (fire loading, i.e. concrete cover over prestressed steel and cast in situ topping), bonding of plaster with polystyrene foam infill blocks and horizontal shear resistance.

Design/Methodology/Approach
A study in the form of an online questionnaire was undertaken. It circulated to relevant consultants, manufacturers, contractors, architects and academics. In addition to this, three manufacturers of the products located in South Africa were interviewed with regards to the plastering behaviour on polystyrene foam infill blocks.

Findings
The consultants were the majority of the respondents. A diversity of views was expressed regarding the structural system, integrity and behaviour of the beam and block slab system.

Research implications
Appropriate training and guaranteed workmanship are essential measures to be considered by the client, before opting to plaster the polystyrene foam infill blocks with a normal sand-cement plaster. Manufacturers should provide fire limitations of their products, i.e. from physical experiments preferably executed by an independent certified fire testing laboratory.
Responding to conference themes

This paper deals with advancing the development/improvement of the beam and block slab systems, for it to be more selectable in housing and urban development.

Practical implications

The certifying engineer should check the concrete cover over prestressing wires on the exposed edges of the precast rib and the roughness of the shear interface by using a surface roughness micrometer.

What is the value of this paper?

This paper outlines the fundamental issues a product user should investigate prior to deciding on the type of suspended slab system to be employed. It also highlights the need for access to relevant knowledge in the widespread use of beam and block slab systems.

Keywords

Horizontal shear resistance (strength), fire resistance and bonding of normal sand-cement plaster with polystyrene foam infill blocks (in the beam and block slab system).

1.1 INTRODUCTION

There are various types of suspended slab systems that are currently used in domestic and light industrial applications, namely, cast in situ solid slab (e.g. Beam and slab), ribbed slab (e.g. Beam and block slab system), hollow/voided slab and corrugated slab. The choice depends, predominantly, on the affordability, suitability and practicality of the flooring system. The structural efficiency (strength to weight ratio) of the beam and block slab had caused it to gain popularity in the lightly loaded structural sector. However, the following concerns have been expressed: fire resistance of structural components, horizontal interface shear resistance and plastering polystyrene foam infill blocks with normal sand-cement plaster.

This research searches for the opinion of the industry on the use of beam and block slab systems. This is achieved by asking some technical questions around the issues that have been identified as problem areas through experience. The findings should illuminate the areas where people have concerns or doubts, and also demand further improvements in the construction methods and the codes of practice.
1.2 LITERATURE REVIEW

1.2.1 DESIGN REQUIREMENTS FOR BEAM AND BLOCK SLAB SYSTEMS

The beam and block slab systems are designed to meet the minimum requirements for the Ultimate and Serviceability Limit State. At Ultimate Limit State, the slab is designed to provide sufficient axial compression strength resulting from the prestressing force, flexural and both vertical and horizontal shear capacities. For vertical shear, the slab is checked for both cracked and uncracked section in bending and for horizontal shear. The top of the precast rib and insitu concrete is checked for horizontal shear capacity. By serviceability limit state, the slab is restricted against excessive vertical downward deflection, tensile and compressive stresses.

1.2.2 HORIZONTAL SHEAR TRANSFER AT THE ROUGHENED INTERFACE OF THE PRECAST RIB AND CAST IN SITU CONCRETE TOPPING

The credibility of the surface preparation for the top horizontal shear interface of precast rib to in situ structural topping is of outmost importance. If a composite section delaminates, the compound flexural strength is lost and failure is likely to occur. The study of horizontal shear transfer across a roughened surface in beam and block slab system conducted by M. Gohnert (1999) concluded that the designer should base the resistance on the surface roughness rather than the concrete compressive strength. This yields to a far more economical solution. Tests were done from 25 to 30MPa in situ cast concrete which is generally used as the structural concrete topping for these slabs. One of the important findings in the study was, "specifying a roughness by merely stating the instrument used to create the undulation is not sufficient; an actual measurement of roughness should be specified". M. Gohnert (1999).

SANS 1879:2011 Clause 5.5 of the code gives guidelines on how to measure the top surface roughness of the precast rib using a surface roughness micrometer. The average depth should comply with clause 4.3.4 (surface roughness), which should be at least 3mm over the longitudinal spacing of 40mm.

Standard ribs do not generally rely on shear lugs for horizontal shear interface resistance. The hooks are often for handling purposes and do not have any significance to horizontal shear strength. A study by E.R. Loov and A.K. Patnaik (1994) proved that the stirrups are typically unstressed and ineffective until horizontal shear stresses exceed 1.5 to 2 MPa and this confirms the importance to ensure the integrity of the roughening.
1.2.3 FIRE RESISTANCE OF BEAM AND BLOCK

In the unfortunate event of fire, the integrity of the structure depends predominantly on the actual member integrity (e.g. Fire rating) and heat/fire confinement (fire progression). The choice of a slab system employable depends on the nature of the building. Domestic houses would normally have a minimum fire rating of 30 minutes. This is to give people enough time to evacuate the building. SABS 0100-1, Table 44 – Fire resistance of prestressed concrete beam, i.e. precast prestressed rib, gives the minimum dimensions for concrete geometry required to achieve the targeted fire rating. SANS 1879:2011, Precast Concrete Suspended Slabs recommends a concrete cover over the prestressing steel of not less than 15mm.

Standard ribs are generally ±60mm deep x ±150mm wide. According to SABS 0100-1, Table 46 – Fire resistance of prestressed concrete floors (with calcareous aggregates), (column 7), standards ribs should be well within these minimum requirements providing they have “hollow infill blocks of clay, or inverted T-section beams with hollow infill blocks of concrete or clay”. This also depends on 50% (gross cross-section) ratio of the solid materials and the saved space.

The beam and block market has diverged in favour of the polystyrene foam infill block compared to concrete or clay hollow infill blocks. Untreated polystyrene foam melts very quickly in fire, thus, leaving the ribs and the concrete topping exposed directly to the flames. Such behaviour leads to accelerated heat deterioration and therefore questions the integrity of multi-storey building from the fire progression point of view, and further reference should be made to SANS 10400-T:2011. The application of the National Building Regulations, Part T: Fire protection and SANS 10400-T: 2011. The application of the National Building Regulations, Part T: Fire protection.

1.2.4 PLASTERING POLYSTYRENE FOAM INFILL BLOCKS WITH A NORMAL SAND-CEMENT PLASTER

The National Research Council Canada (division of building research) performed tests of plastering on polystyrene foam with cement plaster. The work published by R. E. Platts (1963) advised that proper techniques and care are necessary for successful plastering over polystyrene foam. Understanding the fundamental characteristics of the plaster base was the key to this success. The polystyrene foam is watertight and has a significant ability to spring back into its original shape after deformation, bending, or stretching. The conventional infill block made of concrete, burnt clay, fired briquettes, shale or clay is fairly permeable and has diverse properties of strength; namely, inflexibility, or elasticity when compared to the polystyrene foam infill block. The plaster on polystyrene foam infill blocks need to be as dry as possible. Apart from other possible reasons, it can only dry from the surface exposed to the air since there is no water.
absorption from its base. The thickness of the plaster need to be minimal as the thick plaster will sag under gravity and detach from the bases. There must be adequate and controlled ventilation for the plaster to dry.

The polystyrene foams have a very low modulus of elasticity. This makes the plaster float and allows any small differential movement between the two elements. This plaster is susceptible to shrinkage cracking by it. This unresisted movement can result in large cracks at weak points. The plaster on conventional infill blocks would usually show very fine cracks. The dry shrinkage cracks can be reduced by a three coat application alternatively by cutting a grid of V-groove and patched when most of the shrinkage has taken place. A final coat can then be applied. O’Kelly (1960) advised that moderate sanding does not decrease the bond. Some modern chemical adhesive products may be applied as a key coat to enhance good bond and ease the strain on the plasterer. The use of fibres in sand-cement plaster has latterly proven to have a significant improvement in the tensile strength of the cement plaster.

An interview with manufacturer ‘A’ (01st March 2013) of beam and block slab system who extensively use polystyrene void former blocks advised that his company apply the normal sand-cement plaster directly on polystyrene foam infill blocks. (“My crew plaster straight on, if it’s the first time you attempt this we recommend slushing it first. Another tip you could use is to mix in some tile cement if you are in a hurry”). He also noted that applying sand cement slush simplifies the job. Manufacturer ‘B and C’ (01st March 2013) advised that a normal-sand cement mix which should be made as dry as possible is used to plaster on polystyrene foam infill blocks. He further noted that the plasterers often wet the mix trying to make it more workable thus causing problems with regards to its drying rate, adhesion characteristic and sagging. Prominence is on the plaster - sand to comply with the grading requirements as recommended by SANS 2001-EM1:2007. Construction works Part EM1: Cement plaster and other relevant specialist literature or mix design.

1.3 RESEARCH METHODOLOGY

A survey questionnaire sought to explore the opinion of the industry on the use of beam and block slab systems was used. Basic technical questions were formulated to search the following areas of concern:

1. Thermal performance i.e. heat resistance of precast prestressed rib and structural cast in situ concrete topping when exposed to elevated temperature (fire loading).
2. Methodology and reliability of plastering polystyrene foam infill block with a normal sand-cement plaster. Does it really work?
3. Limit state of cracking of normal sand-cement plaster when laid onto conventional and polystyrene foam infill blocks and structural cast in situ topping and precast, prestressed rib.
4. Horizontal shear resistance between the top of a standard precast prestressed rib and cast in situ concrete.

An online survey was designed and a random invitation through electronic mail was circulated to relevant consultants, manufacturers, contractors, architects and academics specializing in structures. Some respondents were identified through their participation in some earlier structural research activities/projects, advertising their products or specialisation through the internet and encountered through previous work related projects.

This study is limited to the beam and block slab systems that have precast prestressed rectangular ribs with a width of 100-200mm and a depth not less than 60mm as recommended by SANS 1879:2011, Precast Concrete Suspended Slabs.

1.4 RESEARCH QUESTIONNAIRE

The following is the list of questions that were addressed to the respondents (industry):

1. Were you involved in any design or work with a beam and block slab system in any of your projects? (Refer to figure 11.1 and 11.2): (yes or no).
2. Describe your background regarding your familiarity with the beam and block slab systems: (consultant, manufacturer, contractor, architect and academics).
3. How many beam and block projects have you completed? (<10 or ≥10).
4. Do you belong to any statutory body such as the Engineering Council of South Africa, South African Institute of Architects, Master Builders or any others?: (yes or no).

For questions 5-15, the respondent had a choice to answer by stating, strongly agree, agree, neutral, disagree and strongly disagree.

5. Normally I have no problem using a beam and block slab system to any class of occupancy building if all fire regulations and minimum standards are within the acceptable limits.
6. A 40-60mm cast in situ structural topping has not shown any structural defects such as cracking and poor compaction as a result of design and construction methodology.
7. Normally I prefer to use polystyrene foam infill blocks rather than conventional infill blocks.
8. I have experienced some cracks in a normal sand-cement ceiling plaster when applied to conventional infill blocks probably because of the design and construction method.

9. I have not experienced any problems when plastering polystyrene foam infill blocks with a normal sand-cement plaster when applying a key-coat.

10. I do not plaster polystyrene foam infill blocks with a normal sand-cement plaster because of lack of information with regards to construction methodology and reliability.

11. The horizontal shear resistance between the top of a standard precast prestressed rib and cast in situ concrete topping raises doubts with respect to effectiveness.

12. The nominal thickness 40-60mm of the structural topping raises doubts with respect to effectiveness when resisting heat.

13. The concrete cover ≥ 15mm over the prestressing steel in the precast ribs raises doubts with respect to effectiveness when resisting heat.

14. I have relied on a normal sand-cement soffit plaster to provide additional fire protection to main structural elements.

15. The design, manufacturing and construction methodology of a beam and block slab system is not adequately documented and controlled, and the engineer is often not given adequate design information with regards to the concrete and steel strength and quality in order to confidently carry out design ratification for the whole structure.

Question 16 (below) was an open general question that allowed the respondent to give more feedback.

16. Please share with us any experiences, general comments and concerns with beam and block slab system.

Figure 11.1 – Typical detail of a beam and block slab system with conventional infill blocks.
(Photograph by: B. Khuzwayo, 2011)
1.5 RESULTS FROM THE SURVEY QUESTIONNAIRE

There were 35 respondents to this survey. 32 (91.43%) of them have been involved in the design of or have worked with the beam and block slab system before. The other 3 (8.57%) have stated no previous involvement with these systems. 68.57% of the respondents were consultants followed by 14.29% from the manufacturing sector, 11.43% from the construction and 5.71% from an academic background. There was no input (0.00%) from the architects. 62.86% of the respondents had done more or equal to 10 beam-and-block projects and 37.14% less than 10 projects. 68.57% of the respondents belong to some statutory body (e.g. Engineering Council of South Africa, South African Institute of Architects, Master Builders or any others) and 31.43% did not. The technical portion of the survey covered by the questionnaire is summarized in table 11.1 as shown below.

<table>
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<td>17.14</td>
<td>20.00</td>
<td>28.57</td>
<td>17.14</td>
<td>17.14</td>
</tr>
<tr>
<td>12</td>
<td>5.71</td>
<td>28.57</td>
<td>22.86</td>
<td>28.57</td>
<td>14.29</td>
</tr>
<tr>
<td>13</td>
<td>5.71</td>
<td>45.71</td>
<td>20.00</td>
<td>14.29</td>
<td>14.29</td>
</tr>
<tr>
<td>14</td>
<td>5.71</td>
<td>45.71</td>
<td>22.86</td>
<td>17.14</td>
<td>8.57</td>
</tr>
<tr>
<td>15</td>
<td>17.14</td>
<td>42.86</td>
<td>8.57</td>
<td>17.14</td>
<td>14.29</td>
</tr>
</tbody>
</table>
1.6 OTHER TECHNICAL COMMENTS RECEIVED FROM RESPONDENTS ARE;

- The propping has often been inadequate (e.g. amount of temporary propping along the length of the precast rib – author’s comment).
- The fire resistance/rating is not always addressed.
- Polystyrene foam infill blocks do not consider the sequence of concrete pours.
- Vertical shear resistance is not always addressed at flat soffit connections (extra steel, wire ties etc.).
- Safety for someone doing an inspection can be worrying (walking on ill-fitting blocks).
- Initial plank erection without correct propping can cause cracking of planks on long spans (general 6m and over).
- A relationship developed by the supplier goes a long way to assuring the designer of the reliability of design parameters.
- To avoid problems I issue the beam and block supplier/contractor with details on how it spans and position of transfer/spreader beams and any necessary additional reinforcement.
- The cast in situ concrete (40-60mm) above the precast pre-stressed ribs offers adequate fire resistance because the cover of this pretension wire is often about 100mm when fire is coming from the top (soffit fire is still a problem – authors comment).
- The design is very specific to loading layout. Concerns are raised with reference to future alterations/additions (long term problems – author’s comment). Generally, we only use the system on shorter spans in lightly loaded residential structures – always with some additional steel when necessary (The slab is a one way spanning structural system – author’s comment).
- We need a detailed code for these types of slabs (refer to SANS 1879 – 2011 – author’s comment).
- Some systems are more suitable for the domestic environment than commercial/industrial and vice versa.
- There appear to be two ‘camps’ of suppliers, one with the necessary technical appreciation of the system and one without. Unfortunately, the latter often offers a cheaper product to the public/builder who does not know any better.
- I approve the beam and block supplier’s layout before construction commences, and this way there are no problems.

1.7 DISCUSSION OF THE RESULTS

65.72% of the respondents admit to not having problems using beam and block slab system to any class of the building if all fire regulations and
minimum standards have been fulfilled. This is a positive sign of the construction industry; however a significant gap is still left for improving this suspended flooring system to become a more preferred alternative structural solution (question 5).

The structural integrity of the cast in situ concrete topping appear to be almost satisfactory but not free from the issues relating to cracking and lack of adequate compaction as a result of the change in profile (e.g. Thickness or depth of the slab), (question 6).

There is a notable percentage of non-aligned appearance with regards to preference in using polystyrene over conventional infill and reliability associated with defects like cracks of normal sand-cement plaster (question 7, 8, 9 and 10).

Differences in opinions and uncertainty have been noted with regards to;

- Effectiveness of the surface shear interface resistance for standard precast prestressed ribs (question 11).
- Fire resistance of 40 – 60mm cast in situ structural topping (12), effectiveness in fire resistance of precast prestressed ribs with a 15mm concrete cover over the prestressing wire (question 13) and effectiveness of normal sand-cement plaster in resisting and shielding heat to structural components (question 14).

60.00% of the respondents are concerned with the availability of necessary documentation (e.g. Quality control test results etc.).

### 1.8 CONCLUSION

The raised/discussed points cannot be ruled at 95% confidence level about its status. However, the results indicate difference in opinions/experience which should trigger immediate improvement of the beam and block flooring system with regards to credibility in;

- Fire resistance of its structural components.
- Resistance of roughened horizontal shear interface.
- Plastering normal sand-cement plaster on polystyrene foam infill blocks.

### 1.9 RECOMMENDATIONS

- All necessary technical documentation should be made available to all parties taking responsibility in the project.
- The manufacturers of the beam and block slab systems should provide roughness ($R_z$) of the horizontal shear interface on their delivery notes.
More research and knowledge is required to back-up the integrity of the methodology of plastering polystyrene foam infill blocks with normal sand-cement plaster.

Certified fire tests of the beam and block slab system need to be quantified and clearly advertised to its uses.

1.10 ACKNOWLEDGEMENTS

The author would like to acknowledge Pieter Boorsma, Mzukisi Mashaba and Abdool Satharia for their technical input.

1.11 REFERENCES

Gohnert, M, a study of horizontal shear in rib and block slab system, prepared for concrete manufacturers’ association, December 1999.


SANS 1879:2011, Precast Concrete Suspended Slabs.


SANS 9001/ISO 9001, Quality management systems - Requirements.

Impact of Student Industrial Training (IT) on the Tanzanian Building Construction Industry

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ABSTRACT

Purpose:
To assess the relevance of industrial Training (IT) course contents of the School of Construction Economics and Management to the needs of the Building Construction Industry Market and analyse its impact.

Design/methodology/approach:
Descriptive research and a combination of sampling techniques were employed. Statistical data were generated using Census and Surveys Processing System software package (CSPro) and analysed accordingly.

Findings:
Indicates that the lack of relevance of IT course content is due to the failure of the training curricula to keep pace to market changes. The IT has the impact of developing professional competency required by the industry, identify gaps in the training curricular of construction professionals, sharpen skills to promote growth and diversity of the industry. It identified lack of proper programming and smooth facilitation as challenges

Response to conference theme and outcomes:
This study demonstrates the importance of Education and Professional development in enhancing sustainability of the construction industry.

Research implications:
The study stands as a base for further research on IT as a mechanism to attain practical professional skill development.

Practical implications:
Proceedings 7th Built Environment Conference 28 – 30 July 2013
Impact on Student industrial Training (IT) on the Tanzanian Building Construction Industry Cape Town, South Africa
The study provides information to schools of Construction Professional Institutions on improvement of IT.

Value:
Future researchers may explore on recommendations for structure and setting of IT and curricular changes to adjust to market needs.

Keywords: Industrial Training, Market needs, Relevance, Building Construction Industry.

1. BACKGROUND INTRODUCTION

Industrial Training refers to work experience that is relevant to practical professional skills development prior to graduation. It is accumulated during the semester breaks at the end of first, second and third years, Shio, (2009). It was introduced in Universities According to Osman, et al in a study on the importance of industrial training students’ perception in the civil engineering sector in Malaysia sector, (2008) with the core objective of helping the students to get a feel of the work environment, and to apply the knowledge taught in lecture in real life situations.

The general objective of Industrial training at Ardhi University is to merge theory and practice. (Ardhi University Prospectus, 2012/12)

Problem History

The problem of the mismatch between the training curriculum and the needs of the building construction industry market is attributed by, the duration of training, which is 8 weeks at present, this is not sufficient to cover the specified course contents given the nature of construction works. Further, placement of students for the IT is done to locations that have no ongoing work at all, or projects that are not in line with the course contents specified for that year of study. Furthermore is a financial constraint to academic supervising staff who fails to frequently visit the students to check and monitor progress and the students’, whereby money given by the higher education students’ loan board is not sufficient. Moreover, organizational, here, the objectives of the IT are not communicated to the people responsible to make it effective, specifically the students, companies, government bodies and agencies. (Department of Building Economics (BE) curriculum and the IT reports of 2006 - 2008. Lastly, of recent is the increase in the number of students at ARU. This presents a serious threat likely to undermine quality of training (Osman et al, 2008).
According to the BE curriculum of 2006 and the 2012 revision, the IT at Ardhi University (ARU) is expected to mould professional in acquiring practical professional skills necessary for growth and sustainability of the construction industry. To exposes students to a broad understanding of the industry needs in terms of expertise requirements, technological advancement, social and economic environment of the industry which is crucial in developing self employment capabilities. A study by Zakaria N. et al, 2006 indicates 100% of graduates agree that industrial training gives graduates students' knowledge on construction technology, contracts, exposure to quantity surveying practice and enhances project management skills, computer applications to profession, commitment and creativity.

Employers' Expectation

A study by Davies H. et al, 1999, revealed that graduates from professional courses are often described by employers as lacking in useful and instant fee earning skills, the study further emphasized that an important objective of any degree programme is to prepare students for work place. The IT documents of 2006, 2007 and 2008 at the School of Construction Economics and Management (SCEM) points out knowledge on Computer and information technology, Construction technology, Construction contracts, exposure to Quantity Surveying professional and practice procedures insights into project management, Commitment and Creativity are highly sought out by employers.

2. RESEARCH PROBLEM

The Tanzania Construction Industry policy of 2006 report the Construction industry to account for more than 5% of the GDP, 9% of employment creation and about 57% of the Capital formation, this rapid growth, demands for well trained, competent, skilled professional in their career expertise to sustain the industry. It requires training curricular that suffices the growth needs of the industry in terms of profession manpower development. At the moment, the IT provided by SCEM at ARU is constrained by the limitation of the mismatch existing between the training curriculum and the needs of the building construction industry markets. The due fact is that the market needs are changing very fast compared with the ability of the training curriculum to adjust. This has resulted in the difficulty the students face in covering the targets specified in the course contents of the IT. Further it has deficient the skills and performance of the construction graduates in the industry market upon employment.

3. PURPOSE
Main Objective

To assess the impact of student IT provided by the School of Construction Economics and management at ARU in Tanzania on the growth of the Building Construction Industry.

Specific objectives

1. To assess relevance of the course contents of the IT to the current market needs of the industry.
2. To analyze the impact of the IT practice on the Tanzanian Building Construction Industry.
3. To examine the challenge faced by the IT and extent of effects to graduates performance in the industry market.
4. To identify and suggest remedies to mitigate the effects and improve the IT to match the market need of the industry.

4. METHODOLOGY

The study assessed the mismatch between the slow changing training curriculum and the fast changing market needs of the Building Construction Industry by describing the state of affairs existing (Oppenheim, 1992) in the provision of the IT by SCEM at Ardhi University. It incorporated opinions and experiences on assessing the impacts of student IT at Ardhi University.

Sample and sampling techniques

Sample selection took into account availability of population, methodology, time and resources, Leedy, (1980). The population was divided into strata constituting 34 class one contractors, 51 Quantity Surveying consulting firms, 202 students from second year to fourth year at SCEM, 27 staff from SCEM, 30 working graduates of experience 1 to five years.

Simple random was used to get the students sample of 55 out of a population of 202 students. On every combination of 55 students, each has an equal chance of being selected in the probability of 1/202 of being first chosen. That each of the (202-1) students not chosen on the first draw has a probability of 1/(202-1) of being second chosen on the second draw, and that each of the (202-55-1) students not chosen on (55-1)th draw has a probability of 1/(202-55+1) of being the last chosen.

Judgemental sampling was employed for working graduates, SCEM staff, contractors and consultants as well as Government agencies. Ease of access was the reason for deploying the technique, Kothari, (2004)

5. Data collection Methods
Questionnaire and interview guide were used to collect data on; Views on relevance of IT course contents to the market needs of the Construction Industry, Impact of IT practice on the Tanzanian Building Construction Industry, Challenges faced by IT, Extent of the effects to graduate performance in the construction industry market and remedies to mitigate the effects. Questionnaire were used because they are simple compared to observation and experiment, Brymen, (2001). Interview guide questions were structure to allow easy coding and analysis of results.

6. Data analysis

Data was analysed using the Census and Survey Processing system (CSPro) software package. It is software for entering, editing, tabulating and disseminating data from census and surveys. It combines the feature of the Integrated Microcomputer processing system (IMPS) and the integrated system for Survey Analysis (ISSA). (USA Census Bureau, 2009). Data from the questionnaire was entered into the data dictionary created for each file used in the screen for data entry (form design), after entering data went through Processing, which entailed editing coding and classification, Batch edit application and Cross tabulation application.

7. FINDINGS

Respondents’ Characteristics

Proportion of respondents comprised of students at ARU who have attended the IT at least once, working graduates with experience between 1to 5 years. Staff from the SCEM at Ardhi University, contracting and consulting firms and government agencies based in Dar es Salaam.

Relevance of Industrial Training Course Contents

The first objective was to find out the relevance of the course contents of the IT to the needs of the building construction industry in Tanzania. The information sought was about respondents’ views on the extent of relevance of the course contents of the IT to market needs. The findings are presented below

Table 1: - Relevance of the course contents of Industrial Training.
<table>
<thead>
<tr>
<th>Specialty</th>
<th>Respondents views (In Number &amp; Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large extent</td>
</tr>
<tr>
<td>Building Economics</td>
<td>12 (17.14%)</td>
</tr>
<tr>
<td>Construction Management</td>
<td>6 (8.57%)</td>
</tr>
<tr>
<td>Building Survey</td>
<td>5 (5.71%)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>23 (32.86%)</td>
</tr>
</tbody>
</table>

Table 1 above indicates that 61.43 percent regard the IT course contents being relevant on an average to the needs of the industry market, compared to 32.86 percent. So the average is on the higher side therefore, the general results indicate majority of respondents view the course contents as being relevant. 64.28 percent of the respondents have studied Building Economics as a course which is the oldest compared to Building Survey and Construction Management which have been established recently. Results contradicts IT reports which commented the course contents failure to match with situation in the market (Industrial training Supervisors report, 2006, 2007, 2008). Respondents’ views can be explained by the fact that placement is done to sites that have no ongoing work and the 8 weeks duration which is not sufficient for effective training given the nature of construction works and hence they lack exposure to and, understanding of the current needs of the market.

**Students’ Expectations of Industrial Training**

Respondents were asked to express their views on this case. They were required to select what were their expectations of the IT. Table 2 below presents the findings.
Table 2 indicates that most students expected the IT to develop their career skills (34.29%) and prepare them for self employment (24.28%). However exposure to the core needs of the industry and building skills and confidence to suit market needs scored low (12.86% each). Now with most students viewing course contents of the IT being relevant to market needs, one would have expected student’s expectation of the IT to score highly on exposure to the market needs of the industry and in building skills and confidence on the same. The low score on the two aspects of market needs concludes that most students are unaware on the currents needs of the building construction industry market. This is a result of the course contents of the IT failure to reflect the current market situation/demands and needs.

Sustainability of the construction industry lies in the preparation and grooming of professional to move the industry forward in terms of skills and expertise. The IT provides the platform for this. Therefore, it is in the best interest construction professional training institutions to meet expectations of the IT.

**Impact of industrial training on the Tanzania building construction Industry**

The second objective was to analyse the impact of the IT. The information sought was respondents’ views on the impact of the IT on the Tanzania building construction industry. Table 3 below presents the findings.

Table 3; - Impact of the IT on Construction Industry

<table>
<thead>
<tr>
<th>Expectations</th>
<th>Building Economics</th>
<th>Construction Management</th>
<th>Building Survey</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop career skills</td>
<td>24 (34.29%)</td>
<td>7 (10%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>31 (44.29%)</td>
</tr>
<tr>
<td>Prepare for self employment</td>
<td>11 (15.71%)</td>
<td>5 (7.14%)</td>
<td>1 (1.43%)</td>
<td>0 (0%)</td>
<td>17 (24.28%)</td>
</tr>
<tr>
<td>Exposure to the core needs of the industry</td>
<td>7 (10%)</td>
<td>1 (1.43%)</td>
<td>1 (1.43%)</td>
<td>0 (0%)</td>
<td>9 (12.86%)</td>
</tr>
<tr>
<td>Build skills &amp; confidence to suit the changing market needs</td>
<td>5 (7.14%)</td>
<td>2 (2.86%)</td>
<td>2 (2.86%)</td>
<td>0 (0%)</td>
<td>9 (12.86%)</td>
</tr>
<tr>
<td>Not stated</td>
<td>3 (4.29%)</td>
<td>1 (1.43%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>4 (5.71%)</td>
</tr>
<tr>
<td>Total</td>
<td>50 (71.43%)</td>
<td>16 (22.86%)</td>
<td>4 (5.71%)</td>
<td>0 (0%)</td>
<td>70 (100%)</td>
</tr>
</tbody>
</table>
Table 3 indicates that 70.21% came from those who studied building economics degree program, it was expected of them to be conversant as to what impact the IT has to the construction industry because the course is older and therefore the objectives and impact to have been well communicated. Now the 36.52% of building economics not sure of the impact of the IT give an indication that the objectives of the IT is not communicated to the people responsible to make it work. This is one of the many challenges facing the IT at Ardhi University.

Construction industry in Tanzania is reported to contribute 9% of employment creation, 5% of GDP and 57% capital formation; therefore sustainability of the industry should be invested heavily on. The most sustainable investment is training of professional to sustain growth through developing professional competency, identifying gaps in the training curriculum, sharpen skills as well as exposure to the core needs of the industry through IT. This will effectively communicate the impact desired of industrial training to those responsible to make it work.

Practice of industrial training and its impact on the building construction industry

Respondents were asked to express their views on the practice of the IT. Their views was sought to find out what transpires in the course of running of the program. Table 4 below presents the findings.

Table 4; - Practice of the IT and its impact on the industry

<table>
<thead>
<tr>
<th>Impact</th>
<th>Building Economics</th>
<th>Construction Management</th>
<th>Building Survey</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profession competency</td>
<td>30 (10.64%)</td>
<td>9 (3.19%)</td>
<td>1 (0.35%)</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Identify gaps</td>
<td>20 (7.09%)</td>
<td>1 (0.35%)</td>
<td>1 (0.35%)</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Sharpen skills</td>
<td>24 (8.51%)</td>
<td>7 (2.48%)</td>
<td>2 (0.71%)</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Promote diversity</td>
<td>19 (6.74%)</td>
<td>4 (1.42%)</td>
<td>5 (1.77%)</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Other</td>
<td>2 (0.71%)</td>
<td>0 (%)</td>
<td>0 (%)</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Not stated</td>
<td>103 (36.52%)</td>
<td>45 (15.96%)</td>
<td>9 (3.19%)</td>
<td>0</td>
<td>157</td>
</tr>
<tr>
<td>Total</td>
<td>198 (70.21%)</td>
<td>66 (23.40%)</td>
<td>18 (6.38%)</td>
<td>0</td>
<td>282</td>
</tr>
</tbody>
</table>

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Construction industry in Tanzania is reported to contribute 9% of employment creation, 5% of GDP and 57% capital formation; therefore sustainability of the industry should be invested heavily on. The most sustainable investment is training of professional to sustain growth through developing professional competency, identifying gaps in the training curriculum, sharpen skills as well as exposure to the core needs of the industry through IT. This will effectively communicate the impact desired of industrial training to those responsible to make it work.

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Table 4; - Practice of the IT and its impact on the industry
Impact on Student Industrial Training (IT) on the Tanzanian Building Construction Industry

Table 4 above indicates that, the current 8 weeks duration is not sufficient to train effectively given the nature of construction works. Likewise funds and technological constraints add up to the challenge. Literature pointed lack of orientation of the IT to students and training companies as one of the challenges. So with 52.86% of respondents strongly agreeing that if worked on, it can contribute into achieving the objectives if the IT which most agree to be aware of. If the objectives are attained then it is evident that IT would bring the desired impact to the industry.

Experience and Challenges Faced by Industrial Training

The third objective was to examine the challenges faced by the IT. The information sought from respondents was on the challenges and how they affect the attainment of the IT objectives. Table 5 below presents the findings.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>Not stated</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>You are well aware on the objectives of IT</td>
<td>0 (0%)</td>
<td>4 (5.71%)</td>
<td>39 (55.7%)</td>
<td>23 (32.86%)</td>
<td>4 (5.71%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>The course contents of IT does reflect objectives</td>
<td>7 (10%)</td>
<td>8 (11.43%)</td>
<td>33 (47.14%)</td>
<td>19 (27.14%)</td>
<td>3 (4.29%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>IT duration (8 weeks) is sufficient to meet the objectives of IT</td>
<td>16 (22.86%)</td>
<td>35 (50%)</td>
<td>11 (15.71%)</td>
<td>5 (7.14%)</td>
<td>3 (4.29%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Funds and technological constraints render IT ineffective</td>
<td>4 (5.71%)</td>
<td>3 (4.29%)</td>
<td>19 (27.14%)</td>
<td>41 (58.57%)</td>
<td>3 (4.29%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Proper orientation of IT to students and training companies/ firms will help meet the objectives set</td>
<td>0 (0%)</td>
<td>5 (7.14%)</td>
<td>26 (37.14%)</td>
<td>37 (52.86%)</td>
<td>2 (2.86%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Well programmed, coordinated IT can achieve all its objectives</td>
<td>1 (1.43%)</td>
<td>3 (4.29%)</td>
<td>17 (24.28%)</td>
<td>46 (65.71%)</td>
<td>3 (4.29%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Attained objectives of IT bring positive impact to the building construction industry</td>
<td>0 (0%)</td>
<td>1 (1.43%)</td>
<td>25 (35.71%)</td>
<td>42 (60%)</td>
<td>2 (2.86%)</td>
<td>70 (100%)</td>
</tr>
</tbody>
</table>
Table 5 points out difficulty in covering the course contents specified for industrial training, insufficient time to complete the training, insufficient funds to students and supervising staff, unavailability of appropriate software be the challenges faced by the IT provided by the (SCEM). These challenges are perpetuated by among other things by the training failure of the curriculum which changes periodically after every five years to accommodate changes in the industry (55.71%). In growing Universities like Ardhi increase in number of students also poses a threat to quality of the IT.

**Remedies to improve Industrial Training**

The fourth objective focused on identifying and suggesting remedies to improve the IT. Respondents’ views were sought on what should be done to improve the IT. Table 6 Below presents the findings.
Table 7 indicate that respondents strongly agree on the remedies to improve the IT (47.14%, 62.86%, 57.14%, 55.71% and 70%). Emphasis should be given on curriculum reviews therefore, to try to accommodate changes in the industry as much as possible. Also for the course contents of the IT to reflect market needs. Increase the duration of the IT and lobbying for more funds. Thus, to achieve the objective of merging theory and practice and, the targeted contents of the IT, training institution should touch base with stakeholders in the industry to effectively communicate these objectives.

**CONCLUSION**
It is concluded that the IT course contents relevance is determined by the training curriculum that bears it, the extent which the curriculum reflects the needs of the Building Construction Industry market. Therefore the mismatch between the curriculum and market needs contribute to the lack of relevance of the course contents.

On the challenges facing the IT, it is concluded that lack of smooth facilitation for the program is a common challenge facing IT program as findings pointed out. Others include, increase in the number of students as at SCEM as the University expands, likewise insufficient funds.

Regarding Impact of the IT on the industry, it is concluded that, IT develops professional competency required by the industry, identify gaps in the training curriculum of construction professional institutions and, sharpen skills to promote growth and diversity of the same.

On Remedies, it is concluded that curricular review should keep pace with the changing market needs of the building construction industry. This is crucial in order to build a capable professional manpower to sustain the industry.

Generally, IT has great potential of impacting the industry in Tanzania positively through developing professional competency required by industry to enhance sustainability.

RECOMMENDATION

It is therefore recommended that frequent curriculum review are done in relation to the demand emanating from the workplaces so as to level the mismatch that currently exists between the course contents of the IT and the need industrial market. This should go in line with revisiting the whole of the IT programme in terms of structure, organization, monitoring and evaluation; it will cater for proper orientation of IT objectives to the stakeholders, setting relevant course contents that can be covered and to increase the duration for the program from the present 8 weeks.

AKNOWLEDGEMENTS

The author acknowledges Dr. Silverius Komba for close supervision of the research. The author acknowledges Mr. Fred Mwaisemba and George Mockray from the National Bureau of statistics for assisting in preparing the program for data and analysis, the higher education student’s loan board for assisting with a loan to financing the research. The author also acknowledges staff at School of Construction Economics and Management at Ardhi University for their cooperation. Lastly the author acknowledges Dr. Kanukisya for constructive criticism and Mr. Hamisi Amani for editing the work.
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The vulnerability of the construction industry to HIV and AIDS

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ABSTRACT

Purpose: This paper discusses the vulnerability of the South African construction industry to HIV and AIDS.

Design/methodology/approach: The research approach involved an extensive review of relevant literature and semi-structured interviews with 28 construction firms in KwaZulu-Natal and Gauteng.

Findings: If the construction industry wants to do well financially, they need a healthy, productive workforce. This in itself should be reason enough to take part in this fight against HIV and AIDS. The construction industry is particularly vulnerable to the epidemic because of its migrant labour force, large unskilled labour force and aging workforce amongst others reason but the industry is not doing enough to assist in this fight to combat HIV and AIDS.

Practical implications: By highlighting the serious threat that HIV and AIDS poses to the industry, the authors highlight the need for the industry to move away from denial of the impact that HIV and AIDS has in the workplace.

Originality/value: HIV and AIDS poses a grave threat to the South African construction industry and the construction industry in South Africa can and must do more.

Keywords: HIV and AIDS, construction industry, South Africa
1. INTRODUCTION

HIV and AIDS is a pandemic with serious implications for South Africa (SA) in general, and the South African construction industry in particular (Meintjes, Bowen & Root, 2007). According to the Department of Public Works (2004) the construction industry has the third highest incidence rate of HIV and AIDS per sector in South Africa. The construction industry has a predominant migratory labour force, making it the prime contributor to the spread of HIV and AIDS as workers are prone to visit prostitutes or have multiple sexual partners when they are separated from their families for long periods of time. Due to the high percentage (approximately 60%) of informal labour engaged in construction (Haupt et al., 2005a), they are less likely to protect themselves against HIV transmission (Meintjes, et al., 2007) due to their lack of knowledge of their risky sexual behaviour.

This paper discusses the effect of HIV and AIDS on the construction industry with particular emphasis on the South African construction industry.

2. LITERATURE REVIEW - THE CONSTRUCTION INDUSTRY

The construction industry is essential to a nation’s growth and a key sector in the nation’s economy and its development in terms of wealth creation and quality of life for its people (Ibrahim, Roy, Ahmed & Imtiaz, 2010; Rwelamila, 2002). It is usually one of the top five employers in any economy and accounts for up to 70% (R1.2 trillion) of the nation’s capital (Simon-Meyer, 2005).

The construction industry provides the physical infrastructure necessary for the country’s development (Rwelamila, 2002) as it is primarily involved in the construction of buildings and other structures, heavy construction, additions, alterations, reconstruction, installation, maintenance and repairs. (Ibrahim, et al., 2010; Simon-Meyer, 2005).

The SA construction industry contributed 3% to the gross domestic product and employed over 1.1 million people in 2009 which is almost twice the number of people employed in the industry since the early 2000s (International Organization for Migration (IOM), 2010). After two decades of decline, activity in the building industry increased rapidly from 2004 mainly due to spending for the preparation for the FIFA 2010 World Cup (ILO, 2010).

HIV and AIDS is a pandemic with serious implications for South Africa in general, and the South African construction industry in particular (Meintjes, et al., 2007). According to the Department of Public Works (2004) the construction industry has the third highest incidence rate of HIV and AIDS per sector in South Africa. The epidemic threatens to reduce the overall construction labour force, increase labour turnover, shift the age structure and change the skill composition of the construction labour supply.
(Haupt, et al., 2005a; Haupt & Smallwood, 2004). In addition to increasing costs and dwindling profits (Ahwireng-Obeng & Akussah, 2003), construction enterprises can expect declining output, diminishing quality and quantity of labour supplied (Barnett & Whiteside, 2006).

The workplace is generally not associated with the transmission of HIV and AIDS (Haupt et al., 2005a), but it provides an ideal platform to reach workers through the development and implementation of workplace policies and programmes on HIV and AIDS (ILO, 2010). However the important role that companies play in addressing the pandemic has not been optimally utilised. In fact the response of corporate South Africa to HIV and AIDS has being slow, partial and erratic (Dickinson, 2004; Haupt, Smallwood & Chileshe, 2005b).

Over 30 years since the first discovery of HIV and AIDS, the majority of companies still feel AIDS is not their problem. A survey conducted by Bureau of Economic Research/ South African Business Coalition on HIV and AIDS (BER/SABCOHA) showed that the construction industry was one of the least responsive industries (BER/SABCOHA, 2004). In a study conducted by Harinarain & Haupt (2010) it was found that only 10% of 123 building contractors in the KwaZulu-Natal province of South Africa had a HIV and AIDS policy in place. A survey by Bowen, et al. (2010) of construction firms in the Western Cape found that most organisations had awareness policies in place but prevention and treatment policies were less common.

The construction industry needs to understand that it makes good business sense to address HIV and AIDS in the workplace because failure to do so results in decreased productivity due to increased absenteeism and also because sick workers are less productive. Fatigue results in frequent accidents in the workplace. The loss of employees to the disease results in increased costs to the company in terms of replacing those skills lost and/or training new employees. Ultimately the declining population growth rate will result in companies having a smaller skills base from which to choose their replacement employees. Labour costs will also increase as companies have to increase their contributions for medical aid and life and/or disability coverage (Ahwireng-Obeng & Akussah, 2003; Haupt, et al., 2005b; ILO, 2010; Meintjes, et al., 2007; Whiteside & Sunter, 2000).

2.1 The vulnerability of the construction industry

The largest study undertaken in South Africa among construction workers was by Bowen, Dorrington, Distiller, Lake and Besesar in 2008 where 10,243 construction employees from 55 companies nationwide participated in order to understand the degree of association between risk factors and the prevalence of HIV and AIDS. Other studies conducted in the construction industry included the study of older construction workers and their awareness of HIV and AIDS (Haupt & Smallwood, 2003a), the
awareness of HIV and AIDS among construction workers in general (Haupt & Smallwood, 2003b), the relationship between age and worker perceptions, knowledge, beliefs, attitudes and behaviour (Haupt, et al., 2005a) and the aspects of HIV and AIDS intervention strategies within the South African construction industry (Haupt, et al., 2005b).

The construction industry is vulnerable to the disease because of its fragmented nature. The industry encompasses numerous companies of various sizes and discourages permanent employment by encouraging subcontracting and labour only subcontracting (Construction Industry Development Board (CIDB), 2003; IOM, 2010; Haupt, et al., 2005a). Other factors include the lack of leadership and the slow response in acknowledging and addressing the disease (Bowen, et al., 2008; Bowen, et al., 2010; Meintjes, et al., 2007).

The construction industry is also particularly vulnerable to the pandemic because it employs a constantly changing labour force that worked on short-term contracts (Dickinson & Versteeg, 2004) and permanent employees who moved between projects across the country and in other countries (ibid). The construction industry has a predominantly migratory labour force, making it the prime contributor to the spread of HIV and AIDS as workers were prone to visit prostitutes or have multiple sexual partners when they are separated from their families for long periods of time (Bowen, et al., 2008; Bowen, et al., 2010; Deacon & Smallwood, 2003; Dickinson & Versteeg, 2004; Haupt et al., 2005a; IOM, 2010; Meintjes, et al., 2007; Whiteside & Sunter, 2000).

Due to the high percentage (approximately 60%) of informal labour engaged in construction (Haupt, et al., 2005a), they were less likely to protect themselves against HIV transmission (Barnett & Whiteside, 2006; Meintjes, et al., 2007) as a result of their lack of knowledge of their risky sexual behaviour and various misconceptions about the disease (IOM, 2010). Workers avoided personal responsibility by believing that the spread of the disease was attributable to external factors (Haupt & Smallwood, 2004), placing themselves and their families at risk (Meintjes, et al., 2007).

The informal nature of the industry which was largely unregulated is also a contributing factor (Barnett & Whiteside, 2006; Bowen, et al., 2010). The industry does not attract enough new young people as there was a decline in interest in careers in the construction industry (a worldwide phenomenon) (Haupt, et al., 2005a). The construction industry vulnerable because of its focus on occupational safety rather than health (Deacon & Smallwood, 2003; Haupt, et al., 2005a) so that health-related interventions were not undertaken nor supported (ibid).

The industry consists of an aging workforce (older workers were those construction workers aged 40 years and older) (Dickinson & Versteeg, 2004; Haupt, et al., 2005a). The harsh environment that these
older workers toil in also exposed them to numerous health threats (Deacon & Smallwood, 2003; Haupt, et al., 2005a).

The construction sector had a large number of semi-skilled and unskilled workers (IOM, 2010) and are dependent on highly skilled people to direct these workers (CIDB, 2003) which further increased the industry’s vulnerability to HIV and AIDS (Ahwireng-Obeng & Akussah, 2003; Meintjes, et al., 2007). The predominantly semi/unskilled workers in a survey conducted by BER/SABCOHA (2005) suggested that HIV prevalence was higher among semi and unskilled workers than among skilled and highly skilled workers. The survey found that the sector employment practices were usually the prime contributor to the spread of HIV and AIDS as it increased the risk of workers becoming infected (BER/SABCOHA, 2005; Dickinson & Versteeg, 2004; Haupt, et al., 2005a).

Given these serious factors, HIV and AIDS poses a grave threat to the South African construction industry and according to Bowen, et al. (2010) and Haupt, et al. (2005b) the construction industry in South Africa could, and must, do more.

3. RESEARCH METHOD

In order to gain an in-depth understanding of how the epidemic was conceived, understood and managed in the construction industry a qualitative study was carried in order to collect resonant and fertile data. Qualitative research seeks meaning (rather than generality as with its quantitative counterpart) and builds understanding by depth instead of condensing information (Leedy & Ormrod, 2010).

Given that the aim of the research was to explore and discuss issues of HIV and AIDS vulnerability in the SA construction industry, rather than focus on the generalisation of the results, purposive sampling was employed as the sampling method (Leedy & Ormrod, 2010). The advantage of purposive sampling is that the researcher can identify participants who are likely to provide data that are detailed and relevant to the research question (Oliver, 2006). Construction firms were identified from the KwaZulu-Natal (KZN) Master Builders Association website. The reason for expanding the study to Gauteng was because some firms in KZN stated that they were unable to carry out the interview and the researcher should contact the ‘head-office’ in Gauteng.

Telephonic semi-structured interviews were conducted with 28 construction firms. The interviews lasted on average 30 minutes and the researcher was clear and unambiguous in the presentation of the questions in order to reduce any misunderstanding or confusion on the part of the interviewee. Semi-structured interviews were selected so that the researcher had key questions and themes to discuss, but it also allowed the interviewee to speak freely and without fear of reprisal as well as allowing for comments and questions from the interviewee to be followed...
up.

4. DATA ANALYSIS AND RESULTS

The analysis of qualitative data does not involve counting and dealing with numbers but is based more on information expressed in words that uncover patterns or themes (Leedy&Ormrod, 2010).

The researcher analysed the data by dividing the text (interview) in small manageable units and then coding it into themes as discussed below.

Sixty eight percent of the contractors interviewed were based in KwaZulu-Natal (KZN) and 32% were based in Gauteng. Out of the 28 contractors interviewed, only 7 firms had a HIV and AIDS policy, 75% of the firms did not have a policy or programme.

The average number of people employed in the participating organisations was 311, with employment ranging from 42 employees to 580 employees. The firms based in Gauteng had a full quantum of staff and in some cases were currently recruiting new employees. The firms in KZN are still trying to overcome downturn in the industry after the 2010 World Cup.

In order to convey just how vulnerable the firms are to the impact of HIV and AIDS, the researcher and interviewees had a discussion on the various problems experienced by the firms, such as loss of employees and skills due to death and ill-health; increasing absenteeism; labour turnover; training and recruitment costs. Only 25% of the firms (those that had HIV and AIDS policies) monitored absenteeism with the intention of viewing the impact that HIV and AIDS has on their employees, the other 75% were aware of the productive days lost due to absenteeism but did not pay too much attention to what attributed it, as it was more a concern of lost profit. All the firms acknowledged that they only kept a small percentage of core essential staff and their unskilled labour usually changed on different projects. The Gauteng firms experienced labour turnover of key personnel when they were offered higher salaries and in Durban labour turnover was experienced by firms retrenching staff. In both scenarios all the firms incurred training and recruitment costs that were in these cases not directly attributable to HIV and AIDS.

The researcher found that mostly large (companies that employ more than 500 employees) and medium (companies that employ between 100 and 500 employees, SABCOHA, 2005) companies had HIV and AIDS policies in place. This research confirmed the findings of Haupt, et al. (2005b) showing that very little has changed 8 years later. The 21 small firms (those with less than 100 employees) did not have policies or programmes in place which lead to an in-depth discussion as to why they were not implementing HIV and AIDS policies and programmes.
Seventy five percent of contractors acknowledged that HIV and AIDS affected them and their employees. They also reported that employees had died from AIDS and that some of their current workforce was HIV-positive. Although aware of the severity of the problem and the vulnerable position they were in they did not foresee themselves implementing a specific HIV and AIDS policy. Reasons stated by the majority of contractors for not implementing a HIV and AIDS policy included:

- “they are a small company”;
- “they do not have the resources to research, draft and implement an HIV and AIDS policy”;
- “they think it would be too costly and time consuming.”
- “they did not have enough information on HIV and AIDS in the workplace and how to implement HIV and AIDS programmes”;
- “managers’ level of concern about the epidemic was low overall”; and
- “HIV and AIDS was not regarded as a key business priority”.

The predominant migratory labour force, made it the prime contributor to the spread of HIV and AIDS (Bowen, et al., 2008; Bowen, et al., 2010; Deacon & Smallwood, 2003; Dickinson & Versteeg, 2004; Haupt et al., 2005a; IOM, 2010; Meintjes, et al., 2007; Whiteside & Sunter, 2000). All 28 firms confirmed working away from home was a serious problem that they encountered which definitely contributed to the spread of HIV and AIDS. In fact one interviewee stated that: “in the first week we see only men’s clothes on the line and in the second week there are female’s clothes on the line.”

The researcher asked those firms that had a HIV and AIDS policy why they decided to implement a policy and the problems they encountered. The response varied from the fact that workers moved around from site to site and were promiscuous, they noticed increased absenteeism and the fact that the client demanded it. One of the problems they experienced in implementing the policy was the fact employees did not want to change their traditional belief systems, for example “employees believed that they will get cured when they go to church or if they go home and slaughter two cows.”

The other problem that these firms experienced was that employees don’t want to know their status as they are afraid and although this percentage was small e.g. 4% of the workforce in one particular firm, it was still 4% too much. One of the firms that implemented a HIV and AIDS policy said that they didn’t experience a 100% success rate, but more employees came out and disclosed their status, and more people were enlightened about the disease. This firm hopes with time they will experience a 100% success rate.

Some of the benefits that the firms experienced from implementing a policy include the fact that employees are taking an interest in their health and asking for assistance, and they are becoming more empowered. Firms
have also noticed a decrease in absenteeism.

Although these firms had policies in place they were unsure of what percentage of the company budget was spent on the implementation of HIV and AIDS programmes. They did however have condom distribution programmes and HIV and AIDS were discussed regularly in toolbox talks and safety inductions. However none of the firms that had policies shared it with the subcontractors or even encouraged their subcontractors to implement a HIV and AIDS policy.

None of the 28 firms funded or are involved in funding research related to the disease. This is a major shortfall in the industry as not enough is been done to protect those most vulnerable, the employees. The 25% of the firms that had policies as had treatment referral systems to assist employees while the smaller firms relied on community clinics and state hospitals to assist their employees. Some of these firms did not even have booklets or brochures on HIV and AIDS which can be obtained for free from the Department of Health.

Those firms that had policies would like to assist the communities in which they work, it is not always possible. For the smaller firms, assisting communities was not even on their agenda.

The interviewees felt that construction firms need to implement HIV and AIDS policies and programmes because firms loose scarce skills, which results in them poaching staff from other firms, which is detrimental to the industry. Recruitment of new staff is also very expensive. Firms need to stop being afraid and need to know the severity of the epidemic in their organisations so that action can be taken.

What is even more distressing is the all interviewees expected future increase in HIV and AIDS prevalence and incidence rates. Construction firms by not acknowledging the vulnerability that HIV and AIDS pose to their firms are not only letting down their employees but they are also failing the country as a whole.

5. CONCLUSION

The consequences of ignoring the threat that HIV and AIDS poses to the construction industry can be catastrophic if the industry continues to ignore the warning signs. However the construction sector has not done enough in order to limit or prevent the impact of HIV and AIDS on its employees. If the construction industry wants to do well financially, they need a healthy, productive workforce. This in itself should be reason enough to take part in this fight against HIV and AIDS. By actively participating in this fight against HIV and AIDS, the construction industry can protect itself, improve the quality of life its employees and also assist the community. This paper highlights the fact that the construction industry is vulnerable to HIV and
AIDS an area of research that the authors will pursue in future research activities.

6. REFERENCES


Public Private Partnerships: Procurement Interventions that facilitate sustainable Built Environment Development

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ABSTRACT AND KEYWORDS

Purpose of this paper
The research undertaken investigates the utilisation of Public Private Partnerships (PPPs) as sustainable procurement interventions in the provision, repair and maintenance of built environment products.

Design methodology
The research is based on international literature surveys. A PPP road corridor/highway case study which includes observation, collection of quantified empirical data and qualitative unstructured interviews was undertaken.

Findings
PPPs provide multifaceted opportunities, which are mostly underutilised as procurement interventions, for the development, repair and maintenance of built environment products.

Limitations/Implications
Although comprehensive research and implementation take place internationally, in some regions such as Europe and Africa, PPPs are less prevalent than for instance in Australia, the United Kingdom and Canada.

Practical implications
Internationally the public sector increasingly experiences financial difficulties in meeting built environment/infrastructure needs such as the provision of schools, hospitals, transportation infrastructure, water services, maintenance, etc., while the private sector's financial and entrepreneurial
ability grows unabated. The table is set for “partnerships”, not adversarial relationships, between the public and the private sector.

**Original value**

PPPs require bipartisanship on all levels of government, the private sector and societies/countries to create independent platforms that can facilitate the utilisation and benefits of PPPs as an additional procurement process. Conclusions are made regarding the virtually untapped possibilities, particularly in developing countries, to provide, repair and maintain existing, often collapsing infrastructure and public buildings.

**Keywords:** Infrastructure, procurement, public private partnership, repairs and maintenance, road corridors

1. **INTRODUCTION**

The development impacts of road corridor/highway construction are important and substantially greater than the cost of actual construction. Resultant property- and socio-economic development is widely discernible, but difficult to quantify. Suitable procurement vehicles are required for execution of projects, making Public Private Partnerships (PPPs) attractive. PPPs are also known as P3s and in the United Kingdom mostly called PFIs (Private Finance Initiatives). The theoretical bases for these developments have been analysed and evaluated. The Maputo Development Corridor (MDC) highway component, stretching over 590 km from Gauteng, the economic heartland of South Africa, to Maputo, the capital of Mozambique, was used as a case study. Reliable statistical data on traffic movements, harbour usage, etc. are available, but the substantial “trickle-down” effect observed is difficult to quantify. PPPs are hailed as desired vehicles, if not a mandatory requirement to create sustainable infrastructure, such as highways. Provision and maintenance of other new infrastructure, as well as repair and maintenance of existing infrastructure, will benefit substantially from PPPs.

2. **PROBLEM STATEMENT, OBJECTIVES AND DELIMITATIONS**

The problem investigated is the following:

> Do PPPs have the ability to provide additional and suitable procurement avenues for infrastructure such as highways, hospitals, water purification, schools, etc.; what are the underlying constraints?

The objectives of the study cover the following:

- To conduct a survey of typical international utilisation of PPPs as procurement vehicles for developments
- To describe the theoretical, and planning and policy aspects underlying the development of highways
To identify the problems and solutions underlying the utilisation of PPPs in infrastructure development
To utilise the MDC as a case study, reflecting the outcomes of an extensive PPP highway corridor development, and empirical research to establish perspectives of beneficiaries and other stakeholders

The following delimitations apply to the study:
- PPP fundamentals portraying perceived practice are provided; a comprehensive practice guide is not provided.
- The MDC also includes a rail link, but the case study is focused on the highway component. Normal corridor spatial-planning principles are not affected by this delimitation.
- The MDC is used as case study to demonstrate outcomes, expanded where relevant, to reflect broader regional and African perspectives.

3. RESEARCH METHODOLOGY
The following research methodologies were applied:

Qualitative research methodologies
A literature and internet survey was undertaken to establish the international salient features of typical PPP practice. Recent conference proceedings were analysed and reduced to descriptive research outcomes, that is, a summary reflecting general practice.

Theoretical perspectives on regional planning and development corridors were compared and concepts related to corridors and their theoretical foundation revisited.

Quantitative research methodologies
Purposive sampling was applied and quantitative structured questionnaires were administered to business owners, managers, government officials and professional persons in the main centres, either on or very close to the highway. In South Africa 76 questionnaires were completed and in Mozambique 14. Quantitative questionnaires were also distributed to members of the Maputo Corridor Logistics Initiative (MCLI).

4. PUBLIC-PRIVATE PARTNERSHIPS CONSTRAINTS
PPPs are internationally used to create infrastructure. A number of countries have been identified by commentators over several years as “leaders” in the field.
5. INTERNATIONAL PERSPECTIVES

The following perspectives held by a number of countries shed light on the utilisation of PPPs:

Australia

Australia is presently hailed by many as the leading country regarding PPPs.

The following literature reflects the Australian position:
- The Australian Government (2008a) overview: National Public Private Partnership Guidelines, reflects the following:
  - Infrastructure is the main focus of PPPs with the private sector providing design, construction, financing, maintenance and delivery.
  - Government contributes land, capital works, risk sharing, revenue diversion, purchasing of agreed services.
  - The private sector receives payment from government or users of economic infrastructure (including toll roads: “user-pay”) contingent on the private sector’s performance.
  - PPPs are not synonymous to privatisation.
  - Table 56.1 shows the key differences in procurement methodology in Australia, portraying to a large extent the universal position.

<table>
<thead>
<tr>
<th>Traditional procurement</th>
<th>PPPs</th>
</tr>
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<tbody>
<tr>
<td>Government purchases an infrastructure asset</td>
<td>Government purchases infrastructure services</td>
</tr>
<tr>
<td>Short-term design and construction contracts (two to four years)</td>
<td>One long-term contract integrating design, build, finance and maintain</td>
</tr>
<tr>
<td>Input-based specifications</td>
<td>Output-based specifications</td>
</tr>
<tr>
<td>Government retains whole-of-life asset risk</td>
<td>Private sector retains whole-of-life asset risk</td>
</tr>
<tr>
<td>Payment profile has a spike at the start to pay for capital costs, with low on-going costs</td>
<td>Payments begin once the asset is commissioned. The payment profile is relatively even, reflecting the level of service provision over the longer term of the contract</td>
</tr>
<tr>
<td>Government is usually liable for construction time and cost overruns</td>
<td>Private contractor is responsible for construction time and cost overruns</td>
</tr>
</tbody>
</table>
Government operates the facility | Government may or may not operate the facility
---|---
Government manages multiple contracts over the life of the facility | Government manages one contract over the life of the facility
Often no on-going performance standards | Performance standards are in place. Payments may be abated if services are not delivered to contractual requirements
Handover quality is less defined | End-of-term handover is quality defined

- The Australian Government (2008b) National Public Private Partnerships: Policy Framework sets the following objectives:
  - Encourage private sector investment in public infrastructure.
  - Encourage innovation.
  - Ensure rigorous governance of the selection of PPP projects.
  - Provide a framework for streamlined procedures.
  - Clearly specify accountability for outcomes.

- Infrastructure Partnerships Australia (2012) ([s.a.], online) reports the following key findings on PPPs and traditional procurement:
  - PPPs are clearly superior in cost-effectiveness.
  - PPPs are expected to contribute a 10-15% share of infrastructure during the next decade. This will generate $6 billion (Australian) in potential community benefits.
  - PPPs are generally executed faster than traditional projects, being superior in terms of cost and time, improving with size and complexity.
  - Contrary to popular belief, PPPs are more transparent than traditional projects.
  - PPPs provide an additional procurement avenue that furthermore provides benefits far beyond the construction time of the projects.

The Royal Institution of Chartered Surveyors (RICS) (2012) reports the following: The Australian market is amongst the most mature in the world. Infrastructure development requires substantial investment, but the 2007/8
financial crisis created banking constraints. Different regulatory frameworks in different states require streamlining, while value for money has to be shown.

**Canada**

PPP Canada was founded as a Crown Corporation with an independent board of directors. Its mandate is to improve the delivery of public infrastructure by achieving better value, timelines and accountability to taxpayers through PPPs.

PPP are utilised by federal government, and are also increasingly being viewed more favourably by provincial governments in Canada.

PPP Canada (2010-2011) reflects the following in their Annual Report on PPPs:

- PPPs are delivering a broad range of on-time, on-budget public infrastructure projects, including transportation, reducing risk and maximising value over the entire project life cycle.

- Integrated solutions regarding design, construction, finance and operation of public infrastructure are developed. PPPs draw leading expertise together in all aspects, using the discipline of competition and capital markets to ensure private sector delivery.

- Federal government is increasingly dedicated to promote the use of PPPs.

- Federal government has committed to the future assessment of the suitability of federal projects for PPP application. All projects with a capital cost in excess of $100 million (Canadian) will be required to be assessed for PPP suitability.

The RICS (2012) indicates that Canada has particular challenges in addressing road and bridge construction. Canada has weathered the 2007/8 financial crisis better than most other developed countries. Government commitment and support have enhanced PPPs, which have a sound success track record. Canada’s reputation as leader in reducing time and cost of bidding has grown. The Canada Pension Investment Board has made significant investments in infrastructure around the world.

**United States of America (USA)**

PPPs in the USA are regarded as an evolving market with new opportunities according to Chase (2009), who regards PPPs as moving through three generations. PPPs have moved on from first-generation monetisation deals, and are now in transition from the second generation ad
hoc projects to the present third generation, where projects with potential should be selected and advanced to well-structured PPP programmes.

During the first generation, public officials for the first time considered innovative private financing. Some unsatisfactory results, discredited PPPs. The second generation also posed problems blamed on public sector fragmentation. However, success has been achieved with corridors and user-pay projects. Improved alignment of interests, incentives and risk sharing between public and private partners produced better results. But the lack of a comprehensive federal PPP programme, still results in ad hoc projects and project partnerships, each time having to reinvent the wheel.

Performance-based approaches have evolved in the third generation, now fostering the development of policy and detailed implementation processes through PPP units in government agencies. Private investors and public pension funds specifically require infrastructure in their portfolios.

Reinhardt (2011) recently reported the following status:
• Noteworthy PPP progress has been made in the water market with quality improvements due to PPPs.

• Buildings provide an opportunity to be exploited by gains that could be made on the misallocation of risks resulting in as much as 30% of project costs.

• Highways have been developed on an on-off PPP basis but are not developing consistently. Yet, Canada, starting at the same time, has established numerous very successful PPPs, presently at the rate of $300 million (Canadian) annually.

• As yet there is not a financial formula for USA highways. There seems to be general consensus that the creation of successful coast-to-coast highway system is only possible on a user-pay basis, thus tolls.

• Like Puerto Rico, it is time that government (USA) realise they are broke and cannot meet expectations. Like Puerto Rico, the USA government could discount this fact and utilise PPPs to tap into private sector capital, creativity and long-term diligence. Puerto Rico is highly successful in this regard.

The RICS (2012) reports that the USA PPP market remains small with only 15 projects having reached closure between 2005 and 2010. However, interest is increasing and the market is expected to grow considerably under budgetary pressure. About half the USA states have enacted PPP-enabling legislation.

The City of Chicago has developed an ordinance (2013) creating the Chicago Infrastructure Trust to attend to infrastructure financing. This
development plan is regarded as a “public-private mechanism” for funding infrastructure improvements by utilising private sector financial and other resources.

**United Kingdom (UK)**

The UK more often refers to a Private Finance Initiative (PFI) than to a PPP. The PPP Forum (2012) describes a PFI as a procurement method where the private sector finances, builds and operates infrastructure and provides long-term facilities management through long-term concession agreements. The lifespan of these concessions is at least 25 years. Payment is made only if services are delivered according to the requirements of the concession.

The National Audit Office in 2003 estimated that 73% of procurement under traditional methods was delivered over budget and 70% was late.

PFI from both a public and a private perspective was challenged to address the above deficiencies.

PFI projects have now probably become the largest infrastructure sector in the UK. Over the past fifteen years the PPP Forum has reported over £60 billion worth of projects signed: almost 100 hospital schemes, more than 100 education projects, more than 800 school projects, 43 transport projects and over 300 other operational projects.

Risk is distributed in PFI projects, and the private sector accepts the risks that they can best manage. Construction and design rest with contractors, while finance providers bear the financial risk. Typical PFI participants are construction contractors, insurance companies, banks, equity investors, professional advisors, and the public sector participants in transport, health, education, etc.

It is estimated that PFI projects are about 2.25% more expensive than traditional projects, attributed to the cost of private sector finance, versus lower-cost public finances.

RICS (2012) reports that the UK government stepped in to support PPP projects under the responsibility of the Infrastructure Finance Unit (IFU). Confidence in PPP procurement was boosted as a result. It is envisaged that the IFU could be extended to form a National Infrastructure Bank. Although the UK PPP market is well developed, it still lacks robust data, and from inception to closing of the contract takes about twice as long as in Canada. Institutional investors are also slow in partaking in PPP projects.

**Europe**

The European view of PPPs is overly positive but politically challenged.

The major motives for moving towards PPPs in Europe are macroeconomic, budgetary and improving efficiency of public service delivery, as reported by McQuaid and Scherrer (2008).
In some European countries there is a strong preference for consensus societies. The political context in Europe is also different from that in Anglo-Saxon countries. There is a reluctance to increase the level of direct privatisation. This position is also confirmed by recent political developments in a strained Eurozone environment.

However, some regard PPPs as the middle ground, and not as privatisation. The uptake of PPPs in Europe is slow, but with the impact of high tax burdens and restrictions placed on governments to borrow money, PPPs are becoming attractive to raise private funds to close infrastructure gaps.

Overall there appears to be considerable scope to develop PPPs in Europe.

South Africa (SA)

- **PPP Manual**

  The SA Government (2004), Department of Finance has created a PPP Manual. In the preface the minister of finance makes the following statement:

  *National Treasury’s PPP Manual* is indeed a world first. It systematically guides public and private parties through the phases of the regulated PPP project cycle for national and provincial government, unpacking policy and providing procedural clarity as it does so. It draws on South African project experience to date and on best international practice, without infringing on the authority of accounting officers and authorities. It sets rigorous risk-assessment standards by which government will make affordable project choices that best leverage private investment for quality public services.

  This manual contains sections on regulations; code of good practice; inspection; feasibility; procurement; management of agreements; auditing; accounting; project finance.

  Although the PPP Manual is available, and some very successful projects, such as the MDC, had been undertaken even before the manual existed, the PPP procurement strategy has lost steam. There appears to be substantial private sector appetite to engage in PPPs, but the success rate of bringing PPPs to fruition is low. Private sector construction contractors have recently indicated that it is becoming too uncertain, cumbersome and costly to pursue proposals despite successful projects having been executed.

- **The MDC**

  The MDC is a success story, also confirmed by the continued smooth operation in PPP format. The following are some of the noteworthy observations:

  - The South African government’s role included entering into agreements with the government of Mozambique and TRAC, which
Public Private Partnerships: Procurement Interventions that facilitate Sustainable Built Environment Development

- The Build-Operate-Transfer (BOT) agreement provides for the N4 toll highway to become the sole property of government after 30 years, with renewal being an option.

- The development equity was secured by a 20% contribution from the construction contractors’ consortium (including some international contractors) and 80% debt by four major banks.

- The highway is so successful on a user-pay basis that it was refinanced in 2006 under improved terms and release of capital.

- Shareholders have been able to successfully trade their interests in TRAC. TRAC is thus a marketable investment instrument.

Royal Institution of Chartered Surveyors (RICS)

The RICS (2012) Policy Report (PR) contains their views on PPPs. They identify the need for PPPs, stating that “they will have to evolve in response to the new economic environment with tighter credit conditions and less government spending”.

In the RICS (2012) PR, PPPs around the world are investigated, with special reference to the UK, Australia, USA, Canada and India. The observations made in the RICS PR agree with the information contained in this paper. The PR contains 25 recommendations pertaining to the future use of PPPs, grouped under the following headings, followed by the specific (summarised, reworded) recommendations:

- **Impact of the financial crisis (international 2007/8 meltdown):** Long-term plans for infrastructure; government intervention regarding lack of bank lending capacity; problems with financing; government financial support for PPPs; creation of PPP project pipelines to promote private sector confidence; clear federal government commitment.

- **Government commitment and support:** Clear legislative and regulatory framework required; legislative clarity between states (USA); establish body to coordinate infrastructure projects.

- **Reform tendering process and bid costs:** Increase public sector ability to assess risk; reliable data on traditional and PPP procurement required; effective comparative borrowing cost analysis of private and government sectors; effective comparison between traditional and PPP procurement; whole-life cost comparison; remove disconnect between design and lifecycle costs.
• **Reform tendering processes and bid costs:** Make them more efficient; reduce the cost and complexity.

• **Increase levels of institutional investment:** Encourage institutional investment; create secondary PPP market investment opportunities.

• **Support innovation and flexibility in PPPs:** Facilitate transfer of knowledge; flexibility in PPP contracts to allow changes; simplify and standardise contracts.

• **Public perception of PPPs:** Address accusations of profiteering against private sector; address negative PPP views; avoid the “no viable alternative to PPP” views.

**General observations: Recent research publications**

Ndoni and Elhag (2012) (UK) report the following main barriers to innovation in PPP/PFI (UK) projects: The one-off nature; the configuration of construction work; lack of joint collaboration; and challenges to management innovation. As possible corrective measures they identify: Formation of interpersonal ties; networks of learning; and joint collaboration between clients, suppliers, manufacturers and researchers. The key ingredients identified as missing in PPPs are how to stimulate innovation, and other factors of significance.

Regan, Smith and Love (2012) (Australia) highlight the Asian Development Bank (ADB) evaluation of PPP policies and programmes in Australia, the UK and 11 developing or emerging countries. The comparisons are based on indicators developed for this evaluation. They indicate that value for money is driven by: risk transfer; whole-of-life costing; innovation; asset utilisation; private sector financial and managerial skills; improved quality of service and performance; and enhanced public management.

The index developed by the ADB is based on 19 indicators, weighted into six categories, namely; legal and regulatory framework (25%); institutional framework (20%); operational maturing (15%); investment climate (15%); financial facilities (15%); and a subnational adjustment factor (10%).

The outcome of the above PPP-readiness index (maturity model) for the identified leading countries is reflected in Table 56.2.
Confirmed by Regan et al. (2012) as two of the most important features for the successful implementation of PPP programmes are firstly a formal policy framework and secondly a pipeline of projects. A supporting PPP facilitating body is furthermore required to advise stakeholders.

Javed, Lam and Chan (2012) (Hong Kong) observe the following: Output specifications are considered an integral part of PPP documentation, covering issues such as physical assets, facilities, level of service, change mechanism, performance criteria linked to costs and risks; pitfalls which abound in the drafting of specifications. Well-designed and structured output specifications that provide the private sector with innovative and cost-effective solutions, minimising future conflicts, are required. They indicate that maximum specification benefits are achieved when the focus is on what should be delivered, rather than on how it should be delivered.

THE MAPUTO DEVELOPMENT CORRIDOR (MDC): A CASE STUDY

Theoretical aspects regarding regional and spatial planning

According to Gertler (1972), regional planning is directed towards facilitating development, private or public, in a manner that results in areas where people settle, establish regional communities, and create the best environment and the soundest use of resources that civilisation is capable of effecting.

Glasson (1978) is of the opinion that growth occurs along diverse channels and is intensified at certain development poles with variable intensities. Perroux (cited in Glasson) (1978) propelled this theory and argues that intensified development should occur in certain growth points or economic spaces from which outward-working forces are generated and to which inward-working forces are attracted. Jooste (1994) postulates that the growth pole theory is one of the most renowned strategies to ignite development in underdeveloped regions. Especially rural developments in a regionalised or nationalised planning system. The rationale behind this theory is premised in the principle of agglomerations and transmissions of economic benefits through certain spheres of influences or poles. Gauteng and Maputo can be seen as agglomerations of economic and industrial...
activities while the MDC may be seen as a channel (axis) to spread the economic and social benefits from and to these two growth poles.

Figure 56.1 diagrammatically reflects the present MDC highway, also indicating “development areas” into Swaziland, capital city Mbabane (o) to the east, and the northern regions of the Limpopo Province with dual development nodal points at Polokwane (l) and Phalaborwa (k). Other corridors also project out of the terminal nodal points of the MDC at Pretoria (a) to Rustenburg (m) and Johannesburg (b) to the Vaal Triangle (n), (a, b, m, n) Gauteng, South Africa and Maputo (j), Mozambique.

![Diagram of MDC highway](image)

**Figure 56.1** Diagrammatic presentation of MDC with development arms

| a: Pretoria | f: Machadodorp |
| b: Johannesburg | g: Nelspruit |
| c: Bronkhorstspruit | h: Malalane |
| d: Witbank | i: Komatiepoort |
| e: Middelburg | j: Maputo |
| k: Phalaborwa |
| l: Polokwane |
| m: Rustenburg |
| n: Vaal Triangle |
| o: Mbabane |

**Government initiatives: PPPs as vehicle**

The objective of the National Physical Development Plan (South Africa) (1975) was to link existing metropolitan areas with identified or future growth poles by means of development corridors. The greater the distances between centres, the stronger these centres should be as development centres. In some cases so-called corridors are not corridors but only finger developments with no equilibrant development centre at the other end.
The MDC is regarded as a most successful PPP, with the concessionary already investigating further similar developments in Africa. In contrast to the success of the MDC (and several other similar corridors in South Africa) as a PPP project, the government agency, South African National Roads Agency Ltd (SANRAL) has recently completed a Gauteng toll-road system (that links the MDC with Johannesburg and Eastern Gauteng) with disastrous financial consequences. Allegations regarding exorbitant tolls and corruption have led to a supreme court ruling suspending tolls in April 2012, the outcome of a public outcry, legal action and possible payment boycotts. In stark contrast, numerous PPP projects are running smoothly, being managed by private sector concessionaries.

A “mid-term” overview

Söderbaum and Taylor (2003), with the aid of seven co-writers, provide a mid-term analysis of the MDC. The following MDC key objectives (1 to 4), in some instances reworded and/or summarised for this report are relevant:

1. To rehabilitate the primary infrastructure network along the corridor, notably road, rail, port and dredging, and border posts, with the participation of the private sector in order to have minimum impact on the fiscus

2. To maximise investment in both the inherent potential of the corridor area and in the added opportunities which infrastructure rehabilitation will create, including the provision of access to global capital and facilitation of regional economic integration

3. To maximise social development, employment opportunities and increase the participation of historically disadvantaged communities

4. To ensure sustainability by developing policy, strategies and frameworks that ensure a holistic, participatory and environmentally sustainable approach to development

Concluding remarks by Söderbaum and Taylor (2003) suggest, contrary to popular belief, that the MDC is a failure as the stated objectives 3 and 4 have not been achieved. They fail to acknowledge or fundamentally evaluate the real effect of the “trickle-down” impact or to provide guidance as to how objectives 3 and 4 should be practically realised. Guidance is also not provided as to how the desired social development and employment resulting from the MDC are measured, or are measurable.

African continent

Jourdan (1998) reports:
An African Development Corridor desktop study was undertaken by the RSDIP (Regional SDI Programme of the SA Department of Trade and Industry) and the Council for Mineral Technology (Mintek) (for NEPAD) in 2006 to investigate the potential and status of continent-wide development corridors, examining in a preliminary fashion the potential of Development Corridors (DCs) across Africa. It makes the case that Africa’s physical and social infrastructure needs are so extensive that they cannot be met in any reasonable time frame without substantive contributions from the private sector.

The Japan International Cooperation Agency (JICA) (2010) has prepared a comprehensive study titled Preparatory Survey for Southern Africa Integrated Regional Transport Programme. This study was conducted to cover the region reportedly with the highest cross-border traffic volumes in Africa, covering the eight most southern countries with 18 corridors. In each case comprehensive trade movement data is available. This study confirms substantial growth in Direct Foreign Investment (DFI) in the region since 2005. However, to ensure sustained development, corridors are a key requirement for growth. JICA (2010) states:

The existing 18 corridors in the region connect local mineral and agricultural resources with global markets. The study proposed redefining the role of regional economic and transport corridors according to growth scenarios (strategies), building on the growth belt concept, which encompasses the integration of resources, value creation, and global markets.

A World Bank (Africa Region) Summary Report (2010) on Mozambique, states that the further extension of the MDC is anchored in a “growth poles strategy” that supports the position in this report, i.e. that development centres/nodal points/growth poles are key drivers of corridor development. Evidence indicates that “a road is a road” that connects growth poles and that development tends to take place mostly in the centres/nodes/poles, with the axis benefitting from socio-economic development along the corridor in a catalytic fashion.

Observations following mid-term 2003

An interview with Chief Executive Officer Brenda Horne (2010) of the non-profit Maputo Corridor Logistics Initiative (MCLI) was conducted to obtain a perspective on the ensuing years since 2003. The MCLI, a non-profit company, was registered to create a body where all stakeholders may contribute to develop the MDC in their collective best interest. The MCLI subscribes to the following mission: “To support the development of the Maputo Corridor into a sustainable, highly efficient transportation route, creating an increasingly favourable climate for investment and new opportunities for communities along the length and breadth of the Corridor”.

In pursuance of the above, the MCLI (2009-2010) has at its disposal extensive quantified and qualitative data that supports MDC attributes.
Questionnaire results: Stakeholders 2011

Out of the 76 respondents in South Africa that completed questionnaires and 14 in Mozambique (the relatively low number of respondents in Mozambique could be attributed to most of the people approached not being fluent enough in English to complete the questionnaires and only 89 km of the highway being in Mozambique) the minority of the South African respondents, 10.5%, had over 20 years’ experience in their current field of work while the majority, 40.8%, had fewer than five years' experience. In contrast, the majority of the respondents in Mozambique, 42.9%, had over 20 years’ experience in their current field of work while only 7.1% had fewer than five years’ experience.

If the substantial "Neutral" and "Missing" responses from Table 56.3 are ignored (taken as 0), the “Disagree” and “Agree” categories provide an enhanced and more powerful response, reflected in the columns marked with an *. The figures provided are expressed as percentages based on the data which reflect an opinion.

Table 56.3 below shows some of the perceptions of the stakeholder respondents regarding the impact of the MDC on general economic growth. The data obtained has been drastically simplified and combined for South Africa and Mozambique in the narrative summary below for this report.

Table 56.3 Simplified MDC stakeholders’ perspectives

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<td>Q4</td>
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<td>Q5</td>
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<td>Q6</td>
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## MOZAMBIQUE

<table>
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<th>Agreement</th>
<th>Neutral &amp; missing</th>
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<td>29</td>
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<tr>
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<td>21</td>
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### CONCLUSIONS

The following aspects require specific attention to engage PPPs successfully for the creation of infrastructure in particular highways:

- Policy and procedure guidelines have to be in place, providing optimal strategies regarding design, build, maintain, manage, finance, skills development, duration and closeout.
- Table 56.1 represents a universal comparison between PPPs and traditional procurement.
- PPPs are not privatisation, but an alternative procurement avenue.
- Long-term risk elements could be “demised” by introducing reviews at time milestones, say 25 years.
- Transparency, accountability and reporting, similar to what is expected of public, listed companies, will counter suspicion of profiteering, corruption and other subjectively perceived risks.
- The identified “tradability” of equity and finance in PPPs indicates the distinct possibility that PPP finance has the potential to become a typical private sector investment instrument.
- PPPs are not a panacea for all problems, but should be regarded as a very viable alternative for many projects that would normally under traditional procurement processes be executed less successfully or perhaps not at all.
- PPPs are complicated, but there is a wealth of successful PPP projects in the world from which lessons could be learned. It is not necessary to reinvent the wheel.
• Various legal frameworks have been tried and tested for PPPs. It is proven common practice to employ achievable, satisfactory legal arrangements and risk mitigation.

• A country is only viable for PPP application if it has a reliable and robust legal system. Many emerging countries simply lack this.

• Recent research reports inter alia indicate the following success factors for PPPs: build human and group relations; test countries/regions by way of a “readiness evaluation (maturity model index)”; use performance specifications based on what rather than how to deliver projects; apply innovative financial modelling.

• Rigorous outcome specifications, model contract documentation and contractual arrangements are imperative requirements for success.

• The most important missing link is the will and dedication to remove impediments and to create policies, structures, procedures and model contract documentation for repetitive application, supported by facilitating catalytic agencies.

The data regarding the MDC, particularly the N4 toll highway, reflect a highly successful outcome. As a PPP it passed the success test in most respects.

It is clear that regional socio-economic development, particularly in Africa, could benefit extensively from corridor-, and more specifically highway developments. Local and regional needs can benefit from “internationalised” and/or “regionalised” PPP solutions.

Well-structured and -managed PPPs provide satisfactory financial outcomes, expressed as return on investment. Government agencies, like SANRAL, not being primarily driven by “business” motives like a private partner, are not transparent and seldom adequately equipped with the necessary combination of business and technical skills to bring difficult solutions to the fore at an acceptable cost and risk level.

No evidence was found which indicated that any of the countries described in this research have adequate public financial and other resources to responsibly further circumvent the necessity and potential of PPPs for infrastructure development. Highways in particular also offer simple user-pay options. Similar benefits are, however, obtainable for other infrastructure projects.

RECOMMENDATION

A “mind switch” from adversarial procurement models to PPPs as procurement models is imperative. Extensive benefits, both financially and as empowerment tools are locked into PPPs. Serious consideration should
be given to extensively apply PPPs to public service projects like highways, water supply and purification, electricity, industrial, commercial and residential buildings, hospitals, etc. The utilisation of Build Operate and Transfer (BOT); Build Operate Train and Transfer (BOTT); Build Own Operate Transfer (BOOT); Repair Operate Train and Transfer (ROTT); and many other models, hold exiting prospects.

REFERENCES


Integrated Project Delivery System Implementation in the public sector in South Africa: A Pilot Study

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ABSTRACT

PURPOSE: This study aims to examine the most commonly used procurement approaches utilised within the public sector of South Africa and to explore the potential impact of using the Integrated Project Delivery System on these types of projects.

RESEARCH DESIGN: The research was conducted via a survey to relevant stakeholders on public sector projects, confined to the KwaZulu-Natal region.

RESEARCH LIMITATIONS: The study has been conducted on public sector projects in KwaZulu-Natal during the past 3 years.

RESEARCH FINDINGS: The study found that specific procurement routes were followed on public sector projects in KwaZulu-Natal, there was little resistance or objection to using a different approach. The Integrated Project Delivery route is known and is an innovation which is being reviewed.
RESPONSE TO CONFERENCE THEME & OUTCOMES: This study will contribute to improvement in delivery of projects with increased efficiency and waste reduction by optimising resource allocation. The study will potentially highlight barriers that inhibit the effective implementation of this form of procurement in South Africa and provide insight on how to overcome these barriers in an effort to enhance the development of the construction industry.

PRACTICAL IMPLICATIONS: This study contributes to the body of knowledge of public sector procurement routes and proposes an Integrated Project Delivery approach given its benefits to all parties involved in the project delivery process.

VALUE OF PAPER: 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. The findings of this study may provide opportunities for increased efficiency and waste reduction by optimising resource allocation. The findings will potentially also highlight barriers that inhibit the effective implementation of this form of procurement system within South Africa.

KEYWORDS: Procurement, public sector, Integrated Project Delivery System

1. INTRODUCTION

The construction industry's use of the Traditional Procurement Methods has become notorious for failing to integrate construction with design (Trigunarsyah, 2004). Arguably, the consequences of this weakness 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, et al., 2002).

Designers' drawings usually convey the quality they intend for the building once completed, often with little concern of how this objective is to be achieved. Typically, the assembly of the building and its associated components reside within the jurisdiction of the contractor. When these designs are of a complex or unusual nature the contractor draws the attention of the design team to the implications of the construction process. Often this action results in variations to the working drawings. Arguably, the lack of consideration for the manner in which a contractor and their team
will apply the design to the construction process often results in project delays in the form of cost increases and schedule delays (Arditi, et al., 2002).

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. This separation deprives the contractor of the opportunity to provide input into the design informed by his 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, et al., 2008).

In order to optimize the construction process, it is essential for constructability to be incorporated into the design process. The seemingly most effective way in which to achieve this objective is to include the construction knowledge and experience of the contractor during the early stages of design. The procurement system of choice is therefore paramount to the success of the project and not just the contractual obligations.

2. LITERATURE

2.1 Procurement Methods

According to Lupton, et al., 2007 'Procurement' often describes the flow of relationships (interactive and contractual) between the client and the construction teams and consultants within a construction project. In most instances in the traditional procurement approach the Architect is appointed as the lead consultant known as the principal agent. However this is not always the case. Companies may stipulate who the principal agent or lead consultant may be and sometimes the client may have pre-selected the principal agent (Lupton, et al., 2007).

The assumed role of planners undertaken by the design team translated in these teams being primarily concerned with the end result. They often failed to consider the necessary construction activities required to complete the works. These details were rather transferred to the constructing team. Through delegating the additional responsibility to the contractor, the design team was requiring the contractor to be liable for much more than was actually required of him. The constructor often experienced construction problems leading to possible delays, inefficient utilization of resources and work that was not sequential, all of which posed a threat to the budget, schedule and health and safety, when constructability was not considered during the design process.

The need for a more comprehensive procurement method becomes increasingly apparent as numerous projects continue to fail to meet delivery
requirements. “Maximising value and minimising waste at the project level is difficult when the contractual structure inhibits coordination, stifles cooperation and innovation, and rewards individual contractors for both reserving good ideas, and optimising their performance at the expense of others” (Matthews and Howell, 2005: 47).

2.2 Project Delivery in the Public Sector
Procurement in the public sector in South Africa is governed by the Construction Procurement Reform Policy which outlines its main objectives as

- Cost certainty at the tender award stage
- Better value for money
- more efficiency in the delivery of public works projects

According to Ambe and Weiss (2012), the reform was initiated to encourage the principles of good governance and a preference system was introduced by the National Treasury to additionally address the socio-economic aims. The author's further explain that the reform was a process devised to address the inconsistency in policy application, fragmentation of the procurement process and want for accountability within the process.

2.3 Integrated Project Delivery System
According to Matthews and Howell (2005) there are four systemic issues which arise when utilising the existing traditional procurement methods, namely:

- Innovative ideas being held back due to competitive bidding processes; in order to gain a competitive edge, contractors often keep their innovations to themselves. Once the contract has been awarded, time and opportunity is often lost as the design team has to amend working drawings to incorporate the ideas.
- Difficulty experienced in innovating across trade boundaries due to contract stipulations; subcontract agreements containing requirements of the party, penalty and remedy details provided difficulty for contractors to innovate across other trades despite their work often being interdependent.
- Absence of formal efforts being made to link planning systems of the subcontractors involved in the process; despite ‘partnering’ sessions being held in some instances, there are no formal records of mutual commitment.
- Subcontractors constantly struggling to optimize individual performance; the subcontract agreement often persuades the contractor to experience an attitudinal change with regards to taking care of his own interests. The contractor protects his own interest often at the expense of the client and even other subcontractors.
The Integrated Procurement Delivery (IPD) System seeks to align the objectives of various parties while providing a system which is more comprehensive. Since a single contract binds the IPD team to the client the risk of claims is mitigated.

“Team members are united together under the prime contract. The team has one price, and that is the price to the Client. The Team has one scope, and that is the project scope as defined in the prime contract. There is no accounting among PTMs Primary Team Members (PTMs) for who is over or who is under budget. Holding everyone solely accountable for their own scope and price would drive the project back down the road to local optimisation and inhibit innovation. IPD was formed to avoid these problems” (Matthews and Howell, 2005:49).

Matthews and Howell (2005) identify two key principles that define the IPDS team relationships. These key principles are:

- Primary Team Members are held responsible for all provisions of the prime contract with the client. The prime contract is signed by the team as a single entity.
- Primary Team Members divide the risk and profit for overall project performance.

Each PTM legally bind themselves to each other to fulfil the requirements of the contract. An agreement to share the costs and profits based on a formula according to the participation on the project is entered into. Possible consequences of the approach have been highlighted, the main concern being that should a PTM err, the other PTM’s are held jointly liable however this may also be regarded as a strength of the system due to the risk of errors and cost overruns being minimised as the consequences are shared rather than a single party accepting liability. The approach of joint risk encourages the team to heighten the group dynamic and aim for a common goal. (Matthews and Howell, 2005)

Bongiorni (2011) identifies challenges and issues experienced with implementing IPDS such as:

- The need for a capable team with regards to the ability to making sound and competent decisions by the client as well as the staff.
- Technological advancements must be made available and team members are required to have detailed knowledge on this in order to aid implementation of IPDS.
- Teams may be structured to allow parties who have experience with each other, therefore diminishing opportunity for new ventures.
- The contractor is involved early in the cost forecasting process, which differs to the commonly used Traditional approach.
• Team members are compensated according to their contribution as stated in the prime contract. This creates an incentive approach which can be highly advantageous.

3. RESEARCH APPROACH

A qualitative methodology was applied in the form of a structured survey consisting of open ended questions. The methodology was conducted on the various key stakeholders involved in the procurement process on construction projects within the public sector. Due to the research being conducted within the public sector, a relatively small sampling population was utilised as there are individuals whom are specifically allocated the responsibility of procurement decisions within the relevant departments. The structure of the approach was based on a literature review on the subject matter.

4. FINDINGS AND DISCUSSION

A majority of participants (75%) acknowledged that shortcomings existed in the current construction and associated procurement processes such as fragmentation and lack of a common goal among the parties to a project. All participants considered the relationship between project delivery and procurement method to be a strong one. However the opinions of the details of the relationship varied. Research has indicated that these shortcomings can be overcome with the implementation of a more comprehensive approach which would seek to align the goals of the parties involved. IPDS has proven to contain characteristics which assist in aligning the objectives of the various parties to a project. Most participants reported that unsuccessful project delivery was due to the inexperience of the construction team. Bongiorni (2011) has highlighted the issue of IPDS requiring competent teams. The term competence in this regard translates to a team which has the necessary knowledge and experience, is reliable, trustworthy and morally transparent.

It is evident from the data that all participants were aware of characteristics of an approach such as the Integrated Project Delivery System (IPDS). The Traditional Procurement System (TPS) had been the preferred method of procurement on public sector projects. The majority of participants concurred that the criteria for the selection of procurement method stemmed from existing policies and frameworks such as the Preferential Procurement Framework and National Treasury guidelines on procurement (CIDB, 2005).

All participants have noted that while successful project delivery has been common, it is often at the sacrifice of secondary objectives. The use of a
principal agent has proven to be advantageous within the construction process with 100% in agreement however the issue of fragmentation of participants due to the Traditional approach has emerged. IPDS contains similarities with regard to the benefits of a main communication link using ‘Primary Team Members’, which would provide the same benefits as a principal agent. These PTM’s share the risk among themselves under the prime contract, while still providing a single line of communication with the client however the risk of fragmentation is eliminated due to the nature of the Integrated Project Delivery System (Matthews and Howell, 2005).

While 75% of participants agreed that IPDS implementation would have a positive impact on the construction process, it is apparent from the 75% who considered IPDS implementation project specific that knowledge on the particulars of IPDS was deficient This reinforces findings by Bongiorni (2011) that identify lack of a capable IPD team as a challenge experienced. Numerous barriers to implementation exist, although the most prevalent being legislative barriers (75%). The implementation of the existing policies and framework in South Africa appeared to be one of the main barriers, while the possibility of collusion tied in closely.

5. CONCLUSION

Jeff Radebe, 1997 Minister of Public Works stated ”The appropriate orientation of public sector procurement would enable the State to use its purchasing power to attain specified socioeconomic objectives. Within the South African context, public sector procurement can make a critical contribution to the transformation and democratisation of South African society. In striving for the above, Government must also ensure that such a procurement policy subscribes to international best practice and reinforces the principles of good governance.” A comprehensive system which has the potential to contribute significantly to the development of the construction industry must be explored.

A standard procurement method and process cannot be developed in seclusion from the objectives and goals which are outlined. The study has illustrated that Integrated Project Delivery Systems should be considered as a potential procurement route within the South African construction public sector despite the primary barriers. These barriers can be overcome with greater knowledge of the details of implementing the Integrated Project Delivery System. The benefits of IPDS address numerous inadequacies of the current procurement systems in use and therefore it may be concluded that with further research into the details of the IPD system, it can potentially contribute to the development of the processes carried out within the public sector in South Africa.
REFERENCES


FOREIGN PROPERTY OWNERSHIP PATTERNS IN SOUTH AFRICA

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ABSTRACT

Purpose:
The nature and extent of foreign ownership of golf and lifestyle estates was investigated in an attempt to determine specific patterns of foreign property ownership in South Africa.

Methodology/Scope:
The extent of foreign ownership of all new companies registered with the Companies and Intellectual Property Registration Office (CIPRO) under the category of 'Real Estate activities' from January 2003 to January 2008 was determined. In addition, foreign ownership of residential units in three suburbs in different provinces was investigated for the five-year period from 2004.

Findings:
The study established that generalisations about foreign property ownership are fraught with difficulties, as ownership patterns vary considerably between different areas and also because identification of foreign owners is limited by the fact that a number of properties are owned by legal entities which do not necessarily reveal the identity of shareholders or beneficiaries.

Value:
The finding that foreign property ownership does not pose a threat to the government’s land re-distribution programme is a valuable input into the continuing debate about the desirability of foreign ownership of property in South Africa. It is further proposed that relevant information from the present disparate sources of information on property ownership be integrated in a single database.

Keywords  Foreign property ownership, South Africa
1. INTRODUCTION

Identification of foreign property ownership patterns in South Africa is a cardinal input into the debate about the merits or not of property ownership by non-SA citizens. Land ownership by foreigners is a contentious issue in many countries (Hodgson et al. 1999; Napier, 2007). In 2005 the then Minister of Agriculture and Land Affairs appointed a Panel of Experts on Foreign Ownership of Land (“The Panel”) to investigate the perception that unregulated ownership of land in South Africa contributes significantly to the lack of readily available and affordable land for land reform.

The publication of the findings of the “The Panel” included, among others, a proposal to create a moratorium on foreign property ownership in coastal areas. The report sparked controversy and debates amongst property experts and individuals which have been widely published in the media. (see e.g. Clarke 2009; National African Farmers Union, 2007). Subsequently, The Department of Rural Development and Land Reform has developed a “Green Paper” (Realestateweb, 2010) addressing amongst other things, the issue of foreign property ownership in South Africa. It was widely anticipated that the “Green Paper” is the first step in a series of measures for government to introduce measures to limit foreign property ownership in South Africa (Kok, 2010).

2. FOREIGN PROPERTY OWNERSHIP IN SOUTH AFRICA

According to Watt (2009) only 0.56% of all residential property in South Africa is owned by foreign nationals. According to the earlier report by “The Panel” released in 2007, foreigners own 1% of erven, 0.6% of farmland, 2% of agricultural holdings and 3% of sectional title units. Both these reports only take individual property ownership into consideration.

The report by Watt (2009) further states that: 49.81% of foreign owned properties are bonded; that foreigners predominantly own freehold properties, followed by sectional title; that 44% of foreign owned properties are located inland and 22% are coastal and that in 2004 foreigners owned 2000 properties compared to 31, 000 properties in 2009.

In the report by “The Panel”, as well as the speech presented by Minister Nkwinthi (Realestateweb, 2010) to parliament, a recurring theme is the difficulty of collecting reliable information on foreign property ownership. The literature review revealed that information available from the Deeds office is limited to that of private individuals. The names and identification numbers of directors of companies or members of close corporations and beneficiaries of trusts are currently not available on deeds records. The report by The Panel (2007) made mention of “defective records”, which are deeds records where there are errors in the information recorded.
Although it is a statutory requirement that any foreign owned company owning property is registered with CIPRO, this information is not retrievable in a useful format. A researcher may request and obtain a list of ‘external’ companies registered within a particular period, but there is no information on which of these companies own property in South Africa. Furthermore, it was found that the data captured by CIPRO under the heading of “description of principal business” may be inaccurate and possibly misleading.

An example is the information available from CIPRO on a company called Codevco as retrieved from their website. According to Codevco’s “certificate of founding statement”, their “description of principal business” is listed as “Research and Development”. However a quick internet search revealed that Codevco is a property development company, responsible for, amongst other things, the development of the much publicized Cosmo City Project in Kaya Sands, Gauteng. Also, Codevco is a partnership between Basil Read, one of South Africa’s oldest construction companies, and the Kopano ke Matla Trust of which COSATU (the Congress of South African Trade Unions) is the sole beneficiary.

In another case, information obtained from CIPRO’s website revealed a company that own in excess of 30 residential properties, whose ‘principal business’ was listed as ‘furniture making’.

Information on private companies and close corporations is available with relatively little effort; however information on Trusts is generally completely unavailable, except under special circumstances. This aspect presents the biggest challenge for any individual or organization attempting to collect information on foreign property ownership.

3. METHODOLOGY AND DATA COLLECTION

In the empirical research component of the study secondary data was collected from the data base of the Department of Trade and Industry (CIPRO) and the Deeds Office via various websites (CIPRO, 2010). Other secondary data was collected from the South African Property Transfer Guide.

The research was conducted in two parts. The first focused on external companies registered with CIPRO. All new registrations over a five year period from January 2003 to January 2008 were investigated. The aim of this part of the research was to ascertain to what extent foreign enterprises were registered under the category of ‘Real Estate activities’.

The second part of the research investigated three suburbs identified in the literature review as being desirable locations for foreign investors (Muller, 2009; Piliso, 2009; Real Estate Web, 2008; SA Hometraders, 2009). The suburbs that were most likely to attract foreign property buyers were selected for the case studies using the following criteria:
Price:
The suburbs with the highest property values, highest property price growth were selected based on information from the South African Property Transfer Guide.

Desirability:
The suburbs with the highest values were ranked based on the ‘desirability’ of the location. The highest number of property sales was used to determine this.

Province:
Suburbs were further grouped into their respective provinces in order to be ensure that one each from the top three provinces could be selected.

Availability of Information:
One suburb was selected from the top three provinces taking into account the availability of suburb and property information. The suburbs selected for the study were Zimbali Port (KwaZulu/Natal), Hyde Park (Gauteng) and Steenberg Village (Western Cape). The data on residential units studied in each suburb were obtained for the period January 2004 to January 2009 (Lightstone 2009a, 2009b, 2009c).

4. FINDINGS

The research shows that of the ‘external’ companies registered with CIPRO in the period between 1 January 2003 and 1 January 2008, only about 7 per cent were registered in the category of ‘Real Estate activities’.

The analysis of the Zimbali municipal valuation roll of 2006 (Port Zimbali, 2006) reveals that 22% of residential properties are owned by natural persons, nearly 12% are owned by private companies and just fewer than 13% are registered to close corporations. These three categories make up 47% of the total number of properties in the roll. The remainder of properties (53%) were not considered in this study.

It is apparent that an analysis of natural persons only, as was done in previous studies (e.g. Watt 2009), will not provide an accurate picture of ownership. Even the inclusion of companies and close corporations leaves 53% of properties unaccounted for.

According to the research findings, Zimbali has the highest overall percentage of foreign property owners of those studied. Of all residential properties owned by private individuals studied, 26.6% are owned by foreigners. 47% of properties owned by private companies are owned by foreigners and South Africans combined and a staggering 70% of all properties owned by close corporations are by combined nationalities.
In total, 14.5% of all properties studied are owned by foreigners outright and a total of 29.2% of all properties studied are owned by combined nationalities. This means that foreigners own or partly own 43.7% of all properties in Zimbali.

In Hyde Park, a total of 183 properties were transferred to natural persons during the study period. Thirty sample units were randomly selected from the total sample frame.

It as established that Hyde Park has the second highest overall percentage of foreign property owners out of the suburbs studied. Of all residential properties owned by private individuals studied, 23.4% are owned by foreigners. 66.7% of properties owned by private companies are owned by foreigners and South Africans combined and 50% of all properties owned by close corporations are by combined nationalities.

As with the suburb of Zimbali, 14.5% of all properties studied are owned by foreigners outright and a total of 27.4% of all properties studied are owned by combined nationalities. This means that foreigners own or partly own 41.9% of all properties studied.

Steenberg has the lowest overall percentage of foreign property owners of the three suburbs studied. Of all residential properties owned by private individuals studied, a third (33.3%) are owned by foreigners. 30% of properties owned by private companies are owned by foreigners and South Africans combined and 50% of all properties owned by close corporations are by combined nationalities.

It is interesting to note that none of the properties studied in all three suburbs are owned by private companies with exclusively foreign directors. Also, rather surprisingly, Steenberg estate, which is located in the Western Cape, has the lowest overall percentage of foreign owners.

Taking all three suburbs into consideration, the research shows that 40.7% of all properties studied are owned or partly owned by non-South Africans.

The results of the study show that out of a total of 155 samples analyzed, 59.3% of properties are owned by South Africans, 16.7% are owned by foreigners, and 24.0% are owned by a combination of South Africans and non-South Africans.

<table>
<thead>
<tr>
<th>OWNERSHIP ENTITY</th>
<th>TOTAL NO. OF UNITS</th>
<th>S.A CITIZENS</th>
<th>NON-S.A CITIZENS</th>
<th>COMBINED CITIZENSHIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORT ZIMBALI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Persons</td>
<td>30</td>
<td>20</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Private Company</td>
<td>15</td>
<td>8</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 1 Summary of the Research Results
The highest percentage of foreign owners (26.6%) in Zimbali is natural persons. Closed corporations show a very high percentage of combined citizenship (70%).

In Steenberg, the highest percentage of foreign property owners is also natural persons (33.3%). There is also a high percentage (50%) of combined citizenship in the group of closed corporations.

In Hyde Park 23.4% of natural persons owners are foreigners with a combined citizenship of 66.7% for private companies.

All three suburbs show similar trends, the highest percentage of sole foreign owners being natural persons and the highest percentage of combined citizenship being found in the form of legal entities. It is interesting to note however, that for the two coastal suburbs, close corporations appear to be the favoured property ownership vehicle, whereas for Hyde Park, which is situated inland in the city of Johannesburg, private companies seem to be the favoured property ownership vehicle by foreign investors.
5. CONCLUSION AND RECOMMENDATIONS

The following property ownership patterns can be identified from the study:

Firstly, the numbers of foreign property owners in the suburbs studied is higher than average national figures of approximately 2% (Watt 2009). This suggests that foreign property ownership is more concentrated in some suburbs than others, and that in order for foreign property ownership data to be more meaningful, the relevant data needs to be made available on a suburb or township level.

Secondly, the research revealed that a significant volume of foreign owned residential property is owned by private companies or close corporations.

Thirdly, the perception that foreign property ownership is primarily located at the coast is incorrect. The literature review indicated that a higher percentage of foreigners own residential property inland.

A fourth finding was the majority of foreign owned ‘external companies’ registered with CIPRO are involved in ‘other’ business activities. According to both the literature review and the research, only a small percentage of ‘external companies’ are registered as being involved in ‘agricultural’ activities. Consequently, foreign property ownership should not pose a threat to, nor negatively interfere with the government’s land redistribution program.

Lastly, the study shows that although foreign property ownership may be a contributing factor, it is not the sole driver of local property prices.

All of the above information suggests that, there are many assumptions about foreign property ownership in the public domain that require further investigation and clarification.

It is recommended that the government investigates the possibility of implementing a new system for the integration of information relating directly and indirectly to the ownership of property. The purpose of the integration system will be to link existing information from different sources (see Figure 1). The suggested sources of existing information to be integrated are the Deeds Office, CIPRO, the banks (Financial Intelligence Centre Act 38 of 2001), property valuation information (Municipalities), the South African Revenue Service (SARS) and the Department of Home Affairs.

In addition to integrating the information, the system would also provide a way of verifying the accuracy of information from different sources. An individual making use of the system searching for the owner(ship) of a particular property will have access to links to information from different sources relating particular property. Such a system would be constantly updated when the information at any of the sources is updated.

From the research it would appear to be very difficult currently to restrict or ban foreign property ownership held in the form of legal entities. Prior to implementing legislature to restrict or ban foreign property ownership
ownership more research is needed on legal entity ownership, and in particular how the legalities around property trusts can be addressed. Furthermore, existing and new information needs to be better organized and more readily accessible.

Consideration also needs to be given as to how the new restrictive regulations will be implemented and what type of training would be needed in order for the new legislation to be effective.

The research has confirmed that foreign property owners are often attracted to invest in “exclusive”, luxury developments. Some residential developments specifically target foreign property owners by marketing a certain type of lifestyle that is completely out of reach for ordinary South Africans. The effects on the built environment are that in many instances “islands of luxury and exclusivity” are created in a “sea of poverty”. This is not purely a South African problem, but a physical manifestation of the inherent inequalities that exist in society.

“The Panel” also recommends the rationalization and harmonization of development planning laws in all provinces and municipalities through the creation and implementation of a national framework. The research shows that this strategy would simplify decision making processes as all municipalities would be working to the same standards and criteria. However more research is needed to investigate exactly how this can be successfully implemented.

The “Green Paper” put forward by The Department of Rural Development and Land Reform (Realestateweb, 2010) proposes a three tiered system of land tenure. In the proposal, foreign property ownership (at the bottom of the tiers) is to be linked to productivity and partnership models with South African citizens. More research is needed regarding the productivity of land, particularly that of agricultural land. This should provide an answer to the question whether land owned by South Africans is more productive than that owned by foreigners, or vice versa. The government should look at the development of an index (productivity index) to measure land productivity. Factors affecting land productivity need to be defined and ways of increasing productivity explored.
Knowledge Management as a Catalyst for Design and Construction Process Improvement

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ABSTRACT

Purpose
This paper aims to investigate the role of Knowledge Management (KM) towards developing innovation solutions to improve the design and construction process.

Design/methodology/approach
To achieve this aim, a research methodology, consists of literature review and case studies, is developed to accomplish four objectives. Firstly, literature is used to build an in depth understanding of the research topic through reviewing (KM), Innovation and process improvement in design and construction. Secondly, two case studies are presented and analysed to highlight the role of (KM) in developing innovative ideas to improve the design and construction process. Thirdly, a model to facilitate the integration of (KM) in design and construction firms is proposed. Finally, research conclusions and recommendations useful to decision makers and construction professionals are outlined.

Findings
Although the research identified a number of barriers that hinder the adoption and application of (KM) and innovation, it highlighted the opportunities of utilising (KM) to develop innovative ideas and solution to improve the design and construction process.

Practical Implications
Adopting the model developed by this research will facilitate the integration of (KM) in design and construction firms as an approach for improvement.

**Originality / Value**

While the paper highlighted the potential of developing innovative solutions to improve the design and construction processes, it identified the challenges that hinder the adoption and application of (KM) and innovation. In addition, the value of the study stems from covering a topic that received little attention in construction literature. Moreover, the developed model will enable design and construction firms to integrate (KM) as an approach for improvement.

**Keywords:** Knowledge Management, Innovation, process improvement, Design and Construction process.

1 **Introduction**

The increasing challenges that face the construction business environment such as growing client expectations, lack of adapting to advanced technologies, changes in policy, economy, law, technology, and competition (Gibson, et al., 2003; Othman, 2008) called for design and construction firms that aim to improve their performance and sustain their competitiveness, to innovate and utilise their resources efficiently. Towards taking advantage of these challenges and overcoming their adverse impact on the organisation’s future, many organisations realized that exploiting their explicit and tacit knowledge is paramount to achieve their clients’ requirements, enhance their performance, increase their market share and improve their methods of doing business. Although (KM) has been used successfully in a number of industries and played a major role in improving their performance, its adoption and application in design and construction firms is limited if compared to other industries (Halim and Othman, 2013). This paper aims to investigate the role of (KM) towards developing innovation solutions to improve the design and construction process.

2 **Research Objectives and Methodology**

To achieve this aim, a research methodology, consisted of literature review and case studies, is designed to accomplish a number of objectives.

- Firstly, reviewing literature related to the research topic through covering (KM), Innovation and process improvement in design and construction.
- Secondly, presenting and analysing two case studies to investigate the role of (KM) in improving the design and construction process.
• Thirdly, proposing a model to facilitate the integration of (KM) in design and construction firms.
• Finally, outlining research conclusions and recommendations useful to decision makers and construction professionals.

3 Literature Review

3.1 Knowledge and Knowledge Management

Knowledge is defined as the fact or condition of knowing something with familiarity gained through experience or association; acquaintance with or understanding of a science, art, or technique (Merriam-Webster’s dictionary, 2013). It includes intimacy and learning obtained through experience or studies that resulted from making comparisons, identifying and making connections. Organisationally, knowledge is concerned with “applied action” or “know-how” that is used to improve organizational performance. Although there are several and sometimes quite confusing statements that claim to be a description of (KM), they agree that (KM) is a multi-disciplinary and holistic initiative adopted across the entire organisation to achieve business objectives by making the best use of knowledge. It necessitates developing cultural and technical foundations to support its implementation. Effective (KM) is now deemed to be the key driver of new knowledge as well as new ideas for the innovation process (Chinowsky and Carrillo, 2008; Young, 2008; McAdam, 2000; Alavi and Leidner, 1999).

3.1.2 Types of Knowledge

(a) Explicit Knowledge
This type of knowledge is found in databases, memos, notes, documents, scientific formula, product specification etc. It is therefore fairly easy to identify, codify, store and retrieve (Brown and Duguid 1998; Wellman, 2009). Explicit Knowledge is the most type of knowledge that could be easily handled by (KM) Systems, which are very effective at facilitating the storage, retrieval, and modification of documents and texts. From the managerial perspective, the greatest challenge with explicit knowledge is ensuring that people have accessibility to what they need when needed. Explicit knowledge is considered as less important (Brown and Duguid, 1998; Cook and Brown, 1999) simpler in nature and cannot contain the rich experience based know-how that can generate sustainable competitive advantage.

(b) Tacit Knowledge
This type of knowledge is found in the minds of stakeholders. Tacit Knowledge has two dimensions, namely technical and cognitive.
The first one encompasses the kind of informal and hard-to-pin-down skills or crafts which often captured in the term “know-how”. The second dimension consists of beliefs, perceptions, ideals, values, emotions and mental models which shape the way of perceiving the world around us (Botha et al., 2008). These characteristics made tacit knowledge difficult to define, transfer, formalise and communicate. Tacit knowledge is acquired largely through association with other people, and requires joint or shared activities to be imparted from one to another (Brown and Duguid 1998; Nonaka 1994). It is regarded as being the most valuable source of knowledge, and the most likely to lead to breakthrough in organisations (Wellman 2009). Gamble and Blackwell (2001) link the lack of focus on tacit knowledge directly to the reduced capability for innovation and sustained competitiveness.

3.1.3 Knowledge Management Activities
(a) Acquire: Knowledge acquisition is the process of obtaining knowledge (Huber, 1991), or transferring from a source to a company through written forms, physical objects, people, cooperation between sources and recipients, courses and outsourcing (Kraaijenbrink et al., 2006).
(b) Codify: Knowledge codification converts the generated knowledge into accessible and applicable formats (Davenport and Prusak, 1998). It is concerned with the capture, representation and storage of knowledge in computerised knowledge bases (Nevo et al., 2007). Hansen et al. (1999) stated that codification strategy supports the use of knowledge repositories such as documentation and more specifically technological databases to store organisational knowledge.
(c) Store: Knowledge storage involves obtaining the knowledge from organisational members and/or external sources, coding and indexing for later retrieval and capturing (Alavi and Leidner, 2001). Storing organisational knowledge enables employees to anticipate future needs of the organisation (Huber, 1991).
(d) Maintain: Maintaining Knowledge stores is essential to the continued progression of an organisation’s ability to learn. It is about providing accurate, consistent relevant and required quantity and quality of knowledge when needed (Holsapple and Singh, 2004).
(e) Transfer: Knowledge transfer is established through person-to-person or system-to-person interaction (Argote, Ingram, 2000) inside and outside the organisation.
(f) Create: Knowledge creation involves developing new content or replacing existing content within the organisation’s tacit and explicit knowledge (Pentland, 1995). While it may be argued
that new knowledge may be created through formalized mechanisms (i.e. surveys and research development (Kayworth and Leidner, 2003) others propose that the creation of new knowledge should not be a formalised process but one which is socially constructed and occurs over time through human networks (Brown and Duguid, 1998; Fahey and Prusak, 1998).

3.1.4 The Pillars of Knowledge Management

(a) People
They have different visions, commitment and culture perspectives. Organizations need individuals or groups to have visions that can lead (KM) initiatives. However, this is not enough for initiatives to be successful; they also need commitment, which is considered the backbone of all implementations. This can be reached by executive management. Another important element to reach a successful (KM) is the organizational culture which depends on the values, believes, geographical locations and people.

(c) Processes
These are the policies that run the activities of the organization. Companies need these processes to organize themselves and create values from their intellectual assets. Occasionally, organizations need to change the structure of their internal processes or the organizational structure to enhance the sharing of knowledge. For instance, if a company is structured in a way that makes different parts compete for resources, then this would probably act as a knowledge sharing barrier.

(c) Technology
It is generally misunderstood as the primary cause for (KM) is primarily about technology, connecting people via emails, getting an intranet, compiling databases etc. is a major misconception. More often than not, technology is a necessity for enabling (KM), as it can ease the communication of information between employees, however it is not the ultimate solution. Additionally, it is crucial that the technology used within an organization suits the processes and people of the organization or else it would be useless.

3.2 Innovation

The term “innovation” refers to a new idea, method or device (Oxford Dictionary, 2013). It is the creation, development and implementation of a new product, process or service, with the aim of improving efficiency,
effectiveness or competitive advantage (Digital Strategy, 2013). It is increasingly seen as a result of an interactive process of knowledge generation and knowledge application (Toedtling and Lehner, 2006).

3.2.1 Types of Innovation
There are diverse views with regard to the different types of innovation. Tidd et al. (2005) argued that there are four types of innovation; hence the innovator has four pathways to investigate when searching for good ideas. These types of innovation are:

- **Product innovation**, which introduces a good or service that is new or significantly improved with respect to its characteristics or intended uses such as improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.
- **Process innovation**, which implements new or significantly improved production or delivery method such as significant changes in techniques, equipment and/or software. Just on time is a good example.
- **Positioning innovation** that uses a product to perform a function different to its intended purpose.
- **Paradigm innovation** which represents major shifts in thinking that lead to change such as developing home computer during the time of expensive mainframe.

A slightly differing view to the above and based on the current theories of innovation, Slaughter (1998) distinguished innovation as:

- **Architectural innovation** is a significant alteration made to components which have a substantial impact with other components and the process.
- **Incremental innovation** represents alternations made on an existing technology that generally stems from the firm implementing the technology.
- **Radical innovation** is a completely brand new idea or process which is articulated to enhance the performance of an industry.
- **System innovation** is the diffusion of several independent innovative components used to compile a new product, process or technique.
- **Modular innovation** represents an important change made to a factor in technology which does not interfere with other factors within the technology.

3.2.2 The Innovation Process
The innovation process encompasses several systematic steps, beginning from problem/requirement analysis to idea generation, idea evaluation,
project planning, product development and testing to finally product marketing. The steps may overlap each other. These steps could be categorised into 3 broad phases, which represent a simplified innovation process, see figure (1) (Tiwari et al., 2007).

![Figure (1) Three phase of simplified innovation process](image)

### 3.2 Knowledge Management and Innovation in Design and Construction

(KM) is now perceived as a core business concern and intellectual asset that play a major role towards sustaining competitive advantage. Within the architecture, engineering and construction (AEC) industry, where the need for innovation and improved business performance requires an effective deployment and utilization of project knowledge, the need for strategic (KM) is also being acknowledged. A recent study conducted by Halim and Othman (2013) showed that the concept of (KM) is not widely used in design and construction firms as a tool to improve their performance due to lack of awareness and poor senior management support. In addition, the study highlighted that (KM) is used mainly in the form of documentation and information technology. On the other hand there are some barriers that hinder the adoption and application of (KM) in the design and construction organisations such as:

- No previous processes or systems that focus on the process of (KM) as they were not part of the original system specification.
- No systems could be used to monitor the creation and distribution of knowledge.
- No means of measuring the performance of the (KM) plan that is being carried out.
• Some people may respond negatively to knowledge as they view it as a threat to their self-image.
• New ideas must be made explicit in a language that all individuals inside the organisation can understand (Kamara, et al., 2002).

3.3.1 Drivers of Innovation in Construction
Drivers of innovation are factors that have the ability to encourage and promote the need to innovate. Drivers are the key influences in the construction industry which bring about and motivate innovative ways of approaching design and construction processes. Since the construction industry is such a diverse sector, there are various ways in which innovation can take place. Innovation occurs at different levels in the design and construction sectors such as industry level (Pries and Janszen, 1995), institutional and firm level (Winch, 1998) and construction project level. Drivers emerge as a response to the increasing global competition and restrictive environment legislation (Manseau and Seaden, 2001), to improve the efficiency and effectiveness of the construction industry (Manley et al., 2005). Furthermore, another major contributing factor that drives innovation is R&D programmes. These programmes are mainly supported and funded by governments, therefore having the ability to carry on producing innovative methods and procedures (Koskela, 2002). Bossink (2004) has identified different levels in the industry from which drivers may occur including environmental pressure, technological capability, knowledge exchange and boundary spanning.

3.3.2 Benefits of Innovation in Design and Construction
The benefits of innovation in the construction industry are (Manley et al., 2005; Blayse and Manley, 2004; Gunnigan and Eaton, 2008):
- Reducing construction cost, time and injury rates.
- Improving productivity, increasing competitiveness and competitive advantage, marketing growth and achieving social objectives such as affordable housing development.
- Enhancing design buildability and economy as well as improving communication and learning.
- Reducing operational and maintenance costs as well as maximising additional opportunities for use of the facility which will generate future income.
- Partnering and alliancing between project stakeholders helps increasing productivity, achieving client satisfaction and improving quality.
3.3.3 Barriers to Innovation in Construction

A barrier to innovation is a circumstance or obstacle that prevents the implementation of innovation in construction. There are currently many reasons as to why the level of innovation is low in the construction sector:

- The short term of projects and minimal investment in R&D initiatives.
- The patterns of ups and downs of the construction industry and impacts of economic recession.
- The complexity, fragmented and non-repetitive nature of construction projects, methods and changes with every site according to the scope and objectives of the project (Leiringer, 2001; Gann and Salter, 2000).
- The slow adoption of new technologies and innovative ideas (Nam and Tatum, 1997; Budiawan, 2003).
- The industry is predominantly made up of small firms which focus mainly on activities that directly affect them and have no strategy on managing technical external changes hinders the ability to innovate (Sexton and Barrett, 2003; Reichstein et al., 2005; Gann, 2000).
- The risks associated with trial-and-error approach which is not accepted in construction (Budiawan, 2003).
- Government statutory regulations and procurement methods adopted also have a significant impact on innovation in construction (Gann and Salter, 2000).
- Poor staff attitude and skilled staff, conservative stakeholders and clients and the high cost of initiatives (Manley, 2006).

4 Case studies highlighting the role of (KM) in developing innovative ideas to improve design and construction process.

4.1 Case Study (1): Keppie Design Architectural Practice, UK

Keppie Design is a Scottish leading independent architectural practice established about 150 years ago. The company has an international reputation in health-care design and education. Throughout that time, the company has established a reputable background in quality buildings that work well technically and aesthetically. A number of issues have been raised and led the company to invest in (KM). Firstly, the rapid expansion of health-care and education projects necessitated opening new offices and doubling staff members which added loads on ordinary forms of knowledge transfer, training and communication. Secondly, the gap
between the technical skills of fresh architectural graduates and needs of the construction industry affected the firm’s reputation. The main challenges that encountered (KM) Implementation and achieving stated objectives are: lack of understanding the benefits of applying (KM), poor circulation of information to remote offices and contacts between architects to discuss repeated issues, the need to form a repository of experience and skills such as directory of standard drawing details, library of technical and design information, and directory of standard firm information for bid documents and finally the need for training. A Knowledge Manager was assigned to facilitate the internal communication, improve the training and professional development within the firm and identify the expertise developed in project working. This was achieved through:

- Active collaboration of all staff members of different organizational levels
- Forming technical working groups to utilise their experience and skills
- Developing a simple intranet model to demonstrate the potentials of communication using a fully developed web based system.
- Observing and guiding the procedure of using the system and developing it.
- Establishing an experience and skills database based on interviews with staff members to facilitate searching for experienced staff based on their different experience levels.

Over a two-year period Keppie Design achieved substantial advantages from a relatively small financial investment in (KM). Trainee staff was quickly inducted into the business, reducing the time to productivity; technical information was readily accessible under the guidance of experienced technical managers; the staff directory allowed increased collaboration among dispersed teams of architects; and the efficiency of bid preparation was substantially improved. Many more opportunities remain to increase productivity through more effective internal communication (Ogiwara, 2009).

4.2 Case study (2): Pochins PLC Construction Company

Pochins PLC is a construction company that was founded in 1935 in North-west England. In addition, to construction, the Pochin Group is interested in many other fields such as commercial and residential property developments. Apart from that, Pochin Group deals in concrete pump hiring. There are almost 500 employees employed in Pochin company within all offices. The company has a number of workshops in Middlewich, Bathgate, Tamworth and Colnbrook, to serve and maintain the concrete
pumps. The main problem that directed Pochin company to invest in (KM), is the need to tackle the issue of wasting organisational resources and repeating the same errors due to poor information transfer between workshops operators. According to Koskela (2007), it was identified that the social interaction within the knowledgeable workers is more efficient and more effective than any other tools or technologies used when managing knowledge. Hence, social interactions should be put in consideration when implementing new solutions in construction organizations. As Pochin Company cares about innovation, an “innovative forum” was implemented in the company so that an employee can submit his/her idea and receive a small encouragement if the idea was accepted. Another implementation that was implemented by Pochin Company was the development of an Intranet solution called “Pochinet”. The Pochinet service is used to share different types of documents such as “daily notices, contact lists, standard forms, health and safety information, QA documents and standard work procedures”. Pochinet is available to the local and wide area of the company, to all pochin’s staff, offices depots, workshops and the majority of construction sites (Koskela, 2007). A number of issues were recognized while sharing the information on Pochinet (Koskela, 2007).

- “Knowledge is only captured in form of documents, which are static in nature and don’t support the knowledge creation lifecycle”
- “Operators, other than who created knowledge, can’t comment or update documents”
- “Rich content (i.e. picture, multimedia) is not easy to embed or associate with knowledge”
- “Searching within the knowledge base is not efficient”
- “Multiple versions of same documents exist leading to confusion”
- “Social interaction is important aspect of knowledge creation, this is not supported by the existing platform”

Towards overcoming these issues, the following steps were carried out.

(a) Identifying user requirements and the type of knowledge created plus the environment within which the knowledge is applied. Results of interviews conducted with operators stated that:
- Ideas should be shared within the accurate time.
- There should be common collaboration.
- Ideas should be discussed in a simple way.
- Not only documents should be posted but also media issues such as photos, sketches, etc.
- Solutions should have a definite timing and should not consume a lot of time (Koskela, 2007).

(b) Discovering potential solutions. After researching and comparing, it was deduced that the “Wiki” form and “Internet forum” are the two technological aspects that satisfied most of the requirements. The
"internet forum" option was chosen to be used in Pochinet due to its market leading position, ease of use, active community development and support." (Koskela, 2007).

(c) Implementing the selected solution and a number of steps were undertaken to ensure that the forum was working and was well understood within all employees. These steps included for instance: Initial starting and set up, adding special software with special censoring to filter any appropriate use of language and motivating people and explain how they could use the forum.

After 6 month of implementation, result showed that ideas were well exchanged, better communication between employees and new topics were discussed, extensive feedback were posted which helped generating more knowledge and applying it to work workplace (Koskela, 2007).

4 A Model to Facilitate the Integration of (KM) In Design and Construction Firms

The proposed model is a business improvement tool designed to facilitate the integration of (KM) into design and construction firms as an approach for improving design and construction process. It adopted the Deming cycle as an effective tool for continual improvement and was successfully adopted and applied in construction (Besterfield et al., 1999; Conrads and Othman, 2011). The model is designed to utilise the different types of knowledge available in design and construction organisations (i.e. explicit and tacit knowledge) and the different activities and pillars of (KM).

![Diagram of Plan Phase, Action Phase, Do Phase, and Study Phase]

Figure (2) Knowledge Management Integration Model
5.1 Model Description
The model consists of four main phases, namely Plan Phase, Do Phase, Study Phase and Action Phase (see figure 2).

5.1.1 Plan Phase
The objective of this phase is to develop a plan for integrating (KM) into design and construction firms. It included:

- Determining the area of improvement and innovation required such as improving the design process, enhancing the skills of human resources or updating the technology adopted.
- Identifying the improvement objectives
- Deciding on the types and sources of knowledge that need to be utilised (explicit and/or tacit).
- Setting improvement timeframe, resources required, work methodology and decision making, as well as performance measure.
- Appointing a person who will lead and manage the process of improvement, who will consequently form the required team.

5.1.2 Do Phase
The objective of the “Do Phase” is to implement the abovementioned plans and execute the required processes using the methods selected. This stage requires the leader of the process to observe the results once the plan has been put into operation. During this phase, employees and stakeholders who have tacit knowledge which is beneficial and critical to the improvement process, have to be contacted to extracted and make better use of their knowledge. This could be done through a series of interviews, involving them in workshops and training programmes to transfer this knowledge to other employees. A step further, tacit knowledge has to be converted into explicit knowledge to remain as valuable source for the organisation. Vice versa, explicit knowledge that may benefit the process and the associated employees has to be acquired, codified, stored, maintained and created.

5.1.3 Study Phase
The “Study Phase” aims to observe the effects of the course of actions taken, analyse the results gained, identify the lessons learned and expect what can be predicted. Within this phase performance measures are used to identify whether use of (KM) helped achieve the stated improvement objectives and if there is any action needs to be taken.

5.1.4 Act Phase
The objective of the “Act Phase” is to highlight findings of the study phase and apply actions needed for improvement. This necessitates that changes
required need to be identified and implemented in order to improve the process and solve the problem in hand.

6 Research Conclusions and Recommendations

After reviewing literature related to KM and innovation and keeping in mind the results of the case studies, the research may come to the following conclusions and recommendations.

- The increasing challenges that encounter the construction business environment necessitated that design and construction firms make better use of their resources mainly (KM) to innovate new ideas to maintain their competitiveness.
- Although (KM) is used widely in other industries to improve their performance, its adoption and application in design and construction is limited. The research has identified the barriers to (KM) and innovation in construction.
- Adopting the model proposed through this research will help integrate (KM) in design and construction firms as an approach for innovation.
- The support of senior management is essential for ensuring the successful application of the developed model and gets its benefits.

References


Chicesterton.


An investigation of Building Information Modelling (BIM) implementation and its effective adoption strategies in South African Architectural firms

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ABSTRACT AND KEYWORDS
Purpose of this paper
BIM’s implementation and adoption has been a challenge to many Architectural firms worldwide, including South Africa as it requires to overcome many barriers and steep learning curves that leads to a paradigm shifts. The aim of the study is to identify the challenges faced by the South African Architectural industry while adopting BIM and the strategies to overcome the same.

Design/methodology/approach
An exploratory research design is used by means of questionnaires and interviews to critically review the current state of BIM regarding BIM adoption and implementation in the South African Architectural industry. Empirical data is used to support primary findings.

Findings
There is no clear consensus regarding BIM implementation; therefore the

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Architectural industry would benefit from a clearly defined procedure which serves as a guideline of strategies to effectively adopt and implement BIM.

**Research limitations/implications (if applicable)**
The research is limited to establish strategies pertaining to dominant challenges faced by South African Architectural firms implementing BIM. Literature concerning BIM in South Africa is not as abundant; therefore expectations in this area may be limited.

**Practical implications (if applicable)**
A clear guideline of strategies in the adoption and implementation of BIM allows Architectural practices an opportunity to lead in the adoption of BIM and support integrated project delivery. The BIM approach affords architects a chance to regain lost ground in respect to their traditional status as leaders.

**Keywords**: BIM, Architecture, South Africa, Adoption, Strategies.

**1. INTRODUCTION**

The Architecture, Engineering, and Construction (AEC) industry is collaborative in nature and requires an extensive exchange of data (Singh et al., 2011). Recently, the construction industry is experiencing a paradigm shift, anticipating Building Information Modelling to become the prime means of information exchange between various stakeholders involved (Droegemuller and Toth, 2012; Watson, 2010; Singh et al, 2011). A Building Information Model (BIM) can be defined as a collaborative mechanism used by any project stakeholder in the AEC industry, as it integrates all building components, their geometry, spatial relationships, quantities, properties, cost estimates and material inventories (Azhar et al, 2008). BIM model is a very good virtual representation which serves as a tool during the design process; in addition, it acts as an interface for information exchange platform between various participants involved in a construction project (Steel et al., 2012; Muthumanickum et al., 2011).

Architects are playing a key role in facilitating the collaborative working practices of any construction project and allow consistent integration of all project data, thus being synchronized with the adoption of BIM may fulfil this role (Husin and Rafi, 2003). However, many architects display social and habitual resistance to change, as they are satisfied with traditional methods to design projects and are sceptical of the new functions and advantages of BIM, however according to research conducted by Yan and Damien (2008), many design teams are planning to adopt BIM in near future.
Like any other technology, BIM also pose limitations and constraints for its effective adoption (Mihindu and Arayici, 2008). Due to misconceptions and inadequate planning, many practitioners in the building industry have had poor experiences during their initial BIM adoption. This may be due to poor technological knowledge, implementation strategies and roadmaps. Simultaneously, there is little on the good practices about the technology and strategy on effective BIM implementation except in developed countries. Building Information Modelling is fairly new to the South African building industry, thus has not yet gained popularity; however it obtained an opportunity to be utilised during the construction and renovation of the 2010 FIFA World cup stadiums (WSP, 2012). Hence investigating the effective adoption of BIM and its challenges are important in developing countries such as South Africa. The aim of the study is to identify the challenges faced by the South African Architectural industry while adopting BIM and the strategies to overcome the same.

The paper has five sections, the second section elaborates the literature on BIM and its application in architectural firms followed by the adoption challenges and strategies in the third section. The fourth section outlines the research methodology used in this study. The fifth section depicts the analysis and results of the study followed by the summary and conclusion at the end.

2. LITERATURE ON BIM AND ITS APPLICABILITY

The Architecture, Engineering and Construction (AEC) industry is information dependent, and there is an extensive amount of information generated and exchanged in a project lifetime, thus information exchange efficiency is imperative (Chen and Kamara, 2011). Further, construction projects are temporary organizations, whereby construction and design specialists only rally during project duration (Muthumanickam et al., 2011), hence the utilization of one projects strategy cannot be replicated with other as they differ in terms of the stakeholders and their relationships. However, the fundamental of a successful construction project is a quality design process (Henderson and Venkatraman, 1993). Traditionally, the architect has a distinct and important role within the design process in construction, ranging from being a design specialist, managing tasks, leading and coordinating the design procedure etc. In recent times, it has been noticed that several changes within the domain of architectural design have been robustly affected by Information and Communication Technologies. The general method of design did not change much until the mid of 19th century, however with the invention of the computer, CAD technologies replaced the traditional design process. The recent advancement in this line is BIM; BIM is advantageous to all the stakeholders of the AEC industry in all the stages of infrastructure project (Eastman et al., 2008). BIM enhances the collaboration of all stakeholders, BIM changes the traditional processes by
improving the utilization through technology to create and edit the design documents through central data bases that are able to store and analyse a vast amount of data (Katz and Candrall, 2010). In the pre-construction phase, BIM is used to estimate the budget and time, through linking the BIM model to a cost/time database thus ensuring concept, feasibility and design benefits of different alternatives (Eastman et al., 2008). During the design phase, BIM improves the quality of design and drawing deliverables through its integrated design and analysis environment (Luthra, 2010). BIM also assists in design efficiency (Eastman et al., 2008) as the central database updates all the changes in the building models at the same time. And identifies the clashes as and when the initiated change generates one. Further, BIM assists in making informed decisions regarding costs before the actual construction stage commences based on the final design models (Morrison, 2010). During the early stages of the design, the cost estimates are based on the unit cost per square foot, as the design progresses more accurate information is used to create more and more accurate and detailed costs estimates. In addition, BIM can aid in executing complex building performance analysis to ensure an optimized sustainable building design, as the most effective decisions related to the sustainable design of a building can be made in the early design and pre-construction stages (Azhar and Brown, 2009), BIM reduces the retrofit costs at the later stages of the project. During the construction stage BIM can create a simulation of day-to-day construction process, thus illustrating how a building or site would be represented pictorially at any point in time and revealing potential risks and opportunities for possible improvements (Azhar et al., 2008). Morrison (2010) claims that through 4D models, a greater control over time can be achieved through identifying any items that are required to be part of the upcoming sequence of work. Further, the model can be used to create a readymade schedule for material ordering, fabrication and delivery for all building components (Azhar et al., 2008). Fabrication can be done by transferring the design model into a BIM fabrication tool and detailed to the level of fabrication details, an accurate representation of the building objects for fabrication and construction are made available (Eastman et al., 2008). BIM is also an important tool during the operational stage; the model creates obtainable concurrent information on performance and various economic aspects of the project (Yan and Damian, 2008). BIM consists of a digital document trial that will assist in transformation and development during operation. Further, the information regarding the project can be loaded in the model after completion of a construction project as built and can be used by the building owner and the facility manager to identify the new opportunities for revenue expansion, fostering new cooperation, innovation and building life-cycle savings (Yan and Damian, 2008). The facility manager can further use the data in the model to prepare maintenance schedules, manage daily operations, for future purchases and construction additions etc.
3. BIM ADOPTION CHALLENGES

The BIM adoption challenges are originating from internal to the external players in the architectural firms. Many architects display social and habitual resistance to change, as they are satisfied with traditional methods to design projects, and are sceptical of the new functions and advantages BIM has to offer, however according to research conducted by Yan and Damien (2008), many design teams are planning to adopt BIM within three years and the others are considering it for future use. An adequate amount of evidence suggests that the Architectural profession has begun to become pressurised regarding the adoption of BIM technology (Arayici et al, 2011), however there exists a gap between architects and their respective other AEC stakeholders regarding the use of ICT tools (Firat et al., 2010). The full benefits of BIM could only be realised if the BIM process is integrated and utilised by all other disciplines in the AEC sector, this may be due to the lack of willingness or resistance to change by other AEC stakeholders (Dawood and Iqbal, 2010).

The economic aspects of implementing BIM pose a variety of challenges such as the cost of software and new hardware, as well as training employees (Luthra, 2010). Further, there are no clear guidelines as how to implement BIM collaboratively in order to achieve its full potential (Coates et al., 2010). In addition, the ownership of the BIM data and protection through copyright has a number of legal issues to the BIM users, which also hinders the adoption of BIM (Eastman et al. 2008; Katz and Candrall, 2010). There is no clear answer regarding the ownership of the drawings or design but treated differently depending on the project specific contractual arrangements. Another issue faced when utilizing BIM, relates to liability or responsibility regarding the information inserted into the model (Azhar et al., 2008). An industry such as the AEC, which is of collaborative in nature, must place emphasis on interoperability concerns, in order to maximise the benefits of BIM (Steel et al, 2012). There are many design applications in the AEC industry; therefore there is a concern of interoperability issues between these different applications and specialties (Campbell, 2007) which also pose challenges to its effective adoption.

4. ADOPTION STRATEGIES

BIM implementation strategies differ depending on the requirements and capacity for improvement within the business (Coates et al., 2010), thus BIM integrated practices is not entirely about purchasing the correct software, but about adopting the correct processes, and ultimately finding the best tools which adds the highest value to the business (Jernigan, 2008). The strategies are also categorized in to external and internal. This paper covers only the internal strategies that an architectural firm may utilize to improve its effective BIM adoption. The strategies for the
successful implementation of BIM based on the past studies are as follows; Identification of a BIM manager, Begin with a small scale, Continuous investments in BIM software and hardware, Increased communication and collaboration among the project stakeholders, Appropriate contracts to inform clients about the usage of BIM, Increase the willingness to use BIM among the project participants through awareness about BIM benefits and training on BIM (Hardin, 2009; Dawood and Igbal, 2010; Luthra, 2010; Agustsson, 2007; Won and Lee, 2010).

5. RESEARCH METHOD

This study intends to develop and validate a survey instrument that assesses the implementation of Building Information Modelling in Gauteng’s Architectural firms, challenges experienced and effective implementation strategies. The questions on the questionnaire had been developed on the basis of the above literature review. A pilot study was conducted by distributing the questionnaire to five individual Architects to identify the instrument’s validity and attains the responses required are free of any ambiguities. Prior to distribution to individual Architects sampled, the questionnaire had been numerous revised according to academic and pilot responses recommendations. The responses were collected in the form of a five point Likert scale and option checks. Questionnaires were directed to 230 architectural firms whose email and physical addresses were retrieved from the Gauteng Institute for Architecture (GIFA), however only approximately 52% of these addresses were valid. A total of 27 questionnaires were received, representing a response rate of 11.74%.

![Figure 1 Reasons for not Using BIM](image-url)

Figure 1 Reasons for not Using BIM
Figure 2. Reasons for using BIM
Figure 3 Challenges while using BIM
6. ANALYSIS AND RESULTS

There were 27 architectural firms participated in the study among which, 16 firms were using BIM on their current projects. Those 16 participants were asked for the challenges and strategies during their effective BIM implementation. The remaining 11 participants were not using BIM before however they are using the 2d and 3d CAD technologies. The questions regarding their non-utilization of BIM were asked and figure 1 summarises the results. The cost of the BIM software and its supporting hardware were mentioned as the prime reason for not utilizing BIM.

The participants who were using BIM were asked to list the reasons for using BIM, to identify the challenges during their BIM implementation and strategies to effectively adopt BIM. The results of the analysis are shown in Figure 2, Figure 3 and Figure 4. From figure 2, it is evident that the main reasons behind the adoption of BIM among the architectural firms were to get the competitive advantages; further the analysis showed that BIM’s capabilities of improving the overall project delivery and quality of the work motivated them to utilize BIM. It is evident from the analysis that there was no push from the external stakeholders to the architectural firms regarding the BIM implementation, the client and other project participants were not insisting /encouraging the utilization of BIM. However, the main
advantages of utilizing BIM in the literature such as its ease of use and increased collaboration among the stakeholders were not realized as the driving force behind the BIM implementation of the architectural firms in this study.

The challenges that the architectural firms faced during their BIM implementation is represented in figure 3. All the possible challenges experienced around the world were accepted as challenges in South Africa too. However, the costs of BIM software, hardware along with its poor interoperability related issues were rated as the main challenges. The poor interoperability might be a reason for the other stakeholder’s non-willingness to BIM implementation which was also recorded as one of the challenges. Hence the architects were not realizing the BIM’s capacity of stakeholder’s collaboration as their main driving force to implement BIM as in figure 2. Further there were no standard guidelines or friendly contractual arrangements regarding the BIM utilization in South Africa, many of the respondents mentioned this as a challenge to the effective BIM adoption. There was also resistance to the new technologies over the traditional methods which are true to all the technological advancements in AEC sector. Legal issues regarding the document ownership and protection, such as Information security and digital rights management of BIM were not recognised as a challenge during BIM implementation as there were only architectural firms mostly utilizing the BIM however in future the rights and security of BIM data becomes a prime challenge if there are no appropriate contractual arrangements among the stakeholders. Access to the training on BIM both internally and externally were also mentioned as challenges, however the clients resistance was not considered as a challenge to the effective BIM implementation.

All the strategies mentioned in the literature review section were also accepted as effective BIM implementation strategies by the respondents. Figure 4 shows the same. Frequent and continuous BIM training programmes to the employees were accepted by all the respondents as an effective BIM implementation strategy. Some strategies which were accepted by almost all the participants such as, assigning a dedicated BIM manager, continual investment on BIM software and hardware, Effective BIM implementation plan. The client’s insistence towards the adoption of BIM is also mentioned as a strategy for the implementation; however, significant number of respondents did fail to agree the same.

7. SUMMARY AND CONCLUSIONS

BIM is fairly new to the South African Architectural industry and the results from this study validate this statement, as most of the respondents are currently utilizing BIM for 0-5 years only. Although not all Architectural firms are utilizing BIM, most are aware of the technology. According to BIM users, the most salient reason for using BIM was to gain competitive advantage in the Industry. Furthermore, previous research stated that the AEC industry is collaborative in nature and requires an extensive exchange of data. Based
on this study it is evident that the continuous investment in the BIM software is one of the success factors to be considered for the effective adoption of BIM however, increased cost of BIM software and hardware were posed as the highest ranked challenges of BIM implementation and the same was also identified as the main reason for not implementing BIM among the non-users. Findings further indicated that the absence of company training programs and non-availability of trained architects were also regarded as major challenges hindering the implementation of BIM, while correspondingly offering BIM training programmes to employees was ranked as the highest success factor.

Further, Empirical data states that architectural firms experience difficulty in successfully implementing BIM due to lack of willingness or resistance to change from traditional methods by project participants. Establishment of new processes and workflows for the BIM implementation was also mentioned as a challenge. Literature further stated that architects face a dominant challenge such as liability concerning ownership of drawings, however findings from the present study indicated that legal issues regarding document ownership and production does not pose as a challenge in South Africa, this is further confirmed during the open ended interview conducted with the successful BIM implementers.

According to the past research conducted globally, interoperability was the main issue which hinders the efficient use of BIM, however in South Africa; interoperability was mentioned as a challenge but not as a leading challenge. Further during the interview among the users revealed that the insistence of BIM utilization through building standards and approval process may force the participants to adapt BIM such as in UK, USA and other Nordic countries. The current study discussed the issues related to the BIM implementation among the South African architectural firms with weaker statistical substantiation. Further research with more sample size is needed to conclude the results with compelling statistical evidences.

8 REFERENCES


ANALYSIS OF PROPERTY AND CONSTRUCTION PERFORMANCE CYCLES IN SOUTH AFRICA

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ABSTRACT

In this paper we explore the characteristics of the different cycles that determine the performance of the South African built environment. Particular attention is given to the characteristics and relationships that existed between the property investment and construction cycles during 2000 – 2010. In this period, the South African built environment experienced a considerable boom driven by macro-economic fundamentals, public sector infrastructural expenditure, and strong property investment fundamentals. The analysis builds on a well-developed literature which suggests the importance of differentiating between property investment and construction cycles. The research findings are based on the statistical analysis of national property investment and construction data.

By providing a better understanding of the timing, amplitude, length and the sequencing of property investment and construction cycles, the research provides the basis for improved decision making in the South African built environment. Thus, developers would be well advised to plan new projects during the downswing phase of the business cycle, to implement them during the upswing phase to reap the benefits at the peak of the property cycle.
1. INTRODUCTION

In the period 2003-2008 South Africa experienced a property boom characterised by rapidly rising property returns and a resultant rise in building activity. This paper identifies the phases of the South African property cycle during this period, paying particular attention to the relationship between the real estate investment and development cycles. The paper highlights that property cycles comprise several cycles which interact with one another. These include the property investment cycle, as well as cycles that relate to the demand for space and the development activity.

Property cycle models often portray a property market that passed through well-defined steps that occur in a well-defined sequence. The sequencing is often initiated with an exogenous stimulus, such as a rise in GDP growth. A rise in economic activity increases the demand for space which results in lower vacancies, higher rentals, higher property values and finally an increase in development activity.

Yet, such sequencing approaches often fail to reflect the complexities of the transmission mechanism that characterise property and development activity and cycles. They include poor information flows, significant lags between market information and decision making, as well as the factors that drive expectations of investors and developers. Also, cognisance is seldom given to the observation that stakeholders in investment and development markets rarely have similar objectives as they respond to different market indicators.

Although the analysis of investment cycles has received considerable attention in the academic, as well as professional literature (Phyrr, 1999; Barras 2009), the complex relationship between property investment and development activity seems to have received less attention.

Our analysis provides an insight into market conditions that characterised the South African property market in the period 2000-2010. This research also identifies the drivers that influenced the sequence, the amplitude and the timing of the property cycles during this period. Therefore, this research provides an insight into whether the South African property cycle reflects models proposed in the literature.

2. LITERATURE REVIEW

In reviewing the history of property cycles Barras (2009) refers to the initial research into business cycles initiated by Wesley Mitchell in 1913.
Mitchell’s work, which started the study on the cyclicality of economic activity, influenced the work of Kuznets (1930) and Burns (1934). Kuznets argued that the long swing of the business cycle has on average been approximately twenty-two years. The early research into property cycles resulted in the identification of a number of different cycles that reflect the characteristics of particular sectors of the economy.

Table 1. Various Models and their Originators

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Originator</th>
<th>Years</th>
<th>Investment Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor</td>
<td>Kitchin</td>
<td>3-5</td>
<td>Inventories</td>
</tr>
<tr>
<td>Major</td>
<td>Juglar</td>
<td>7-11</td>
<td>Plant And Machinery</td>
</tr>
<tr>
<td>Long Swing</td>
<td>Kuznets</td>
<td>15-25</td>
<td>Building</td>
</tr>
<tr>
<td>Long Wave</td>
<td>Kondratieff</td>
<td>45-60</td>
<td>Infrastructure</td>
</tr>
</tbody>
</table>

Early property cycle theories also placed a strong emphasis on the relationship between economic development, population growth and the demand for space. Thus, the focus was placed, in the main, on the relationship between the size of an economy and the demand for factors of production such as land, labour and capital. It is only recently that the focus of the discussion moved on to the identification of endogenous factors – namely the characteristics of property markets that drive outcomes in property markets. The focus on such endogenous drivers is based on the observation that property cycles exist because supply (development activity) only responds to the demand with a considerable lag. These lags are a result of poor information flows and the time it takes for developments to be brought to the market.

Barras (2009) suggests that the shorter cycles, which include investment cycles, should be seen as being “demand side” in nature, while longer cycles have a supply side dimension and are therefore possibly of greater relevance to the understanding of building activity and the building cycle. Based on this argument, the question arises whether one should distinguish between long (development cycles) cycles of some 15-20 years and shorter investment cycles with an average length between 4-7 years.

Barras (2009) and Wheaton (1987) traced three office market cycles in the United States between 1960 and 1986, and suggest that on average they last for 10 years. They also illustrated how the dynamics of the investment cycle were portrayed through fluctuations in office employment, net absorption of space, the vacancy rate, building starts and completions.

As illustrated in Figure 1, the property market moves from a period of excess demand to a period of excess supply. The early phase of the
The property cycle tends to be characterised by a shortage of supply. As the property cycle progresses, the demand-supply gap narrows and vacancy rates decline. Once the property market peaks, development activity maintains a strong momentum resulting in development activity with supply exceeding demand. This results in a declining phase of the property cycle characterised by an oversupply. It is only in the trough of the property cycle that property dynamics restore the balance between demand and supply for space.

**Figure 1.** Phases of the Real Estate Supply/Demand Cycle

Source: Economic Characteristics of the Real Estate Cycle (Phyrr et al., 1999 p. 32).

More recently, the relationship between the demand for space, property values and development activity was illustrated by Wheaton & Di...
Pasquale (1996). The Di Pasquale model suggests that the performance of property markets is influenced by three interconnected markets. These include the user market, the investment market and the development market. The user market encapsulates the interaction between the demand and supply for space. In the user market the interaction between demand and supply results in a certain level of vacancies and resultant rentals. Rentals are then capitalised in the financial markets. The capitalisation rate is influenced by reigning interest rates and the expectations that investors have regarding future rentals and capital growth. In turn, property values enter the development market where developers decide whether to supply the market or not. Development activity will be influenced by the difference between development costs and property values.

THE INTERACTION BETWEEN MARKETS

![Diagram of market interaction](image-url)
In modelling property cycles, three approaches have received prominence.

Phyr, Webb and Born (1990) explain property cycles in terms of an expanded cash flow model that integrates four types of cycles: (1) Property demand and supply cycles, (2) inflation rate cycles; (3) property life cycles; and (4) ownership life cycles. In this theoretical framework, the interrelationships between the different sectors of the market are net operating income of properties, property values and development activities. Witten (1987) identifies four distinct phases of the real estate cycle, namely (1) development; (2) overbuilding; (3) adjustment; and (4) acquisition.

The Mueller and Laposa (1994) model is based on the identification of market equilibrium based on vacancy rate estimations and, in particular, the equilibrium or natural vacancy rate. The natural vacancy rate is used to position markets along the property cycle and provide an indication of whether markets are under-or over-supplied. It places the emphasis on the impact that different vacancy rate scenarios have on rents, property values and development activity.

Roulac (1993) focuses on the interconnectedness of the multiple cyclical forces that influence real estate cycles. For each of the six four-year periods, from 1972 through 1995, eight basic measures of real estate markets are considered. These include the overall economy, office demand, construction, property values, the volume of transactions, debt capital available for speculative real estate, equity investor interest and tax are considered. The important point of this approach is that it brings to the fore the sequencing of drivers that influence property markets that drive property cycles.

**METHODOLOGY AND DATA**

In attempting to identify the phases of the South African property cycle in the period 2000 – 2010, the research analysed critical trends and data in the space, financial and development markets depicted in Table 2.
Table 2. Research Variables

<table>
<thead>
<tr>
<th>The Demand For Space</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>StatsSA , SARB</td>
</tr>
<tr>
<td>Vacancy Rates</td>
<td>IPD</td>
</tr>
<tr>
<td>Rentals</td>
<td>IPD</td>
</tr>
<tr>
<td><strong>Financial markets</strong></td>
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<td>Interest Rates</td>
<td>SARB</td>
</tr>
<tr>
<td>Total Returns</td>
<td>IPD</td>
</tr>
<tr>
<td>Capitalisation Rate</td>
<td>IPD</td>
</tr>
<tr>
<td><strong>Development market</strong></td>
<td></td>
</tr>
<tr>
<td>Non-Residential Building Plans Passed</td>
<td>StatsSA</td>
</tr>
<tr>
<td>(constant prices )</td>
<td></td>
</tr>
<tr>
<td>Non-Residential Buildings Completed</td>
<td>StatsSA</td>
</tr>
<tr>
<td>(constant prices )</td>
<td></td>
</tr>
<tr>
<td>BER Building Cost Index</td>
<td>BER</td>
</tr>
</tbody>
</table>

Notes: StatsSA Statistics South Africa, Pretoria; SARB South African Reserve Bank, Pretoria; IPD International Property Databank; BER Bureau for Economic Research, Stellenbosch University.

The data were analysed by means of a table provided in Annexure A. It illustrates the major trends that occurred in the user, investment and development markets in the period 2000-2010.

THE USER MARKET

To understand the dynamics of the user market, data were collected to reflect the demand and supply of space. We used the data to assess the relationship between the macro economy (an exogenous factor) and the demand for space, as reflected in property investment returns and vacancy levels.

In the period 2000-2010 the South African economy went through four important phases. The first phase which extends from 2000 to 2003 was characterised by subdued economic growth with an average GDP growth of 3.4%. In Q4 2003 interest rates decline to 12.4% which provides an important catalyst for economic growth. In the second period 2004 – 2007 economic growth accelerates and averages 5.3%. Quarterly y-o-y
economic growth peaks at 7.1% in Q4 2006 and the year-on-year rise in the coincident indicator accelerates to 9.7% in 2006. The final period, from 2008 – 2010 sees a slowdown in economic activity and by Q4 2008 economic growth slows to 1.8%.

The relationship between property investment returns, as measured by the IPD, and vacancies is illustrated in Figure 3. While the correlation between IPD returns and the y-o-y movement of the coincident indicator for the period 2000 – 2010 is estimated at 68.7%, it declines to 35.4% in terms of the lagging indicator and 0.09% in terms of the leading indicator.

![IPD Returns and Vacancies](source: IPD)

**Figure 3. IPD Returns and Vacancies 2000 -2010**

In the period 2003 -2004 IPD vacancy rates strengthen from 11.1% to 7.6%, and a year later the long term average vacancy rate of 7.1% is reached. Vacancy rates in all sectors of the market continue to decline and touch their lowest level in 2006. By 2007 retail vacancy rates decline...
to 2.7%, with the vacancy rate in the office sector declining to 6.1% and the industrial sector recording a vacancy rate of 1.3%.

From 2003 onwards the strengthening of vacancy rates has a positive impact on rentals and rental escalations exceed the inflation rate. From 2002 to 2003, average rentals for the commercial property sector rise from 3% to 12%. Rental increases also peak in 2006, followed by a weakening of market conditions in 2008 when rental increases enter negative territory, namely -2%.

The data focused on the user market therefore suggest three broad phases. First, a recessionary phase in the period 2000-2002, characterised by slow economic growth and a market showing subdued growth. This is followed by a recovery period from 2003 to 2005 which sees a significant decline in vacancy rates. In this period rental escalations accelerated. Vacancies and rental increase peaked in the period 2006 and 2007. The period 2008-2010 is characterised by a contraction of economic growth, and a slowdown in market activity.

The Investment Market

An analysis of the period 2000-2010 shows that the investment sphere of the property market went through three phases. In the period 2000-2002 the commercial market recorded relatively subdued investment returns with total returns, as measured by the IPD, remaining close to 10%. This trend is reflected in Figure 4 which illustrates that a return of 11% was achieved in 2000, 10.4% in 2001, and 9.5% in 2002. In 2003 the investment market enters a recovery phase with total returns accelerating to 15.2% and total returns in 2005 peaking at 30%. The decline in vacancy rates and the resultant increase in rentals started to strengthen capitalization rates from 2004 onwards. This also suggests that the improvement in capitalization rates started to strengthen a year after conditions in the user market started to improve. Possibly investors had to be convinced that conditions had improved in the user market before allowing yields to strengthen. In the period 2004 until 2007, IPD capitalisation rates continued to strengthen reaching a low of 8.4% in 2007. In 2008 a weakening of market conditions resulted in capitalisation rates rising to 9.1%, with total returns declining to 9%. 
THE DEVELOPMENT SECTOR

The performance of the development sector is a function of specific parameters which include capital values generated in the user and financial markets, interest rates and development costs.

Although market conditions had started to improve from 2003 onwards, building demand as measured by the StatsSA time series Building Plans Passed (at constant 2005 prices), only started to improve two years later in 2005. In 2005 Buildings Completed accelerates y-o-y by 54%. Two years later in 2007, Buildings Completed accelerates by 73% y-o-y. The value of Building Plans Passed peaks in 2007 at R 14 780 754 000. Buildings Completed peaks a year later in 2008 at R 13 413 798 000.

The critical observation is that building activity in the period 2000 -2010 occurred with a lag compared to activity in the user and financial markets. While investment returns and Building Plans Passed peaked in 2005, Buildings Completed peaked later in 2007.
Figure 5 shows the IPD returns against the y-o-y percentage change in Building Plans Passed and Buildings Completed. It illustrates that while the growth in Building Plans Passed was fairly closely related to IPD property returns, Buildings Completed peaked at the end of the investment cycle.

![Figure 5. IPD Returns versus percentage increase in Building Plans Passed & Completed](image)

Source: IPD

**IDENTIFYING THE PHASES OF THE SA PROPERTY CYCLE**

As illustrated in the previous discussion, the user, investment and development markets showed particular characteristics in the period 2000-2010. The data nevertheless suggest that that property cycle went through particular phases as illustrated in Figure 6. It suggests that the property cycle...
market went through four stages namely, recession, recovery, supply expansion, and contraction.

![The four phases of the SA property market](image)

**Figure 6.** The four phases of the SA property market

Source: Adapted from Muller and Laposa (1994)

The characteristics of the different phases of the property cycle can be summarised as follows:

**2000-2002 RECESSION**

In the recessionary period the economy showed lacklustre growth and vacancy rates remained relatively high. The year-on-year rise in net operating income (NOI) remained negative and capitalisation rates for all sectors of the commercial property market remained constant at approximately 12%. Total IPD returns dipped to 9.5% in 2002 and the performance of Building Plans Passed and Completed remained subdued with Buildings Completed declining by 35% y-o-y on 2002.
2003-2005 RECOVERY
During the recovery stage, the performance of the South African economy improved with, for example, GDP growth exceeding 5% during 2005. The rise in demand for additional space resulted in vacancy rates declining to 11% in 2003 and by 2005 average vacancy rates for the commercial property sector declined to 5.5%. A gradual improvement in market conditions resulted in net rentals rising from 3% in 2002 to 17% in 2004. In the financial markets, total IPD returns increased from 15.2% in 2003 to 30% in 2005. In the development sector the value of Building Plans Passed accelerated by 24% in 2004 and by 54% in 2005. Buildings Completed showed no significant change, increasing moderately by 9% in 2003, by 8% in 2004 and by 7% in 2005. This period can therefore largely be characterised as a period of strengthening conditions in the national economy, as well as in the investment market. There seems little evidence of significant activity in the development market.

2006-2008 SUPPLY EXPANSION AND PEAK OF THE PROPERTY CYCLE
In the period 2006-2008, the economy peaks with a y-o-y GDP growth rising by as much as 7.1% in Q4 2006. By Q4 2008 GDP growth declines to 1.8%. In this period the property market continues to show a strong performance, with the vacancy rate for the commercial sector declining to 3.3% in 2007. Total property investment returns remained at relatively high levels at 27.4% in 2006 and 27.7% in 2007.

In 2008 market fundamentals weaken and vacancy rates start to rise. Rental increases accelerate to 27% in 2006 only to decline to -2% in 2008. Capitalisation rates continued to strengthen until 2007. Buildings Completed continued to rise by 31% in 2006 and peaked at 73% in 2007. As the market fundamentals weakened after 2007, Buildings Completed rose by only 29% in 2008.

This period can therefore be labelled as the peak of the property cycle. In this period the user and investment markets continue to show a strong performance. Building Plans Passed and Completed show a strong performance and start to oversupply the market.
2009-2010 CONTRACTION
In 2009 the South African economy records negative economic growth for all four quarters with positive growth only returning in 2010. Vacancies rise from 4.2% in 2008 to 7.1% in 2009, and 6.6% in 2010.

In 2008 rental levels decline by -2% and in 2010 rental growth weakens still further and records a -4% return. During this period, capitalisation rates rise by an average of 9.4% across the retail, office and industrial sectors. Total IPD returns declined from 12.8% in 2008, to 9.1% in 2009. Building Plans Passed retracts strongly, recording -8% in 2009 and -36% in 2010. Similarly, Building Completed declined by 6% in 2009 and a further -34% in 2010.

This phase of the property cycle sees a decline in the user and investment markets. But the supply in building activity continues to further oversupply the market resulting in rising vacancy rates.

CONCLUSION
The research suggests that in the period 2000-2010 the South African property cycle went through several stages driven by conditions in the space, financial and development markets.

Recession in the commercial property market largely came to an end in 2002 which was followed by a recovery phase. Recovery was characterised by a strong improvement in macro-economic fundamentals, an improvement in market conditions and rising property returns. In the period 2005-2008 the property market entered an expansionary phase which not only saw property returns peak in 2006, but also saw Building Plans Passed and Completed peak in 2007 and 2008 respectively. Finally, the period 2008-2010 saw the contraction of the property market, characterised by a weakening of economic fundamentals, property investment returns and building activity.

This research has provided an insight into the different phases of the South African property cycle, and illustrates the sequencing of the South Africa property cycle between 2000 -2010. This sequencing also reflects previous
cyclical models of the property cycle that have highlighted the interconnectedness of the property user, investment and development markets. This analysis sheds light on whether building cycles should merely be seen as a component of the property cycle. This research is important for stakeholders in the property and construction markets because it highlights the timing of investment decisions. Those roleplayers in the built environment who are able to correctly assess the phases of the property cycle stand to benefit most.
REFERENCES


Appendix A

### THE USER MARKET

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<tr>
<td>THE BOOM YEARS</td>
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</tbody>
</table>

#### Economy
- In Q3 economic growth touches 5%.
- The global economy continues to show strong growth, SA economy slows to 1.5% in Q3.
- GDP grows at an average pace with the economy growing between 3.5% to 3.9%.
- Economy accelerates at this point and reaches 5.7% in Q4.
- The economy continues to show strong performance, with GDP growth between 5% and 5.5%.
- In Q4 GDP growth gradually declines from 6.6% in Q1 to 4.0% in Q4.
- GDP growth is growing at 7.1% yoy.
- Durin the year the economy slows from 4.8% in Q1 to an 1.8% in Q4.
- Negative economic growth for the entire year with Q2 recording a -2.7%.
- Economic growth starts improving again at a rate of 3.1% yoy.

#### Business Cycle Indicators
- The leading indicator experiences an increase of 9.4% in 2000, with the coincident indicator showing moderate increases in the period 2000-2003. The coincident Indicator touches 1.4% rise in 2003.
- The leading indicator shows yoy 10.3% rise in 2004, and the coincident indicator shows a 9.5% in 2004 and peaks in 2006 at 9.6%. The lagging indicator rises from 2005 onwards.
- In 2007 the yoy rise in the leading indicator declines to 0.1% and enters negative territory in 2008/9. Touching -11.7% in 2009. The coincident Indicator declines to 8.1% in 2007 and declines to -11.7% in 2009. The lagging indicator increases in 2007 to 6.1% and rises to 9.1% in 2008.
### Vacancy Rates

<table>
<thead>
<tr>
<th>Sector</th>
<th>Vacancy Rates</th>
<th>Retail</th>
<th>Office</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>yoy.</td>
<td>5.6%</td>
<td>16.9%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Office</td>
<td>yoy.</td>
<td>6.5%</td>
<td>19.8%</td>
<td>10.4%</td>
</tr>
<tr>
<td>Industrial</td>
<td>yoy.</td>
<td>3.3%</td>
<td>1.9%</td>
<td>11.7%</td>
</tr>
</tbody>
</table>

**Vacancy Rates**

- The natural vacancy rate is achieved in the industrial sector.
- Vacancy rates start to decline in all sectors.
- In Q3, the office and retail natural vacancy rate is declining in all sectors.
- Retail vacancy rates decline to lowest point at 2.7%.

**Rentals**

- Retail rentals are rising yoy by 4%.
- Office: 6% and industrial: 1%
- All rental increases slow to -2% for the entire sector.

**Net Rental Increases**

- The industrial net rental increase peaks at 12%.
- The office sector rental increase peaks at 22%.
- All rental increases in IPD Index peak at 27%.

- The retail sector Net rental peak at 14%.

**Strong Appreciation of Net Rental Increases**

- Slow down in growth.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Retail</th>
<th>Office</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>11%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>7.7%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>3.3%</td>
<td>1.9%</td>
<td>11.7%</td>
</tr>
</tbody>
</table>

**The Industrial Sector**

- Slow down in growth.

<table>
<thead>
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<th>Sector</th>
<th>Retail</th>
<th>Office</th>
<th>Industrial</th>
</tr>
</thead>
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<tr>
<td>Retail</td>
<td>11%</td>
<td></td>
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</tr>
<tr>
<td>Office</td>
<td>7.7%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>3.3%</td>
<td>1.9%</td>
<td>11.7%</td>
</tr>
</tbody>
</table>
## Financial Markets

<table>
<thead>
<tr>
<th>Interest Rates</th>
<th>Interest rates are relatively constant at 14.5%</th>
<th>Interest rates rise from 15% in Q1 to 17% in Q4</th>
<th>Strong decline in interest rates declining to 11.5% in Q4</th>
<th>Interest rates remain stable between 11% and 15%</th>
<th>Interest rates start rising to 12.5%</th>
<th>Interest rates move upwards to 15%</th>
<th>Interest rates start declining from 13% to 10.5%</th>
<th>Interest rates decline to 9.5%</th>
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<tbody>
<tr>
<td>Capitalization Rates (IPD All sectors)</td>
<td>12.3 0%</td>
<td>12.1 0%</td>
<td>12.4 0%</td>
<td>12.4 0%</td>
<td>11.7 0%</td>
<td>10.7 0%</td>
<td>9.50 %</td>
<td>8.40 %</td>
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<tr>
<td>Total Returns in the Commercial Property Sector</td>
<td>Returns are relatively stable at between 9.5% to 11%.</td>
<td>Returns rise from 15.2% in 2003 peaking at 30.0% in 2005</td>
<td>Total returns at 27.4% yoy</td>
<td>Office and retail returns peak, office at 25.2% and industrial at 33.0%</td>
<td>Total IPD returns decline to 12.8% in 2008 and decline to 9.1% in 2009</td>
<td>Total returns rise to 13.4% yoy</td>
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</tbody>
</table>

### The Construction Sector

Proceedings 7th Built Environment Conference  
Analysis of Property and Construction Performance Cycles in South Africa  
Cape Town, South Africa  
28 – 30 July 2013
### Analysis of Property and Construction Performance Cycles in South Africa

**Cape Town, South Africa**

**ISBN 978-0-620-55984-3**

<table>
<thead>
<tr>
<th>Non-residential building plans passed, value constant 2010 prices</th>
<th>Building plans passed declined by -9% yoy</th>
<th>Building plans passed increased by 14% yoy</th>
<th>Building plans passed increased by 4% yoy</th>
<th>Building plans passed increased by 24% yoy</th>
<th>Building plans passed increased by 54% yoy</th>
<th>Building plans passed peak at R14,780,754 in real terms 7% rise yoy</th>
<th>Building plans passed drop to -1% yoy</th>
<th>Building plans passed declines to -8% yoy</th>
<th>Building plans passed records 36% growth</th>
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</thead>
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<tr>
<td>Building plans completed, constant 2010 prices</td>
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<td>Building plans completed increased by 8% yoy</td>
<td>Building plans completed increased by 7%</td>
<td>Building plans completed increased by 31%</td>
<td>Building plans completed increased by 73%</td>
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<td>Building plans completed increased by 7%</td>
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<td>BER Building Cost Index</td>
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<td>14.4 % yoy</td>
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</table>
Contribution of Employer’s Agent to Client satisfaction on Design & Build projects

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Leeds Metropolitan University, Leeds, LS2 8AG

ABSTRACT
Purpose: to present an analysis of client satisfaction and assesses how an Employer’s Agent can improve client satisfaction to a Design and Build project. Little critical analysis has been devoted to the role of the Employer’s Agent in Design and Build projects, an increasingly popular method of construction procurement. Client satisfaction is important for the continued sustainability of the construction industry.

Research design: the findings presented here have been derived from qualitative data collection methods based upon online survey questionnaires. These form a representative sample of current UK industry trends and professional opinions. The sample was relatively small and further research based on case study analysis is recommended to validate these findings.

Findings and implications: suggest that cost is often of most importance to clients although the Employer’s Agent must also manage the project in terms of time and quality. Projects are complex, diverse and liable to change and there is no “one size fits all” solution. Achieving client satisfaction in design is fundamental to project success and is largely determined by a detailed Employer’s Requirements document. If Employers’ Agents manage projects pro-actively they can make an effective contribution to client satisfaction

KEYWORDS: Design & Build, Employer’s Agent, Employer’s Requirements, Client Satisfaction,
1. INTRODUCTION

This paper explores the role of the Employer’s Agent in a Design & Build project, and how they can contribute to improved client satisfaction. Common criticisms of UK construction industry performance are well documented concentrating on poor client satisfaction, significant delays, unpredictable costs, disputes and similar issues which have been amplified by the current recession.

A lack of understanding of the client’s needs and an inability to meet them within budget and on time has long been a criticism of the UK construction industry. Many academic and professional texts have been critical of the construction industry, outlining client dissatisfaction as one of the main failings of the industry. However, dramatic improvements have been demonstrated on client-led projects throughout the UK (Egan 1998). An exaggerated emphasis and understanding of “what the client wants” at the earliest stage within a project is critical. In a complex and diverse industry the dilemma for professional services providers is how to achieve increased client satisfaction.

Chosen procurement strategies within the construction industry are highly influential on a project’s success. Common criticisms of the construction industry can largely be attributed to the poor selection of procurement strategy and the key participants. Many clients still do not understand that fiercely competitive tenders and accepting the lowest bid, characteristics synonymous with traditional contracting, does not provide value for money (National Audit Office, 2001). The latest figures from the RICS contracts In Use Survey (2011) confirm widespread use of Design and Build contracts (which accounts for 43% of contracts by value and 13% by number). The essential characteristic of a Design & Build procurement strategy is the integration of the design and construction process. The risk of design and construction performance is transferred to the Design & Build contractor and there should be greater price certainty.

The Design & Build procurement method can help to improve client satisfaction. Little critical analysis has so far been devoted to the role of the Employer’s Agent and how their professional services can be provided to match their client’s expectations of satisfaction and value for money. Hackett (1998) described the Employer’s Agent as the technical and professional eyes, ears and mouthpiece of the employer, a role unique to a Design & Build project. The Employer’s Agent is vital in all phases of construction providing a number of core services (RICS Schedule of Services, 2012). In addition to these the Employer’s Agent is involved in the preparation, design, pre-construction, construction and finally the use stage of a project (RIBA Plan of Work, 2007). The way in which the Employer’s...
Agent can improve client satisfaction through successful and effective completion of their core services and tasks throughout the project phases will form the basis of this paper.

2. LITERATURE REVIEW

Lam, Chan and Chan (2008) undertook a study in Hong Kong to investigate the determinants of a successful Design & Build project. This developed a project success index concentrating on time, cost, quality and functionality as indicators of effective performance. This study aimed to establish the benefits of Design & Build. Ndekugri and Turner (1994) found that if the clients’ criteria are met, then the performance of a Design & Build project can be considered a success. Songer and Molenaar (1996) similarly although more elaborately, indicated that the primary success criteria of a Design & Build project is that it is on budget, on schedule and conforms to the clients expectations. The Edmond study concluded that the nature of the project, the effectiveness of project management and the application of innovative management techniques were common determinants of project success.

Hackett (1998) highlighted dealing with change as a problem area involved in Design & Build procurement. The “blur” between what is perceived as an Employer’s change requirement and what is no more than the contractor’s own design development is an issue that can lead to cost increases due to variations and the need for resolution of differences or disputes. Another critical issue with Design & Build projects is the contractor’s difficulty in interpreting the scope of works. This fundamental flaw can only be overcome by a concise Employer’s Requirements (ER’s) document (Robinson Lloyd Architecture Ltd).

Sanvido and Konchar (1996) conducted an empirical study in the US to look at the comparative merits and differences between Construction Management, Design & Build and Traditional (design-bid-build) procurement. The analysis of 351 projects concluded that Design & Build projects experienced less cost, less programme slippage, improved operation and maintenance quality. This study confirmed that the advantages outweigh any disadvantages and Design & Build procurement is arguably the most effective method of procuring a project.

In Design & Build projects design and construction can be carried out in parallel, therefore the overall programme time is reduced. There is also reasonable cost certainty because the contract sum is known at the outset (JCT, 2012). This supports the argument that in terms of time and cost the Design & Build procurement method is advantageous to the client. In terms of quality the defining of a project is the most critical element in a project control cycle (Harrison & Lock, 2004). A poorly prepared Employer’s
Requirements document in a Design & Build project can lead to reduced quality in the final product.

The core of a project's success as supported by Ndekugri and Turner (1994) is achieving client satisfaction by meeting a client's desired criteria. The common determinants of a successful Design & Build project all have some link to the responsibilities of an Employer’s Agent. More importantly the common criticisms of Design & Build projects also have some parallels drawn to the role of the Employer's Agent. To date, there appears to have been only limited reference or analysis made to the Employer’s Agent’s role and their contribution to meeting client’s satisfaction requirements and expectations.

Satisfaction is defined as fulfilment of one’s wishes, expectations, or needs (Simpson & Weiner, 2002). The needs, wishes and expectations of construction clients are diverse and challenging and depend upon the specifics of a project. In order to counteract the current decline in construction output better client relationship management alongside new procurement methods are identified as areas for improvement (UK Government Construction Strategy, 2011). The Government's Construction Strategy emphasises the importance of understanding a client's criteria pre-construction and therefore identifying the specifics of a client's needs is of paramount importance to the project team including the Employer’s Agent. The complex and diverse nature of the industry means that clients vary greatly between projects, and therefore they do not always require the same outcomes (Turner, 2007). Private and public clients will have varying expectations and success criteria for a project.

Bennett, Pothecary & Robinson (1996) undertook a survey to evaluate the performance of Design & Build projects in terms of time, cost and quality and found that in comparison to traditional procurement D&B projects achieve 13% savings in cost and are 50% more likely to be on budget. The RICS procurement guide (1996) highlighted that D&B projects provide relative price certainty before the project starts provided that the Employer’s Requirements document is adequate and post contract variations are kept to a minimum.

Griffith, Knight & King (2003) emphasised that a fundamental change was necessary to refocus the construction process on the end user and integration was required to implement these changes. Importantly the Employer’s Agent has a pivotal role in advising the client the best way in which to manage the integration of design and construction in order to ensure satisfaction of the client's objectives.

To critically evaluate how an Employer’s Agent can help to achieve improved client satisfaction it must be understood what a client expects in terms of performance criteria. These criteria will provide the basis upon which the client will judge the success or lack of success of a project.
Latham (1994) attempted to rank clients satisfaction criteria and the results showed that certain criteria are common to all types of clients and projects. These common criteria were ranked by various client groups in order to establish perceived levels of importance. Franks (1998) expanded on the work of Latham (1994) to produce criteria and rankings of importance presented in table 1. Latham (1994) and Franks (1998) highlighted that client satisfaction criteria are centred on the themes of quality, cost and time. Other recognised authors such as Naoum (1991) and Curtis, Ward and Chapman (1991) further support that client objectives revolve around these concepts.

Table 1: Source: Data adapted from Building Procurement Systems (Franks, 1998) p.4 and Constructing the Team (Latham, 1994) p.12.

<table>
<thead>
<tr>
<th>Client Requirements</th>
<th>Ranking Criterion</th>
<th>Cost</th>
<th>Domestic</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Total Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value for Money</td>
<td>Cost</td>
<td>*****</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>12</td>
</tr>
<tr>
<td>Timely Delivery</td>
<td>Time</td>
<td>*****</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>12</td>
</tr>
<tr>
<td>Aesthetically Pleasing</td>
<td>Quality</td>
<td>*****</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>10</td>
</tr>
<tr>
<td>Fit for Purpose</td>
<td>Quality</td>
<td>*****</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>9</td>
</tr>
<tr>
<td>Reasonable Running Costs</td>
<td>Cost</td>
<td>*****</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>9</td>
</tr>
</tbody>
</table>

Early contractor involvement helps to flush out deficiencies in design; their input will help to head off problems during the construction phase later on when making changes becomes very costly (Jackson, 2004). The early consideration of constructability when the ability to influence project costs is higher was seen to be vital in achieving better performance and better value for money from the client’s perspective (Best & Valence, 2012).

Latham (1994) highlighted that too many clients still equate value with cost and simply select designers and contractors on the exclusive basis of lowest tender, and also that the industry needs to educate and help its clients in differentiating between best value and lowest price. NEDO (1998) showed that client satisfaction levels are more influenced by an accurate estimation of programme and ability to complete by a given date rather than simply completing a project as fast as possible and stressed that client satisfaction is linked to not simply quick but also punctual construction. Walker (1995) identified four factors which influence construction time performance:

- Construction management effectiveness
- The client and clients representatives ability to maintain positive team relationships with both the contractor and design team
- Designs teams ability to maintain communication with the contracting party
- Various other factors relating to the scope and complexity of the project
There is no industry recognised definition of quality in terms of construction work. However, it can be defined as the standard of something as measured against other things of a similar kind (Simpson & Weiner, 2002). The British Property Federations Survey of Major Clients 1997 (Egan, 1998) revealed that more than a third of construction clients were dissatisfied with a contractor’s ability to resolve defects and deliver a product of the required quality.

Masterman (2002) and Ashford (1989) established that the following quality related criteria would commonly impact on client satisfaction levels:

- Reliability and durability of design
- Innovative design ideas and appearance of the final product
- Fitness for purpose

Clients often want the highest quality construction and the shortest programme with the lowest cost (Curtis, Ward, & Chapman, 1991). This is indicative of an ideal situation however as time, cost and quality are not independent of each other this is difficult to achieve. The interdependency between the three parameters of time, cost and quality means a change in one can lead to a negative effect on another. The vast majority of projects are procured simply on the basis of time and cost (Bennett & Grice, 1990). Hughes and Williams (1991) believed this was understandable as industry recognised project control systems highlight time and cost, and overlook the relative importance of quality. Egan (1998) suggested that replacing competitive tendering with long term relationships based on clear measurement of performance will help to improve the time, cost and quality certainty of construction projects.

Masterman (2002) considers how the criteria of time, cost and quality were commonly ranked in importance by clients. The results illustrated that quality was of the highest importance followed by cost and therefore time being of the lowest importance. However these findings were contradicted by Brooks (2007) who found that clients ranked cost of the highest importance. Clients will argue that short timescale and project quality may be more important than lowest cost, but still want the lowest cost (Brooks, 2007).

Traditional procurement routes have declined in popularity in recent years (Larmour, 2011), and this has seen the rise of more innovative methods such as Design & Build. The Employer’s Agent fulfils a pivotal role in a Design & Build contract as a combined project manager, contract administrator and cost manager (Rawlinson, 2007).

Gouranga & Hannan (1997) state that Design & Build project delivery is risky for both contractors and clients unless the risks are properly identified, analysed and managed throughout the bid preparation and project execution stage. Risk management is concerned with
improving confidence that the outcome of the project will deliver the business benefit expectations (Dallas, 2006).

The role taken by the Employer’s Agent must be clearly defined by the client and can vary from simple contract administration to a full project management service (Potts 2008). The scope of the Employer’s Agent’s services will be contractually agreed between both parties. The Employer’s Agent must ensure the Employers Requirements are investigated, developed and communicated as the briefing process progresses. Whilst effective briefing cannot guarantee a building will be perfectly suited to its occupants, it can help avoid serious mistakes and achieve improved client satisfaction (Constructing Excellence, 2004). A detailed Employer’s Requirements document will ensure cost certainty but will have a detrimental effect on the projects programme and overall quality of the finished product. The conventional guidance for design and build construction clients is that post-contract design changes should be avoided wherever possible and the Employer's Agent should advise as much (Mosey, 2012).

3. METHODOLOGY AND DATA COLLECTION

This study is based on primary data collection methods using an online questionnaire based survey. However, to enhance the paper’s findings and to collect qualitative data it is considered that these are appropriate methods to use (Fellows and Liu, 2008). The type of data needed was qualitative in nature due to the purpose of the study, as it required opinions of professionals representing clients’ and Design & Build contractors as well as professionals who provide Employer’s Agent services to clients' based on experience (Robson, 2002). A questionnaire was identified as the most suitable technique for collection of data in comparison to an interview (face to face and/or telephone) due to the nature of the data required. A pilot survey was not used. A total of 100 questionnaires were sent, out and the sample selected was based on a client database of a UK property consultancy based in Manchester, England. A total of 29 (29%) survey questionnaires were completed. Fowler (1984, quoted in Fellows and Liu, 2008, p. 183) noted “there is no agreed-upon standard for a minimum acceptable response rate”. Although this was a disappointing response rate the sample size is sufficiently large to obtain data from and to present some results. The reasons for non-respondents were not investigated as part of a follow-up study and so some caution is necessary in reaching conclusions.
on the results obtained since the un-tested views of non-respondents have not been included in this analysis.

To analyse how an Employer’s Agent can contribute to improved client satisfaction it must be understood exactly what is meant by client satisfaction. Client satisfaction is defined and analysed in terms of time, cost, quality and the recurring failures of projects and how these can be overcome. The procurement procedures and essential features of Design and Build contracting are discussed.

4. PRESENTATION AND ANALYSIS OF RESULTS

The primary research for this paper follows Franks (1998) analysis and findings of client satisfaction criteria and seeks to critically review if perceptions have changed in the intervening period. It also seeks to add to the findings of the Hong Kong and US research from the 1990s, cited above. Questionnaire results (29 responses) were obtained using a simple Likert scale of “Least important -1” to “Most Important – 5” in response to prepared statements or questions. There was also the opportunity for respondents to add their own comments.

Results, as presented in figure 1, support the notion that cost is of greatest importance to the client whereas time is of least importance. These results contradict those of Latham (1994) and Franks (1998) who found that clients often rank time, cost and quality of equal importance.
The questionnaire asked respondents to rank the importance of five cost criteria: achieving value for money, achieving lowest completed project cost, minimising cost overruns, minimising maintenance and running costs and achieving accuracy in cost estimates. Table 2 shows the findings. Achieving value for money was ranked on average of the highest importance to client satisfaction. However, it was also ranked of least importance fifteen times out of a possible twenty nine. The minimising of maintenance and running costs was the lowest average ranked statement but was also ranked most important by thirteen of the responding individuals. The results do support that achieving value for money is on average of most importance to a construction client however this data also illustrates differences in opinion between the industry professionals and so cannot be taken on face value.

Table 2: Cost Criteria

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
<th>Average ranking</th>
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</table>
To ascertain fundamental concepts of client satisfaction the questionnaire respondents were asked to rank specific statements regarding time and the management and implementation of a construction project in terms of importance. The selected five criteria were: Construction management effectiveness, positive team working, effective communications between the parties, accurate pre-contract estimation of programme and early identification of delays on site. The results are presented in table 3.

Table 3: Importance of time factors

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
<th>Average ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Management</td>
<td>24.14%</td>
<td>20.69%</td>
<td>31.03%</td>
<td>17.24%</td>
<td>6.90%</td>
<td>29</td>
<td>3.38</td>
</tr>
<tr>
<td>Positive team working</td>
<td>34.48%</td>
<td>17.24%</td>
<td>13.79%</td>
<td>6.90%</td>
<td>27.59%</td>
<td>29</td>
<td>3.24</td>
</tr>
<tr>
<td>[10]</td>
<td>[5]</td>
<td>[4]</td>
<td>[2]</td>
<td>[8]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective communication</td>
<td>10.34%</td>
<td>34.48%</td>
<td>17.24%</td>
<td>31.03%</td>
<td>6.90%</td>
<td>29</td>
<td>3.10</td>
</tr>
<tr>
<td>between parties</td>
<td>[3]</td>
<td>[10]</td>
<td>[5]</td>
<td>[9]</td>
<td>[2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accurate pre-contract</td>
<td>20.69%</td>
<td>13.79%</td>
<td>17.24%</td>
<td>17.24%</td>
<td>31.03%</td>
<td>29</td>
<td>2.76</td>
</tr>
<tr>
<td>Early identification of delays</td>
<td>10.34%</td>
<td>13.79%</td>
<td>20.69%</td>
<td>27.59%</td>
<td>27.59%</td>
<td>29</td>
<td>2.52</td>
</tr>
<tr>
<td>on site</td>
<td>[3]</td>
<td>[4]</td>
<td>[6]</td>
<td>[8]</td>
<td>[8]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results here show that construction management effectiveness was of the highest importance to the client as it received the highest average ranking, whereas early identification of delays on site was of the least importance. The range of average rankings between the five criteria was low at a value of 0.86, therefore supporting the work of Walker (1995) that various factors are important in terms of maximising time performance.

In order to ascertain the current importance of quality related factors in a Design & Build project the questionnaire asked respondents to rank the importance of: reliability and durability of final design, achieving fitness for purpose, innovative design ideas, aesthetically pleasing product and use of sustainable materials and construction methods.
Table 4: Importance of Quality factors

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
<th>Average ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability and Durability of final design</td>
<td>24.14%</td>
<td>20.69%</td>
<td>13.79%</td>
<td>17.24%</td>
<td>24.14%</td>
<td>7</td>
<td>3.03</td>
</tr>
<tr>
<td>Achieving fitness for purpose</td>
<td>24.14%</td>
<td>13.79%</td>
<td>20.69%</td>
<td>24.14%</td>
<td>17.24%</td>
<td>3</td>
<td>3.31</td>
</tr>
<tr>
<td>Innovative design ideas</td>
<td>3.45%</td>
<td>10.34%</td>
<td>41.38%</td>
<td>24.14%</td>
<td>20.69%</td>
<td>12</td>
<td>2.52</td>
</tr>
<tr>
<td>Use of sustainable materials &amp; construction methods</td>
<td>10.34%</td>
<td>31.03%</td>
<td>20.69%</td>
<td>24.14%</td>
<td>41.38%</td>
<td>5</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Answers to the above question are presented in table 4 and supported the argument that ensuring fitness for purpose was of the greatest importance to achieving maximum client satisfaction in relation to the design of a construction project. However, producing an aesthetically pleasing end product was portrayed as of least importance to the client. Reliability and durability of final design, innovative design ideas and use of sustainable materials and construction methods were all ranked with an extremely similar level of importance. These results support the opinion of Simpson & Weiner (2002) that there is no industry recognised definition for quality in a construction project and it is extremely dependent on the specifics and circumstances of a given project.

This paper supports the view that Design & Build is currently the most popular method of procurement in the UK construction industry. Sixty five per cent of questionnaire respondents stated that Design & Build was most often used within their organisation with only fourteen per cent stating the use of alternative traditional methods. This trend in chosen procurement strategies was also supported by one interview respondent who stated that Design & Build was their preferred method.
The questionnaire then asked respondents to identify the most important factor which influences procurement choice from the following criteria: allocation of risk, speed of delivery, cost, clients involvement, complexity of project.

There was a strong consensus of opinion that the allocation of risk is the most influential factor when a client is choosing an appropriate procurement route. Over sixty five per cent of respondents questioned stated allocation of risk in comparison to fourteen per cent choosing cost.
Three of the responding individuals further expanded on their answer. One of which highlighted “this may vary according to client type” and another who suggested “experience in construction and knowledge of methods may also be influential to a decision”. Another stated:

“An organisations business case, which is the economic justification for embarking on the project, may also influence choice of a procurement route……. Another influence you might also want to consider is the type of the client organisation i.e. private or public. These two have completely different approaches as to how they procure projects.”

Forty six per cent of questionnaire respondents identified risk allocation as the main advantage of Design & Build in comparison to cost certainty, speed of delivery and early contractor involvement.

Despite the difficulties caused by producing a detailed Employer’s Requirements document as highlighted by Bennett, Pothecary & Robinson (1996) this research showed that a detailed Employer’s Requirements document is often preferred by the client. Eighty nine per cent of survey respondents stated detailed Employers Requirements lead to greater client satisfaction. It is important therefore that the Employer’s Agent must ask whether the project is quality, time or cost driven, as this will influence the depth of content in the Employer’s Requirements document.

One respondent added: “Detailed Employer’s Requirements ensure that the brief is accurately conveyed to the Contractor and his proposals reflect the client's ambitions for the project. The Employer's Requirements however need to remain as performance specifications and outline drawings only to ensure that the Contractor is able to use his expertise to add value to the procurement route.”
Questionnaire respondents also highlighted that the Employer’s Agent is arguably of most importance during the post-contract stage of a project. However the majority (fifty four per cent) supported the view that the Employer’s Agent has equal importance both pre-and post-contract. One questionnaire respondent stated “from cradle to grave involvement for the project ensures understanding and control” and another highlighted that “all stages play important roles in successfully delivering projects”, again highlighting the importance of the Employer’s Agent throughout the project.

Table 5 shows that the Employer’s Agent’s responsibility to administer the contractual provisions was ranked on average of the highest importance with change management believed to be of the least importance. One respondent identified “ensuring Contract Documentation is correct and back to back with any third party agreements” and “ensuring a tight control on the administration of a contract” as fundamental responsibilities of the Employer’s Agent.

Table 5: Employer’s Agent’s responsibilities

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
<th>Average ranking</th>
</tr>
</thead>
</table>
Managing risk was believed to be of increased importance in comparison to other responsibilities of the Employer’s Agent. Risk allocation is seen as an important driver to Design & Build being the preferred method of procurement.

Managing risk was believed to be of increased importance in comparison to other responsibilities of the Employer’s Agent. Risk allocation is seen as an important driver to Design & Build being the preferred method of procurement.

|--------------|------------|------------|------------|------------|------------|---|-----|

Forty per cent of individuals strongly agreed with the statement, fifty per cent agreed and only three of the twenty nine respondents either disagreed or strongly disagreed. Overall these results present a strong view that the EA can specifically make an effective contribution to improved client satisfaction.

**DISCUSSION AND CONCLUSIONS**

The purpose of the paper was to evaluate of client satisfaction and assesses how an Employer’s Agent can improve client satisfaction to a Design and Build project. The findings acknowledge the relevance of Cost, time and quality to the satisfaction of clients on design and build projects.
However evidence suggests that they are not of equal importance to all clients and are dependent on circumstances. Client satisfaction depends on the specifics of each project; there is no single common solution.

Design and Build contractors assume the risk for integrated design and construction but lack of client control and post-contract changes are also identified as disadvantages of Design and Build procurement. Employer’s Agents must advise on appropriate risk allocation measures to achieve balance between these perceived advantages and disadvantages.

Clients prefer a detailed Employer’s requirements document although not to the extent that this stifles the creative input of the Design and Build contractor and their ability to maximise value to the project through the supply chain. Again, an Employer’s Agent can contribute to client satisfaction by balancing these two conflicting objectives. An Employer’s Agent must be a pro-active client representative and manage the project through all stages from inception to completion/handover.

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Perceived barriers to FM Contribution in design decision making process

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ABSTRACT & KEY WORDS

Purpose: The problems arising during building use and operation resulting in high cost of maintenance and poor building performance are argued to be due to lack of adequate consideration given to operational requirements during the design process. Considering that Facilities Managers (FMs) are key stakeholders in the operational phase of the building, their voices in advising the design team can be critical. However evidence suggests that the traditional design process rarely involve the FMs to contribute to decision making until the later stage of occupation. The aim of this research was therefore to investigate the factors that hinder FMs from effectively contributing to the decision making in the design process.

Research Design: An online questionnaire survey was conducted targeting FMs views concerning factors that hinder them from having a significant contribution in decision making in the design process.

Findings & Implications: The findings show that generally FMs agree of the potential positive contribution they can make to optimising design solutions. This can ultimately contribute to better performing projects. However they recognise internal and external perception issues which can impact on their full involvement. Internal issues such as lack of recognition and support from the organisation and the FM’s limited access to strategic information are seem to be major hindrances to the FMs full contribution in the design process. Externally, the attitudes of and recognition of FM by the design team are perceived to have an influence on the FMs contribution in the design process.

Keywords: Design, Decision making, Facilities Management, Building performance
1. INTRODUCTION

The performance of buildings in its operation phase is an important consideration for clients. There is growing evidence that clients are not just happy to have a building delivered successfully in terms of time, cost and quality, but are also concerned with its overall performance during its operation phase. This shift is also noticed in project management literature where the emphasis in perceptions of critical success factors is no longer just on project management performance but on the performance of the project as a whole. See for example Jugved and Muller (2005).

The influence of good designs on operational performance of buildings is acknowledged in literature (Office of Government Architect, 2013). It is therefore important that the design process is seen to be effective as it is here that decisions which impact on the performance of the building are made. This can be particularly important as the process involves varied stakeholders.

Traditionally the Architect designs a building, which is intended to house the client’s business activity, and then the Facilities Manager (FM) operates and maintains the building and its support services ensuring it supports core business activity. It is therefore argued that the contribution of both parties can be critical to the success of the overall project. However the traditional design process seems to create a gap between design team and FM, which would have otherwise acted as a key link fostering relationships and ensuring communication and interaction. The importance of communication between design team and FM through out the design process is crucial as it creates a forum for dialogue (Mohammed and Hassanain, 2010), sharing of knowledge through lesson learned (Jensen, 2009) and problem solving to ensure the best will be achieved for the design. Instead both work independently of one another with the Architect/Designer focusing on the design process and the FM only coming together when problems arise, usually during building use (occupation).

The influence building design has on operation, maintenance and life span of a building cannot be over-emphasised as it will have an impact on its performance (Chantler and Swallow, 1996). This can also be a determinant
factor on it meeting operational and statutory requirements which can result in financial and/or legal implication with the most detrimental effect being to public health and safety. The Office of Government Architect, Australia (2013) for example in their Guide to good design recognise the implications of poor designs which can lead to poor building performance during the operation stage.

This paper like many others argue for a considered involvement of the facilities manager in the design process as such would encourage and ensure the design team take into consideration the operational requirements of the business, the needs of the end-user and the FMs views as more often than not there is a focus on ‘buildability at the expense of ‘operability & maintainability’. The FM’s involvement can also ensure involvement of other key consultants/specialist (i.e. energy specialist) whose input at the beginning will be essential to the overall performance and sustainability of the building. In addition the FM will likely be the one responsible for the building, he/she can bring to the design team and design process day-to-day life experience of a building and input feedback from previous building performance assessment and post occupancy evaluation (POE), which other design team members may lack.

It seems however that although the benefits of having the FM’s voice heard in the design decision making process, evidence suggests that FMs continue to have a limited role in the design process. This paper reports on a study on the role of FMs in the design process. It focuses on factors that hinder them from taking up this strategic role. This paper starts with a review of literature on the potential contribution of the FM in the design decision making process. This is followed by a discussion of the presentation and analysis of data collected using an online questionnaire survey.

**FACILITIES MANAGERS IN THE DESIGN PROCESS**

The high cost of operating and maintaining facilities have been argued to be due to facilities not meeting operational requirements. It is important to identify how operational requirements are considered during design process and establish how FM function is viewed within the client organisation, as this will determine the value attributed to it and the role it
plays. FM has for some time not had the recognition and appreciation it craves as it has been viewed as a cost cutting function by client organisations and its services often limited (restrained) to building operations and maintenance, which has hindered any recognition of its potential contributions in other areas of the client organisation. Atkins & Brooks (2005) warn that although cost savings may suit immediate needs of a client organisation it cannot be viewed in isolation. Price (2002) is of the opinion that FM needs to change its language and approach to one, which is relevant to a client’s strategic business if it intends to perform at a strategic level.

Grimshaw (1999) and Price (2002) refer to FM as beset by paradoxes, which have played a role in its development. Among them is the assertion of a strategic discipline, while its practitioners actually function at an operational level. Strategic Facilities Management (SFM) addresses the relationship between organisational performance and built environment (Edun-Fotwe et al., 2003). Wiggins, (2006) among others (for example Alexander, 1990; Atkins and Brooks, 2005) identify varied benefits of strategic role of the FM, one of which is ‘Identifying business needs and user requirements to ensure the facility will support business operations and workforce in their tasks efficiently.’ It is widely documented that facilities managers can contribute greatly through their involvement in the design process ensuring maintainability, flexibility and reduced environmental impact of buildings both in the short and long-term (Jaunzens, et al., 2001; Mohammed and Hassanain, 2010; Atkins and Brooks, 2005; Mitchell, 2009; Alexander, 1994; Elledge, 2010; Jensen, 2009; Hill, 2009; Erdener, 2003; and Edum-Fotwe et al., 2003). However, client organisations are not always informed on design or more accurately do not really know what it entails. The involvement of the facilities Manager, as considered in the literature above, is crucial in ensuring the client organisation remain informed and make best value decisions. Facilities managers through the design process champions the needs of the client, business and users, ensuring optimal performance, engaging in dialogue with design team to ensure the proposal suits the client organisations requirements. The design process is the starting point from where everything else progresses and it is vital to get it right from the beginning ensuring the completed building will be fit for the purpose it was designed and intended for and therefore avoiding future problems.

Jaunzens, et al. (2001) suggested that the involvement of the FM in the design process can ensures consideration and incorporation of operational
requirements throughout all stages resulting in a building, which is better suited to business needs. The FMs contribution in the design process can also help to improve communication and interaction amongst the design team for understanding of what needs to be achieved and how it will be achieved and ensuring design for ease of maintenance (Mohammed and Hassanain 2010). Knowledge transfer is also a recognised benefit for involvement of the FM in the design process. It is argued that identification and correction of mistakes through the transfer of knowledge from lessons learned gained during operation and use of buildings used to improve existing buildings and inform new buildings (Jensen, 2009). Edum-Fotwe et al. (2003) also suggests that the involvement of the FM can enhance building performance as a result of informing key design decisions as the design develops ensuring ease in operation and maintenance.

FMs can also add value to the design process through design input and influence from briefing through to occupancy as their knowledge and experience will provide invaluable information enabling for informed building related decisions (Elledge, 2010; Blyth & Worthington, 2001 quoted in Brochner 2010; El-Haram & Agapiou, 2002; Jensen, 2009 and Featherstone & Baldry 2000), which will generates cost savings through out the projects life cycle (Mitchell, 2009) and will also ensure new facilities are fit for purpose due to lessons learned.

The influence building design has on building performance (operation and maintenance) and organisational effectiveness (delivery of operational and strategic objectives) is significant and is on which requires careful consideration as building design places a heavy burden on the building through out its life span (Ishak et. al., 2007). Further, it is crucial for the building to satisfy the needs and requirements for which it was intended as this will have an impact on how the building will be used: space created; layout; accessibility; positioning of equipment, furniture and services; environment created; building systems and controls selection and maintained. Ramly (2006, quoted in Ishak et. al. 2007, p.116) suggests 4 factors, which require building design consideration to avoid post-occupancy problems as they impact maintenance: main fabric; internal finishes; special design features and cleaning & house keeping.

Elledge (2010), refers to the importance of the facilities managers early involvement in the design process as the knowledge gained will be used to operate the building effectively and further identifies the need for the
facilities manager involvement and interaction with the architects as integral to obtaining vital and crucial building documentation. Understanding how the building works and having available information on the building, which is relevant and up to date, is vital to the facilities manager’s role. Nutt (1993, quoted in Kelly et al., 2005, p.362) places emphasis on the importance of understanding the purpose of the project and its proposed use. This is supported by Bleicher (2006) who believes that buildings will perform and achieve their intended needs if the facilities manager better understands the original intent of the designers.

The rise of operating and maintenance cost are argued to be as a result of the this approach as little or no consideration is given to operational requirements of a building during the design process which the link between the designer (architect) and facilities manager would have encouraged. The design plays a critical role in defining the outcome of the building and it condition: performance (functionality), physical attributes (aesthetics), quality, life span (durability, longevity) and sustainability. The importance of the link between FM and design is more than just about the operation and maintenance of a building. It has far wider reaching impacts on the building, client organisation and end-users. As everyday passes new and improved technologies are emerging, which are aimed at improving our environments, the way we live and the way we work. Focal to this, is the building and key to effective management in availability of the right information.

Mohammed and Hassanain (2010) identify the involvement of the facilities manager in the design process as assessing for maintainability of drawings by design team. The facilities manager with the support of the designer (architect - leader of the designer team and process) and client acts as control point (gate way) between design and the design team. The facilities manager and will assess the work of design team (review and approval) based on specific requirements to ensure functionality, maintainability, sustainability to name a few are met. The advantage of involving the facilities manager is evident in their experience of building operation and feedback gained which will inform design decisions and aid in the development and implementation of a maintenance criteria used to check drawings from design team at key stages to ensure progression to the next and ultimately final design for construction. Drawings, which do not meet the maintenance criteria, will be referred to the originator (design team member) for review and necessary update/correction.
Jaunzens et al. (2001) identifies five primary tasks of a facilities manager within their all role through out the design process: ask the appropriate questions; provide appropriate information; set out their principles in terms of policy, strategy, objectives and preferred tactics; choose appropriate standards and key performance indicators (KPIs); and identify supporting best practice documentation.

The discussion above clearly supports the need for involvement of the FM in the design decision making processes. This is particularly important as decisions made at this stage will have significant influence on the performance of the building facility during its operation stage. While this is the case, evidence suggests that the level of contribution by the FM at the design stage can be limited. The data presented in the next sections, seek to understand further the perception of FMs concerning the key barriers that prevent them from full involvement at the design stage.

METHODOLOGY

This paper is based on data collected for a research project which investigated the contribution of facilities managers in the design process for building projects. Data was collected using a questionnaire survey similar to many other studies in this area. The sample population was drawn from professionals performing various facilities management function in higher education institutions firms in the UK. The higher education institutions were targeted as they all seem to have organised in-house facilities management services teams providing a range of services from domestic services to strategic planning with the aim of ensuring smooth running of universities core business. A total of 100 questionnaires was sent to facilities managers in universities, out of which 33 (33%) completed questionnaires. This is within the expected response rate in questionnaire surveys (Burns 2000 and Denscomb 2003).

RESULTS & DISCUSSION

The facilities management function in organisations is performed by individuals with various titles. This study recognised this and collected data about the functional areas of respondents. It is interesting to note that of
the 33 respondents only three (3) respondents held the job title ‘Facilities Manager’. Others included Maintenance service manager, Works manager, Head services coordinator, Head of facilities management, Director of property & services, Estates operation manager, Director of estates development and facilities management, Assistant director of campus services etc. It is clear from this that the title facilities manager was not widely used by practitioners, however the varied titles used encompassed a wide range of facilities management functions.

The key focus for the paper was to evaluate the perception of key barriers to effective contribution of the FM in the design process. Respondents were asked to indicate the type of services provided in their organisations. Table 1 below presents a summary of the data. The ratings are based on percentage of respondents who indicated performance of the functions listed.

Table 1: Facilities Management Services

<table>
<thead>
<tr>
<th>Service</th>
<th>Rating/Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Maintenance</td>
<td>90.60%</td>
</tr>
<tr>
<td>Project Management</td>
<td>84.40%</td>
</tr>
<tr>
<td>M&amp;E Maintenance</td>
<td>81.30%</td>
</tr>
<tr>
<td>Acting As Intelligent Client</td>
<td>78.10%</td>
</tr>
<tr>
<td>Waste &amp; Recycling</td>
<td>75.00%</td>
</tr>
<tr>
<td>Post Room</td>
<td>71.90%</td>
</tr>
<tr>
<td>Property Asset Management</td>
<td>71.90%</td>
</tr>
<tr>
<td>Domestic Services (E.G. Cleaning)</td>
<td>71.90%</td>
</tr>
<tr>
<td>Reception/Pottering</td>
<td>68.80%</td>
</tr>
<tr>
<td>Health And Safety</td>
<td>65.60%</td>
</tr>
<tr>
<td>Sustainable Development</td>
<td>59.40%</td>
</tr>
<tr>
<td>Security</td>
<td>56.30%</td>
</tr>
<tr>
<td>Project Design</td>
<td>56.30%</td>
</tr>
<tr>
<td>Space Planning</td>
<td>56.30%</td>
</tr>
<tr>
<td>Travel And Transport</td>
<td>53.10%</td>
</tr>
<tr>
<td>Relocation Services</td>
<td>46.90%</td>
</tr>
<tr>
<td>Procurement</td>
<td>43.80%</td>
</tr>
<tr>
<td>Interior Design</td>
<td>40.60%</td>
</tr>
<tr>
<td>Hospitality</td>
<td>31.30%</td>
</tr>
<tr>
<td>Business Strategy</td>
<td>25.00%</td>
</tr>
<tr>
<td>Business Analysis</td>
<td>15.60%</td>
</tr>
<tr>
<td>HR Services</td>
<td>6.30%</td>
</tr>
<tr>
<td>Financial Services</td>
<td>3.10%</td>
</tr>
<tr>
<td>ICT</td>
<td>3.10%</td>
</tr>
</tbody>
</table>
Based on the data presented, it is clear that the top five (5) services provided by respondents were: Building maintenance (90.6%), Project management (84.40%), M&E maintenance (81.30%), Acting as ‘intelligent client’ (78.10%) and waste & recycling (75%). The five (5) least provided services were: Financial services (3.10%), ICT (3.10%), HR services (6.3%), Finance (12.50%) and Business analysis (15.60%). The results are similar to those identified in BIFM & DTI (2004) ‘Rethinking Facilities Management’ survey in which these services were found to be ranked relatively high. Interestingly, their involvement in design did not score very high. This is a notable result considering the significant levels of investments universities are making in developing new and existing infrastructure.

Respondents were also asked questions designed to determine the extent of the Facilities Managers involvement in the design process and barriers to their involvement. While all respondents agreed of the importance of their involvement in decision making in the design process, the findings suggests that there is a difference in perception of the most appropriate stage to be involved in. Table 2 shows the respondents perception of the preferred stages to get involved in. The top two (2) stages were identified as design with 89.7% and occupancy with 82.8%. The least stage of involvement was construction with 58.6%. This result was not surprising given that the design stage is where key decisions on layout, accommodation, space allocation, materials, equipment & system selection, realisation of client & end-user requirements/needs etc can be made which would impact on the finished building. Further, the design stage is considered as a key platform for exchange of ideas. The occupancy stage is where the building is put to the test, when it is actually in use and this is managed and monitored by the Facilities manager.

Table 2: Preferred stages of involvement

<table>
<thead>
<tr>
<th>Stage</th>
<th>Rating/Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-brief [Business Case]</td>
<td>69.00%</td>
</tr>
<tr>
<td>Briefing</td>
<td>75.90%</td>
</tr>
</tbody>
</table>
Further to this, respondents were asked to rate the extent to which they believed they should be involved in, in the design process based on four (4) criteria: no involvement, limited involvement, some involvement and full involvement. It was clear from respondents that they believed the Facilities Managers should be involved in all stages. The findings however presents interesting results [see table 3]. For example Less than half (13) of respondents indicated facilities managers full involvement in the briefing stage. This was surprising as the briefing stage is the starting point of the process and integral for ensuring appropriate consideration of client organisation and end-user needs and performance amongst etc. which is importance for effective FM function. 37.0% of respondents indicated the Facilities Manager should have full involvement in the design stage. This like the briefing stage in integral as it ensures elements from the design team which ensured the building was fit for purpose had not only been considered but inputted into the design. Not surprising was the finding that 92.9% of respondents were of the opinion that the Facilities Manager should have ‘full involvement’ in the occupancy stage.

<table>
<thead>
<tr>
<th>Stage</th>
<th>No Involvement [%]</th>
<th>Limited Involvement [%]</th>
<th>Some involvement [%]</th>
<th>Full involvement [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-brief [Business Case]</td>
<td>10.7</td>
<td>25.0</td>
<td>32.1</td>
<td>32.1</td>
</tr>
<tr>
<td>Briefing</td>
<td>7.4</td>
<td>11.1</td>
<td>33.3</td>
<td>48.1</td>
</tr>
<tr>
<td>Design</td>
<td>0.0</td>
<td>3.7</td>
<td>59.3</td>
<td>37</td>
</tr>
<tr>
<td>Construction</td>
<td>8.0</td>
<td>12.0</td>
<td>44.0</td>
<td>36.0</td>
</tr>
<tr>
<td>Occupancy</td>
<td>0.0</td>
<td>3.6</td>
<td>3.6</td>
<td>92.9</td>
</tr>
</tbody>
</table>

Table 3: Extent of design process involvement
The key focus for this paper was to understand the FMs perception of key barriers to their effective contribution to decision making in the design process. Respondents were asked to indicate which factors on a list were significant barriers to their involvement. Table xx4 presents a summary of results. The top three (3) barriers were identified as: insufficient consideration by design team on operational requirements (69.2%), attitude of design team, lack of appreciation of FM expertise (61.5%), lack of recognition of significance of FM contribution to organization’s business. Surprisingly, the issue of inadequate qualification of facilities manager was identified as the least barrier (3.8%). The list included an option for respondents to indicate other barriers. Two of the ‘other’ barriers included: designers on a tight programme and one respondent was of the opinion that there were no real barriers, just getting the time and opportunity to get involved.

Table 4: Perceived barriers to FM involvement

<table>
<thead>
<tr>
<th>Stage</th>
<th>Rating/Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of recognition of significance of FM contribution</td>
<td>53.80%</td>
</tr>
<tr>
<td>Lack of support and financial backing from senior</td>
<td>3.80%</td>
</tr>
<tr>
<td>Slow and reactive approach to dealing with end-user</td>
<td>11.50%</td>
</tr>
<tr>
<td>Insufficient consideration by design team on operational</td>
<td>69.20%</td>
</tr>
<tr>
<td>Attitude of design team and their lack of appreciation</td>
<td>61.50%</td>
</tr>
<tr>
<td>Requirements of FM differ from that of developer</td>
<td>46.20%</td>
</tr>
<tr>
<td>Facilities manager inadequately qualified to get involved</td>
<td>3.80%</td>
</tr>
<tr>
<td>Facilities manager’s lack of or limited access to</td>
<td>7.70%</td>
</tr>
<tr>
<td>strategic information</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION AND CONCLUSIONS

The primary aim of this paper was to evaluate perceived key barriers to the effective contribution of the facilities manager in decision making in the design process. It was important to note in the data that FM practitioners come from varied professional backgrounds and equally have varied skill sets, performing at operational and strategic levels. The need for involvement in the design process was unanimous, as FM practitioners believed their involvement would be of value and they could contribute to all stages, however their primary stages of choice were design and occupancy, with more involvement in the latter stage as they felt they could contribute more. The occupancy stage seems to provide a comfort level which they are used to and feel best suited in terms of their reactive approach, operational nature and skill set. While this is the case the importance of the FM contribution in the early stages of the project can not be ignored. The briefing stage offers the FM practitioner the opportunity to mould outcome: the building, as it establishes the purpose and performance of the building as once built ideas, opinions and ideas which may be beneficial and could have been tested will be too late to include, creating for a costly and difficult building operation and maintenance period.

The lack of involvement of FM practitioners was attributed to perception and project related barriers as FM practitioners did not feel their expertise, views and requirements were given due recognition and insufficiently considered. The irony is that without the input of the FM practitioner who has the expertise, knowledge and information required to ensure the operation requirements are not only considered by incorporated into the design, it will always be insufficiently considered. So FM practitioners need to get involved in the design process from the start; changing the approach and taking responsibility. The perceived lack of recognition by the design team and their lack of lack of the FMs role were also seen as potential barriers to the FMs involvement.

This paper demonstrated that the involvement of the facilities manager in decision making in the design process can yield potential benefits to the overall performance of a building. However there seems to exist external and internal issues which hinder the full involvement of the facilities manager. A clear demonstration of the value of this involvement is
considered as a key step in encouraging the design team to integrate fully the facilities manager in the design decision making process.

**BIBLIOGRAPHY**


Jensen, A., Damgaard, T. & Kristiansen, K. (n.d) The role of facilities management in building projects


The Image of Construction: A High School Perspective

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ABSTRACT

Purpose:
This study seeks to examine the relationship between the image of the construction industry and its development and sustainability.

Research design:
A review of literature was conducted in order to establish the link between the image of construction and the critical skills shortage. A sample of high school students was surveyed to establish their views on the image of the construction industry and its attractiveness as a career choice.

Research limitations/implications:
For geographical reasons, the study was conducted in KwaZulu-Natal as a result of limited resources and time available to do the study.

Findings:
It was found that the construction industry had a poor image and that it was not conducive to a sustainable industry. There were decreasing numbers of new entrants and a growing shortage of skills as a result of the unattractive industry. Few students considered construction viable as a career choice.

Response to conference theme and outcomes:
This study demonstrates the importance of improving the image of the industry so that it can be sustained for future generations. Fewer new entrants will result in a shrinking industry.
Practical implications:
Through improving the industry’s image, the skills shortage could be reduced through attracting new entrants to consider construction as a viable career choice.

Keywords: Image, industry development and sustainability, career choice, factors influencing industry image

1. INTRODUCTION

Many authors have stated that the construction industry was important to the economy of any country, whether it be first world or third world (Rameezdeen, 2007; R Engineering Jobs, 2011; Diamini, 2012; Wibowo, 2009; Didiza, 2008; DG Enterprise, 2000; Yeung and Chang, 2002). According to Wibowo (2009), the construction industry contributed to the economy in four ways, namely, (1) it provided the basic infrastructure every country needed such as, for example, roads, bridges, and housing; (2) it provided physical structures wherein other industries could operate; (3) it created employment opportunities as a major employer of labour; and (4) it contributed a significant portion of Gross Domestic Product (GDP).

Past research indicated that the construction industry had suffered from its poor image (Rameezdeen, 2007; Chan and Connolly, 2012; Skitmore, 1991; Tucker, et al., 1999; Pearce, 2003; Sizemore, 2006). They identified a number of factors that were contributing to the poor image of the sector. Rameezdeen (2007) identified a cycle that influenced the image, namely that poor quality inputs resulted in poor quality outputs. The image needed to be improved in order to attract new entrants and increase the quality of inputs (DG Enterprise, 2000).

Several authors have shown concern about the critical shortage of skills (Makhene and Twala, 2009; International Labour Organisation (ILO), 2001; Sizemore, 2006; CIDB, 2012a). There were generally limited numbers of new entrants in construction (Chan and Connolly, 2012). The poor image made the industry unattractive as a career choice, which resulted in fewer people interested in making a career in construction (Makhene and Twala, 2009). Haupt, et al. (2010) stated that the workforce was an aging one and the proportion of the older workers was growing when compared with the younger worker cohort. There were not enough new and younger entrants to offset the amount of retiring workers (DG Enterprise, 2000). School students were not introduced sufficiently to the industry and the availability of construction careers at school level. The lack of new entrants has caused concerns over meeting the current increased in demand for construction outputs (Chan and Connolly, 2012). The shortage of skills,
coupled with the poor image and lack of new entrants, endangered the development and sustainability of the construction industry.

2. LITERATURE REVIEW

2.1 Construction and the national economy

As of the fourth quarter of 2012, the construction industry contributed 3.5% to the South African national GDP (Statistics SA, 2013). The industry accounted for around 7.8% of total employment, which included both the formal and informal sectors (Statistics SA, 2012). The construction industry played an active role in most other industries as well. The accommodation industry was reliant on construction, as well as the real estate and finance sectors. Due to the size of construction equipment, the construction sector also contributed to the manufacturing industry (Wibowo, 2009).

It has been noted that the construction industry played an important role in economic growth (Hillebrandt, 2000). Dlamini (2012) tested the link between construction output and economic growth. He concluded that expenditure in construction did not necessarily result in economic growth, but that it contributed to employment creation and capital infrastructure which could lead to economic growth. However, governments were able to use macroeconomic policy tools in order to stabilise the economy during times of recession. Governments could implement fiscal policy by increasing government spending on construction projects. This created labour demand which resulted in increased employment (Ball and Wood, 1995). Because credit was a vital part in any construction project, the introduction of monetary policy that affected the interest rate would significantly influence the construction sector (Briscoe, 2009).

2.2 The image and contributory factors

It has been noted globally that the construction industry had been suffering from a poor image (Rameezdeen, 2007; Chan and Connolly, 2012; Pearce, 2003; ILO, 2001; Makhene and Twala, 2009; Clarke and Boyd, 2011). The amount of factors that were contributing to this negative perception was worrying. Rameezdeen (2007) stated that the industry had a reputation for low quality work, high cost and poor health and safety statistics. The poor image had resulted in a shortage of critical skills as there were fewer new entrants and people who viewed construction as a viable career option (Chan and Connolly, 2012; Clarke and Boyd, 2011).
The following factors were identified as being contributory to the poor image of the construction industry, namely

1) **Careers in construction were less prestigious than other industries**

Construction workers were viewed as blue collar workers, which in turn were synonymous with low status jobs (ILO, 2001). Young people viewed any career that involved manual labour as a low status career due to the wages being low in comparison with other industries and the lack of clear career paths (Tucker, et al., 1999). Young people viewed the status of a career as an important factor in deciding on a career path. According to the ILO (2001), the construction industry of some countries such as, for example, Malaysia was reliant on illegal immigrants, which further deteriorated the status of the industry and the workers therein.

2) **Construction offered little career advancement opportunities**

Makhene and Twala (2009) found that there was a lack of well-defined career paths in construction. Young people felt that it was not possible to make a career out of construction and they generally did not know about the career opportunities available in the industry (Tucker, et al., 1999). Chan and Connolly (2012) stated that school students generally were not aware of the career opportunities available in the industry.

3) **Jobs in construction did not pay well**

According to Makhene and Twala (2009), jobs in construction were paying less than other industries. The low wage levels were one of the main reasons the construction industry was having trouble with retaining labour (ILO, 2001).

4) **Construction provided a harsh work environment**

Construction work was generally executed in the open air. The work was seen as dirty, tough and unhealthy resulting in young people pursuing careers in other industries (Makhene and Twala, 2009; Tucker, et al., 1999). Workers were exposed to the natural elements which made it a difficult work environment. Construction workers could be subject to slippery conditions and discomforting conditions which could affect their health, safety and efficiency (Radevsky, et al., 2012).
5) **The industry had poor health and safety records**

Despite recent efforts to improve health and safety performance in the industry, there were still worrying amounts of site accidents and work related deaths. The construction industry had the highest number of fatalities. The industry also had a significant amount of non-fatal injuries (Pearce, 2003).

6) **There was fraud and corruption in construction**

It is generally known that fraud and collusion occurred within the construction industry (Pearl,*et al.*, 2005; Vee and Skitmore, 2003). Construction companies formed cartels in order to monopolise a sector or geographical area. These cartels offered tender prices which were generally significantly higher than market prices. According to CIDB (2011:ii), the barriers to quality in construction were “corruption, political interference and institutional barriers”. They (*Ibid.*) stated that these barriers were becoming more apparent in South Africa.

2.3 **Critical skills shortage**

The poor image of the industry had limited the growth of the industry as there were fewer new entrants in the industry, resulting in a critical skills shortage and an increase in the country’s unemployment level (ILO, 2001). Young adults viewed any career that involved manual labour as a low status career, due to the wages being low in comparison with other industries and the lack of clear career paths (Tucker,*et al.*, 1999).

According to the Business Conditions Survey conducted by CIDB (2012b) in the 4th quarter of 2012, 54% of respondents recorded a shortage of critical skills. The increase of 9% during the last quarter indicated that demand for skilled labour was on the increase. However, due to the construction industry’s poor image and the lack of new entrants, the supply of skilled labour was on a decline (Skitmore, 1991). As the demand for work increased, the demand for skilled labour increased relatively (Makhene and Twala, 2009).

3. **METHODOLOGY**

Relevant literature and previous studies on the image of the industry and skills shortages were extensively reviewed to contextualise the study. The researcher explored the link between the image and the skills shortage.
A survey consisting of questionnaires was conducted in order to test high school students’ attitudes toward a career in construction. The students were asked about what they knew about the industry and built environment professions. Students were presented with several statements to which they had to respond numerically on a 10-point Likert scale where 1=totally disagree and 10=totally agree. The 10-point scale was used so that students could provide an idea of the extent to which they agreed or disagreed with a statement, as opposed to the norm: disagree, neutral or agree. If the students agreed or disagreed outright and in unison, it will be easily identified and documented. The central measures of tendency were calculated such as the mean together with the measures of dispersion around the mean in the form of the standard deviation, allowing the ranking by the means of responses to statements presented to the students. The descriptive statistical analysis was done using MS EXCEL.

4. FINDINGS

The sample comprised of high school students who were in Grades 10 to 12, which could be translated into an age group of 15-18 years. A hundred questionnaires were distributed and 82 were returned, representing a response rate of 82%. The sample had a relatively equal gender spreading with 42 students being male and 40 female. Table 1 indicates the distribution of respondents over 8 schools in the Durban Metropolitan area.

<table>
<thead>
<tr>
<th>Table 1: Participating schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
</tr>
<tr>
<td>Fairvale Secondary</td>
</tr>
<tr>
<td>Westville Boys High School</td>
</tr>
<tr>
<td>New Forest High School</td>
</tr>
<tr>
<td>Kloof High School</td>
</tr>
<tr>
<td>Queensborough Girls High School</td>
</tr>
<tr>
<td>Rossborough High School</td>
</tr>
<tr>
<td>Durban Academic</td>
</tr>
<tr>
<td>Phambili High School</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

Table 2 indicates high school students’ level of knowledge about the job descriptions of the key built environment professions within the industry.

Table 2: Knowledge about profession (ranked by means)
From Table 2 it is evident that students knew more about architecture (mean=7.85) than contractors (mean=5.21) and sub-contractors (mean=4.29). However, all the means were below 7.85 suggestive of a lack of knowledge about the stakeholders and participants in the industry. It is worrying that school students did not know about the vast variety of careers available in the industry, since it caters for a large variety of aptitudes. Examples include artists in architecture, mathematically gifted persons in engineering and quantity surveying, legal professionals in arbitration, adjudication and mediation, and people with management skills such as project managers and contractors.

The responses of students to statements about the construction industry are shown in Table 3.

**Table 3a:** Student attitudes towards the Construction Industry (ranked by mean responses)

<table>
<thead>
<tr>
<th>Statements</th>
<th>N</th>
<th>Max</th>
<th>Min</th>
<th>Mean</th>
<th>SD</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>A career in construction is fulfilling as results can be seen</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>7.51</td>
<td>2.26</td>
<td>1</td>
</tr>
<tr>
<td>The construction industry pays well</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>7.32</td>
<td>2.18</td>
<td>2</td>
</tr>
<tr>
<td>A career in construction is rewarding</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>7.12</td>
<td>2.16</td>
<td>3</td>
</tr>
<tr>
<td>The construction industry enjoys a positive image</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>6.65</td>
<td>2.24</td>
<td>4</td>
</tr>
<tr>
<td>There are a lot of problem solving opportunities in construction projects</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>6.61</td>
<td>2.80</td>
<td>5</td>
</tr>
<tr>
<td>It is better to work in an office than it is to work outside on site</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>5.88</td>
<td>3.23</td>
<td>6</td>
</tr>
<tr>
<td>The construction industry is too physically demanding</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>5.50</td>
<td>2.92</td>
<td>7</td>
</tr>
<tr>
<td>The construction industry is a male dominated industry</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>5.46</td>
<td>3.41</td>
<td>8</td>
</tr>
<tr>
<td>Construction industry is not suitable for disabled persons</td>
<td>82</td>
<td>10</td>
<td>1</td>
<td>5.43</td>
<td>2.98</td>
<td>9</td>
</tr>
</tbody>
</table>
From Table 3a and 3b it is evident that students felt most strongly about a career in construction being fulfilling as results could be seen (mean=7.51), paying well (mean=7.32) and being rewarding careerwise (mean=7.12). In contrast, the students felt most negative about there being no jobs in construction (mean=3.33) and few career advancement opportunities in construction (mean=3.91). The question that arises is why were they not willing to consider careers in construction if they felt that careers were available, rewarding and that it was paying well?

Students were largely undecided about whether or not a career in construction was prestigious (mean=5.35) despite them agreeing that there were career advancement opportunities in construction and that jobs in construction paid well. They felt neutral about the working conditions being tough and dangerous as construction work was physically demanding (mean=5.50), unsafe (mean=5.23) and that it was better to work in an office than on a construction site (mean=5.88). The students tended to be neutral about whether corruption was evident in construction projects (mean=4.43).

In general the students tended to be indifferent or undecided about most aspects of construction presented to them in the various statements since 11 of the 16 statements had means between 4.00 and 7.00. There was no clear correlation between the literature and the research findings. The students disagreed with some of the image-contributing-factors identified in literature but they were largely undecided. It is possible that the
students did not have sufficient knowledge about the industry to provide more definitive responses.

Clearly, high school students need to be exposed to the construction industry and the careers the industry offers. They know that there are jobs and career advancement opportunities available and that a career in construction could be rewarding and well paid, yet they did not view a career in construction as viable as seen in Table 4.

<table>
<thead>
<tr>
<th>Table 4: Construction as a career choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
</tr>
<tr>
<td>How attractive is a career in construction for you?</td>
</tr>
<tr>
<td>Do you want to work in the construction industry?</td>
</tr>
<tr>
<td>How much does your perception of an industry influence your decision to follow a career in that industry?</td>
</tr>
</tbody>
</table>

The findings of Table 4 suggest that construction was not a preferred career choice with all means below 6.57. Students felt that their perception of an industry only marginally influenced whether they saw a career in that industry as viable (mean=6.35). The construction industry should theoretically provide attractive career choices to a large number of young people, but it is worrying that they still did not view construction careers as attractive and viable.

5. CONCLUSION

Research conducted in the past two decades revealed that the construction industry had suffered from its poor image. The industry had become synonymous with low prestige, low pay, low quality, physically demanding and dangerous careers. There was a lack of new entrants and skilled labour which could be explained as the resultant of the industry’s poor image.

High school students did not view careers in construction as a viable career choice. The students were largely undecided about most of the industry’s characteristics presented to them. This could be explained by the fact that they did not know if the statements were true or not, indicating a lack of knowledge about the inner workings of the industry. The survey also indicated that high school students did not know the job descriptions of key professions in the industry. If school leavers did not consider a career in
construction as attractive, the industry would shrink and become stagnant and become reliant on importing professionals and skilled workers.

The industry must work towards making the careers attractive for the modern young adult. By improving the image of the industry, it could be expected that the public will have a higher regard for those employed in construction. It is important that the industry promotes itself by teaching school leavers about the workings of the industry and the variety of available careers therein. It is through the influx of young blood that the industry will be sustained as a severe shortage of workers and professionals will result in the demise of South Africa’s construction industry.

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Water supply challenges in Makhado Municipality, Vhembe district, Limpopo Province

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ABSTRACT AND KEYWORDS

Purpose of this paper
To evaluate if the water supply service delivery to the communities in the Vhembe district of Limpopo Province by the Makhado Local Municipality is according to that required by Government and by the community.

Design/methodology/approach
Methodology: The findings were based on a questionnaire completed by a total of 90 respondents from three towns served by the Makhado Municipality. The questionnaire consisted of 19 questions. The profile of the respondent, water supply, the quantum of water delivery and questions on quality of water were provided. An open-ended question was also formulated to allow for comments by the respondents.

Findings
It was found that the water supply is erratic and irregular with frequent, long break down periods and that the quantity of water per household was below the accepted standard. However the quality of water was generally good.
Research limitations/implications
The causes of the water delivery problems were not investigated. The study suggested solutions but did not test such solutions. The study was restricted to three towns only.

Value of paper
The study describes the water supply problems in significant detail. These findings can be used by local councils to mobilise, plan and structure a proper response to address the delivery problems.

Keywords: Limpopo, Local government, Service delivery, South Africa, Water supply.

1. INTRODUCTION

1.1. Background

Since 1994, the democratically elected government of South Africa sought to redress the disproportionate allocation of water among the South African population by adopting a new Constitution and enacting legislation that made provision of water a basic human right. The government adopted a new institutional framework to provide water to the people based on the principles of equity, sustainability and efficiency. The Water Services Act of 1997 (No. 108 of 1997), Section 3(1) states “everyone has a right of access to basic water supply and basic sanitation”. This right to water amounts to the water quantity called the “reserve.” The “reserve” is basic human subsistence amount which every person is entitled to (25 litres per person per day or 6 000 litres per household per month) including the needs of the person’s immediate environment (National Water Act, 1998).

The government’s pace in delivering basic services to rural communities has been slow since 1994. Tsatsire (2008) indicated that the slow pace of service delivery by local government resulted in public protests. Communities lost patience in the slow pace of service delivery.

Within the Vhembe District and Makhado Local Municipality in particular, several complaints regarding inconsistent water supply and poor water quality of the supplied water have been raised by residents of Makhado Local Municipality. These developments indicate that from the residents’ perspective, water supply problems exist in Makhado Local Municipality.
1.2 Importance of the Study

The study attempts to verify two questions regarding water supply in Makhado Local Municipality:

1) Do water supply problems exist in Makhado Local Municipality?
2) If water supply problems do exist, to describe the extent of such problems.

The Vhembe District Water Services Development Plan (2010) indicates that the water supply level of service for most households in Makhado Local Municipality is below the government’s stated “reserve” and that a total of 128 372 households (42.5%) of all the households in Vhembe District do not have access to water according to Reconstruction and Development Plan standards. This represents a significant portion of households who do not have access to a basic level of water.

Media reports over the past three years state that residents of Makhado Local Municipality regularly complain about irregular water supply to their households and that the water is of poor quality (Municipal IQ 2011, Dube 2010). The need therefore exists for explorative research to validate the residents’ water supply problems and evaluate the extent of the problems. The merit of this research is to confirm and describe this supposed problems and to indicate suggested courses of rectifying actions.

2. THE PROBLEM STATEMENT

2.1 The Problem

Water supply problems exist in Makhado Local Municipality and a scientific analysis will be able to more fully described the problems.

2.2 The Sub-problems

The problem can be resolved more easily if it is broken down into the following sub-problems:

- First sub-problem: Describe when and how often water supply is unavailable to households within Makhado Local Municipality?
- Second sub-problem: Describe the quantity (or pressure) of water available per day and per given time of the year to households in Makhado Local Municipality and how this quantity compare with the legislated free basic water right (the Reserve).
- Third sub-problem: Describe how consumers in Makhado Local Municipality perceive the quality of the supplied water in terms of
smell, taste and colour compared to the World Health Organization (WHO) Water Drinking Water Quality Guidelines.

2.3 Data Collection Methods

The data relating to each sub problem was collected by means of questionnaires completed by respondents who were randomly selected at social convenience meetings and gatherings in each of the study areas. Thirty (30) respondents completed questionnaires in each area of Louis Trichardt town, Sinthumule Kutama and Elim villages hence a total number of 90 questionnaires were completed. This method of sampling was preferred because each member of the population had the same chance of being selected (Welman, et al, 2005).

3. REVIEW OF RELATED LITERATURE

3.1 Water Service Delivery in Third World Countries

Access to clean drinking water remains one of the major problems facing Third World countries. According to Haddad (2004) at least one in six people worldwide lack access to clean drinking water and have no choice but to drink water that they know is contaminated with potentially life-threatening bacteria.

The United Nations Integrated Regional Information Network (IRIN, 2006) website reports that freshwater resources around the world are dwindling. Inadequate access to water is especially severe in the developing world, which lacks the infrastructure and coping mechanisms of industrialized nations.

3.2 Water Service Delivery in South Africa

Water services provision to the areas populated by black people was inferior to that enjoyed by the white communities (MacKay, 2003). Most rural black communities were classified as homelands prior to the advent of democracy in 1994. The homeland administrators was responsible to supply water to the communities in the homelands and to maintain water infrastructure. Most homeland administrators and townships did provide offer water supply through a standpipe in a community (Earle et al, 2005).

Since the homeland administration suffered from inefficient management and lack of funding, the homeland communities suffered an inequitable, inconsistent and limited access to clean drinking water.

In 1994, the management of all water supply schemes previously managed by the homeland administrators was transferred to the newly
elected national government together with the responsibility to supply communities with water under improved service levels. The 1994 Water Supply and Sanitation Policy White Paper of the Department of Water Affairs and Forestry (DWAF) focused the DWAF resources on capital costs to extend basic water services infrastructure, while recovering operation and maintenance costs from user charges (Marah et al, 2004). However, by the late 1990’s the lack of payment for water services was affecting the expansion of basic water services (Earle et al, 2005). The unsustainability of water supply contributed to the persistence of water supply problems in the rural communities.

3.3. Government Constitutional and Institutional Initiatives after 1994

Before 1994, no national institution was responsible for ensuring equitable and sustainable access to water supply service and no structured national legislation existed which regulated the provision of this service (Van Schalkwyk, 2001). In an endeavor to correct the apartheid era system of disproportionate distribution of water to citizens, the new government passed two Acts of Parliament, the National Water Act (NWA) of 1998 and the Water Services Act (WSA) of 1997.

The aim of the National Water Act (1998) is to regulate water use in South Africa and ensure equitable and sustainable use of available water resources (both surface and underground water). The Act aims to do this by meeting the basic human needs, promoting equitable access to water, efficient and sustainable use of water and reducing and preventing pollution and degradation of water resources.

In terms of water service delivery, the act is applicable to the use of water, the protection of water resources, water use charges and reporting. Unfortunately the National Water Act to date had little impact on water service delivery in rural areas (Van Schalkwyk A, 2001). The Water Services Act of 1997 regulates the provision of water services and sanitation in South Africa and provides for:

- The identification of a Water Services Authority (WSA)
- The identification of a Water Service Provider (WSP)

According to Mhlanga and Walker (1999) the primary objectives of the Act are to provide for:

- the right of access to basic water supply and sanitation
- the accountability of water services providers
- a regulatory framework for water service institutions
• promotion of effective water resource management and conservation
• financial assistance to water services institution
• the preparation and adoption of water services development plans by water services authorities.

A Water Services Authority (WSA) is defined as ‘any local government body, municipality, including a district or rural council (as defined by the Local Government Transition Act, 1993) responsible for ensuring access by every citizen to water supply and sanitation services’.

Every Water Services Authority has a duty to all consumers or potential consumers in its area of jurisdiction to progressively ensure efficient, affordable, economical and sustainable access to water services (Mhlanga and Walker 1999:6).

However research by Van Schalkwyk (2001) indicated that the role of district municipalities in terms of actual water service delivery, has been minimal particularly in the rural areas. He concludes that the active involvement of the WSA in rural communities is not considered to be a determinant for sustainable water service delivery.

The Water Service Provider (WSP) is the organisation responsible for the management of water services infrastructure and the physical and organizational arrangements to provide water and sanitation services. The WSP operates under contract from the WSA.

The responsibilities of the water service provider include:

• Delivering retail water service to consumers
• Governance
• Administration of retail water supply systems
• Revenue collections from retail water sales
• Customer relations and resolving customer complaints

Van Schalkwyk (2001) stated that the selection of the WSPs especially in the rural areas, for each village or settlement, was a key decision in determining the success of water service provision.

Matji (2003) reports that after 1994, a number of rural water supply schemes were completed in the Kwazulu-Natal, Eastern Cape, Mpumalanga and the North West Provinces through the Reconstruction and Development Programme (RDP). Some of these schemes have been reported to be functional, intermittently functional, or non-functional.

For rural schemes in South Africa, communal street tap systems are commonly provided as water supply points. However research by Van Schalkwyk (1996) has shown that communities having a moderate to high level of living, strongly object to communal tap systems and are thus likely to install unauthorised yard connections and avoid payment for services. In the Northern Province (now Limpopo) fewer than 20 rural domestic water
supply schemes were satisfactorily providing water services to the consumers. Breakdowns on some water supply schemes last between 3 and 6 months without any repair work (Van Schalkwyk, 2001).

With regards to quality of the water supplied to communities, the WHO Guidelines for Drinking Water Quality states that the appearance, taste and odour of drinking-water should be acceptable to the consumer. Therefore the provision of drinking water must not only be safe but also acceptable in appearance, taste and odour. Water that is aesthetically unacceptable will undermine the confidence of consumers and will lead to complaints and unacceptability (WHO, 2010).

4. DATA ANALYSIS

4.1 Respondents’ Locality and Profile

The respondent’s profile indicated that two thirds (67%) of respondents live in a rural area of which 58% are female. The vast majority (86%) are not older than 50 years of age with 73% being employed. Typical households consist of between 4 and 8 individuals. (See Table 1)

<table>
<thead>
<tr>
<th>Measurement Item</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Locality</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>33%</td>
</tr>
<tr>
<td>Rural</td>
<td>67%</td>
</tr>
<tr>
<td>2 Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>42%</td>
</tr>
<tr>
<td>Female</td>
<td>58%</td>
</tr>
<tr>
<td>3 Age</td>
<td></td>
</tr>
<tr>
<td>18 – 35 years (Youth)</td>
<td>39%</td>
</tr>
<tr>
<td>36 – 50 years (Middle Ages)</td>
<td>47%</td>
</tr>
<tr>
<td>51 + years (Senior Ages)</td>
<td>14%</td>
</tr>
<tr>
<td>4 Employment</td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>73%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>27%</td>
</tr>
<tr>
<td>5 Household size</td>
<td></td>
</tr>
<tr>
<td>1 - 3 people</td>
<td>21%</td>
</tr>
<tr>
<td>4 - 8 people</td>
<td>71%</td>
</tr>
<tr>
<td>9 – 12 people</td>
<td>8%</td>
</tr>
</tbody>
</table>

4.2 Status of Water Supply

The purpose and data of this section evaluated the following:
**Do you receive potable water in your household?** The results show that all respondents (100%) receive municipal water.

**Where do you mainly receive water in your household?** The results indicated that the source of water for respondents was split in a 30:70 ratio between taps inside households and street standpipes respectively.

**If from Standpipe or other source, what is the distance between household and source?** The majority of the respondents (52%) collect water from within 100 metres of their houses (mostly water taps inside their houses and not standpipes). A total of 26% of the respondents in rural localities collect water from standpipes located between 100 to 200 metres of respondents’ households. The results show therefore that overall 78% of the respondents collect water within the 200 metres travelling distance as stipulated in the Water Services Act (1997).

Respectively, 14% and 6% of the respondents in rural localities of Sinthumule Kutama and Elim receive water between 200 to 500 metres and 500 metres to 1 kilometre of their households respectively.

The last group of respondents (2%) walks more than 1 kilometre to collect water for their households and these are located in rural areas of Sinthumule Kutama and Elim.

**How often is water available to you?** The results show that only 17% of the respondents, mainly in Makhado urban, receive water 24 hours a day. The majority of the respondents (47%) receive have water available for less than 9 hours per day. At least 31% have water available to them for between 9 to 15 hours per day and 5% have water available for between 16 and 23 hours per day.

**How much water do you receive daily for your household?** Based on the Water Services Act (1997)’s “reserve” concept, every person is required to receive a minimum quantity of water of 25 litres per day. Table 2 indicates the results of respondents’ reserve amount compared to actual amount of water received. The “Reserve” Target Amount is a result of the average household size for each area multiplied by 25 litres per person per day. The Average Actual Amount is the average amount of water received by respondents and has been obtained from the questionnaires.
Makhado urban residents receive the most water per day, i.e. at least 250 litres per household per day which amounts to 7 500 litres per household per month. The most likely explanation is that because these respondents receive water from taps located in their houses, at the times when water is available, they manage to collect water and store it in storage tanks for use during times when water is unavailable. On the contrary, the rural respondents residing in Elim and Sithumule Kutama receive an average of 100 litres per household per day which amounts to 3 000 litres per household per month from street standpipes. Usually there are long queues at the standpipes at the times when water is available. The residents take turns to fill their water containers.

Which time of the year is water not sufficient for your household? A general consensus exists among the respondents that seasonal variations affect water availability in Makhado Local Municipality. Results from respondents show that 27% of the respondents do not have sufficient water between August and October months whilst 25% of respondents do not have sufficient water during November to January months. The results show that water availability to residents slightly improves between February to April and between May to July months where 17% and 24% of the respondents respectively acknowledge that water is insufficient for their households. Only a small percentage of respondents (7%) are not affected by seasonal variations, that is, water is always available to them.

If there is a system breakdown, how many days do you wait for water supply to be restored? Restoration of water supply systems in Makhado Local Municipality takes anything from 1 day to 300 days. Due to this huge dispersion of results, the data was placed into groups to enable the data to be worked on effectively. The data was grouped as follows:

- 1 – 3 days (short restoration period);
4 – 10 days (medium restoration period); and
10 days + (long restoration period)

The criteria used to group the data in the groups as described above was based on a reasonable person’s view regarding water services provision. A total of 41% of the respondents noted that it took on average between 1 to 3 days for water supply to be restored after a breakdown. Restoration of water supplies for between 4 to 10 days is experienced by 36% of the respondents, with the bulk of them from Sinthumule Kutama. A percentage of 23% of the respondents have water supplies restored to them after 10 days. Some respondents indicated that a period of 300 days can pass before water supply was restored. The results therefore suggest that the water supply pattern may be described as erratic and irregular.

4.3 Water Quality

The purpose and data of this section of the questionnaire established the respondents’ perception regarding the following:

**Colour of water.** The majority of the respondents (77%) confirm that they receive water of a clear colour whilst 20% say that they receive milky water and 3% of the respondents indicated that they receive water that is a muddy brown colour.

**Smell of water.** A total of 91% of the respondents acknowledged that the supplied water does not smell. The rest of the respondents (9%) indicated that the water has a smell. It can be observed that the majority of the respondents find the water not having any smell therefore acceptable.

**Taste of water.** The results show that 63% of the respondents found the taste of the water to be acceptable most of the time whilst 28% of the respondents find the taste of the water to be acceptable at certain times. Only 9% of the respondents found the taste of the water not to be acceptable.

**Overall Quality of supplied water.** A total of 61% of the respondents found the overall quality of the water to be of good quality while 39% of the respondents found the overall quality of the water to be bad quality.

The majority of the respondents found the colour, smell and taste of the supplied water to be acceptable most of the times. The overall result is that the residents of Makhado Local Municipality regard the quality of water that they receive to be of good quality.
5. FINDINGS

The results from the data analysis conducted in this study showed that the quantity of water supplied to respondents in Elim and Sinthumule Kutama fall below the “reserve” amount of 6 000 litres per household per month. The results also show that water is not available to the majority of respondents for a greater part of the day. Some respondents in Elim indicated that water is not available to them for many weeks during breakdowns and on the occasions that it is available, many people flock to the communal standpipes to collect the water and this often results in very long queues. At most times, people end up unable to collect municipal water from the standpipes.

The first sub-problem of this study was: When and how often is water supply unavailable to households within Makhado Local Municipality? The study found that on a regular basis and at various times of the day, the supply of water to households in the study area can be described as erratic and falling below the “reserve” guideline.

The results show that water is available to 78% of respondents for between 1 to 15 hours per day. The results also show that 59% of the respondents regard the repair of the water supply systems to take between medium to long times (between 4 to 300 days) when it breaks down compared to 41% who regard the repairs to take short periods of time (1 to 3 days). The results therefore suggest that the water supply pattern may be described as erratic and irregular.

The second sub-problem was: what quantity (or pressure) of water is available per day and per given time of the year to households in Makhado Local Municipality and how does this quantity compare with the legislated free basic water right (the Reserve)?

The irregularity of water supply is supported by the results which show that water is not sufficient for up to 27% of respondents between the months of August to January. In the colder winter months of February to July, water supply improves slightly where between 17% and 24% of the respondents regard water supply to be insufficient. The results also show that the rural respondents of Sinthumule Kutama and Elim receive water which is less than the “reserve” amount of 6 000 litres per household per month.

The third sub-problem was: How do consumers in Makhado Local Municipality perceive the quality of the supplied water in terms of smell, taste and colour compared to the World Health Organization (WHO) Water Drinking Water Quality Guidelines?

Analysed results from the questionnaire shows that 61% of the respondents regard the overall water quality of the supplied water to be of good quality while 39% of the respondents said that the quality of the water...
was bad. The majority of the communities therefore perceive the water quality to be acceptable.

6. RECOMMENDATIONS

The study established that water supply problems with regards to regularity of supply and the amount of water supplied to residents in Makhado urban, Elim and Sinthumule Kutama areas exist. However the study did not delve into the causes of these supply problems. It is therefore recommended that further research be conducted to establish these causes i.e.: low productivity of personnel, inadequate/lack of training of personnel, insufficient finance, etc.

The study further recommends that Makhado Local Municipality establishes active communication channels between the municipality and communities. Issues such as current service delivery problems as well as strategies and initiatives to rectify the problems (e.g. water infrastructure projects planned by the municipality) can be communicated through these channels.

The possibility of protests by communities is high judging from the strong disgruntlements and negative sentiments regarding water supply issues expressed by respondents in the comments contained in the questionnaires.

7. CONCLUSIONS

Basic services delivery, including regular supply of adequate and clean water to communities within a maximum of 200 metres from every household remains one of government’s key priorities. Supply of clean water has positive implications to communities in terms of physical health, convenience and improved quality of life in general. This study shows that Makhado Local Municipality has to expeditiously come up with strategies that will improve access to water for all residents by 2014.

Issues such as water systems operations, management and maintenance, skills shortages and maintenance budgets need to be investigated as a matter of urgency. Active involvement by all societal structures in integrated planning activities is highly critical as well as regular communication between the municipality and its customers.

The results of the study show that a significant number of respondents are happy with the quality of water that they receive from Makhado Local Municipality. Whilst these results are commendable, greater effort must be made to supply water of acceptable quality to the rest of the residents who currently do not receive water of acceptable quality.
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A Multi-Causal Approach to Construction Accident Investigation

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ABSTRACT AND KEYWORDS

Purpose of this paper
By using a multi-causal model of accident investigation, accident reports will be more accurate. Consequently, the investigation process will be improved while the occurrence of accidents could decrease as the remedial measures will address the correct causes to prevent recurrences.

Design/methodology/approach
A case study approach will be followed where the actual causes are analyzed based on the actual investigation process followed. These findings will be compared with what a multi-causal approach would have identified.

Findings
Investigations into accidents fail to identify the correct cause of the accident which leads to incorrect remedial action allowing the accident to reoccur. The multi-causal approach identified the causes of accidents more accurately and the remedial measures were more appropriate.

Research limitations/implications
The study will be restricted to the KwaZulu-Natal province of South Africa given the time and resource constraints.
Practical Implications
This study contributes to the development and sustainability of the construction industry by rectifying and improving accident investigation processes which will lead to less injuries and death on site.

Response to Conference Theme & Outcomes
This study will contribute to improvement of the construction process and quality of life of construction workers.

Keywords: Accidents, accident causation, accident investigation, health and safety

1. INTRODUCTION

The construction industry contributes to the improvement of the quality of the lives of people in the form of its products such as housing, schools, healthcare facilities, and roads. However, for many workers, their families and friends involvement in the construction industry leads to the unimaginable pain and suffering associated with an accidental death or injury (Lingard and Rowlinson, 2005). The sector continues to kill and maim more of its workers each year than almost any other industry. This dismal performance track record has created negative impressions of the industry and sector (Smallwood and Haupt, 2005).

Time, cost and quality have persistently been the priority on construction projects, brushing aside health and safety. Employers have tended to focus on maximizing profits rather than establishing comprehensive accident prevention systems and procedures. They lack understanding regarding the actual cost of an accident until it has occurred (Hamid, et al., 2008).

According to Hinze, et al., (1998:67), “Accident prevention begins with having a clear understanding of those factors that play key roles in their causation.” The examination of the causes of accidents is necessary considering the potential consequences of accidents, high casualty tolls, environmental damage, economic losses and ethical/moral considerations (Saleh and Pendley, 2012). Poor health and safety (H&S) not only hurts workers themselves but also the companies that hire them or for whom they work, their families, and the broader community (Arboleda and Abraham, 2004).
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). 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, 2004).

In recent times many theories of accident causation have been developed. Unfortunately, most of them have focused on construction workers being the primary and often sole cause of accidents that have occurred on construction sites - a basic tenet of the behavioural safety approach espoused by Krause and Hidley (1990) and others. Consequently the remedial measures introduced post-accident investigations have been misdirected. 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.

This paper makes its contribution by re-analysing existing accident reports using a multi-causal approach to determine whether the causes recorded in the accident reports were correctly identified and whether the suggested remedial measures would prevent the re-occurrence of those or similar accidents in the future.

2. LITERATURE REVIEW

According to Hamid, et al., (2008), accidents are unplanned incidents that are both unexpected and unwanted. They result in injury, damage to equipment/material and fatality. A combination of contributing causes, unsafe acts and unsafe conditions lead to the occurrence of accidents. The root causes of an accident must be identified so that health and safety (H&S) performance may be improved (Hamid, et al., 2008).

It was noted by Arboleda and Abraham (2004) that by improving health and safety there would be a beneficial outcome as profitability and efficiency would increase; disputes, conflicts and delays would reduce; and competitiveness would enhance.
According to Haslam, et al., (2005), there has been limited investigation regarding the causes of accidents in relation to managerial, site and individual factors. Various theories regarding accident causation have been developed. According to Smallwood and Haupt (2004) the following theories were the most popular, namely

- Accident proneness theory;
- Goals – Freedom – Alertness theory;
- Adjustment stress theory;
- Chain of events (Domino theory);
- Distractions theory.

These theories focus on construction workers being at fault. Therefore the investigation process utilized misidentifies the true cause resulting in recurrence. Accidents are preventable and should be regarded as failures of management (Haupt and Smallwood, 2004). The aim of organisations therefore 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.

There is no agreement on the causes of accidents and many theories and models have been developed over the years. A theory or model of accident causation is required to examine the direct causes and the circumstances preceding the accident. These theories or models have been classified in several ways. For example, Hollnagel (2002) and Qureshi (2007) classified accident models as either

- Sequential or event-based which describe accidents as the result of sequence of discrete events that occur in a specific temporal order;
- Epidemiological which describe accidents in analogy with a disease, namely the outcome of a combination of manifest and latent factors that happen to exist together in space and time; or
- Systemic consider the performance of the system as a whole and describe accidents as emergent phenomena, or complex and interconnected network of events that exist coincidentally in a specific time and space, which are normal or natural in the sense of being something that must be expected.

Abdelhamid and Everett (2000) classified accidents in terms of accident causation models such as domino theory and multiple causation and human error theories such as behavior models, human factor models and Ferrel theory. Howell, Ballard, Abdelhamid and Mitropoulos (2002) claim that no model provides an understanding of the causes of
construction accidents sufficient to prevent the kinds of accidents that now plague the industry and refer to

- behavior models where the blame falls mainly on the human unsafe characteristic only; and
- human factors models where human error is the main cause of accidents but the design of the workplace and tasks that do not consider human limitations also contribute.

According to Mitropoulos, Abdelhamid and Howell (2005) their systems view or model would focus on the activity level by looking at the production system comprised of interacting variables that generated risks and shape work behaviors. Their model suggests a reduction of task unpredictability and improvement of error management capabilities.

It is argued that the effective use of accident causation models or theories can identify the sources of accidents and ultimately reduce or eliminate accidents (Arboleda and Abraham, 2004; Suraji et al., 2001). According to Abdelhamid and Everett (2000), prevention efforts could then be directed at the root causes of accidents and not at the symptoms, resulting in improved accident prevention approaches. The theories provide theoretical frameworks to guide the retrospective analysis of accidents and the prospective identification of hazards (Lehto and Salvendy, 1991).

2.1. Model of Causal Influences in Construction Accidents

This model is one of the most recent ones developed. Loughborough University and University of Manchester Institute of Science and Technology (UMIST) on behalf of the Health and Safety Executive (HSE) in the United Kingdom conducted a research study using a combination of focus groups and a detailed study of 100 construction accidents to identify where H&S was compromised and the reasons for the compromise (Haslam, Hide, Gibb, Gyi, Pavitt, Atkinson and Duff, 2005). The objective of the study was to use the information obtained from the research to describe the processes of accident causation, including the contribution of management, project, site, and individual factors in construction industry accidents.
The multi-causal model that emerged as shown in Figure 1 demonstrates that there are many contributing factors and causes in accidents that occur on site (Hamid, et al., 2008). The model aims to ultimately identify the root causes of accidents and prevent recurrence.

The model describes how accidents arise from a failure in the interaction between the work team, workplace, equipment and materials. These Immediate Accident Circumstances are affected by Shaping Factors whereby the actions, behaviour, capabilities and communication of the work team are affected by their attitudes, motivations, knowledge, skills, supervision, health and fatigue. The workplace is affected by site constraints, work scheduling and housekeeping. The suitability, usability, condition and, therefore safety of materials and equipment depend on their design, specification and supply/availability. These shaping factors are subject to Originating Influences or root causes, including the permanent works design, project management, construction processes, H&S culture,
risk management, client requirements, economic climate and education provision. The model suggests that achieving a sustained improvement in H&S in the industry will require concerted efforts directed at all levels in the influence hierarchy.

3. METHODOLOGY

Relevant literature and previous studies on causation theories were extensively reviewed to contextualize the study and explore the focus of the causes of construction accidents. Sources such as academic journals and peer reviewed articles were utilized to conduct the necessary research.

A case study approach was utilized so that comparisons could be made. An investigation of the causes of accidents was conducted by the using the multi-causal model to compare the findings with the recorded findings in existing accident investigation reports.

For the purpose of this study, five construction accidents were randomly selected from the accident investigation reports of a construction company based in KwaZulu-Natal.

4. DATA ANALYSIS

The accident description and identified causes of five site accident reports were extracted from the actual reports of the company that were made available. These are shown in Table 1. The actual accident descriptions were used to do an analysis using the multi-causal approach.

Table 1 Accident Information from existing investigation reports

<table>
<thead>
<tr>
<th>ACCIDENT NO:</th>
<th>ACCIDENT DESCRIPTION:</th>
<th>IDENTIFIED DIRECT/INDIRECT CAUSE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Supervisor had asked the Charge-hand, and 2 General Workers, of which the deceased was one, to alter segments of the “Birdcage” scaffold structure in order to fit the decolite cladding. The Charge-hand, then asked the deceased to fetch a 2-cup replacement standard. On his return, and after interaction with the other General Worker, the deceased was not</td>
<td>1. A responsible person had not been appointed in writing. 2. A risk assessment had not been conducted for the scaffold modification. 3. Loosened boards were not removed. 4. Boards resting on loosened ledgers were unstable. 5. The deceased was not</td>
</tr>
<tr>
<td>ACCIDENT NO:</td>
<td>ACCIDENT DESCRIPTION:</td>
<td>IDENTIFIED DIRECT/INDIRECT CAUSE:</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Failure to follow safe working procedures.</td>
<td>1. Improper operating procedures.</td>
</tr>
<tr>
<td></td>
<td>Deceased is exposed to danger as he is standing in the danger zone.</td>
<td>2. Risk assessment appointed to task was not followed.</td>
</tr>
<tr>
<td></td>
<td>There is no mechanical system to ensure release of the tailgate catch before elevation.</td>
<td>3. Incompetent work.</td>
</tr>
<tr>
<td>2</td>
<td>At approximately 13H00 on the 8th of December 2011, the deceased arrived on site to deliver a load of G6 aggregate. Once in position, he engaged the tipping mechanism for the truck prior to activating the lever to unlock the tail gate. As a result the truck bin reached maximum tipping angle but failed to release the material. He went to the rear of the truck and presumably realizing the problem, stood behind the tail gate striking the gate’s locking mechanism with a metal rod to force it to release. With the restraint mechanism disabled, the tailgate opened and the approximate 22m³ load of aggregate was discharged, completely engulfing him and leading ultimately to suffocation.</td>
<td>4. Lack of attention and observance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Gloves were not used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Time constraints caused the injured to be stressed.</td>
</tr>
<tr>
<td>3</td>
<td>The injured was assisting with the stripping of scaffolding that was built around a column. He was part of a team of three workers when the scaffold that was being dismantled came down to a 1.2m level, the injured together with his induna started to throw scaffolding material to the floor instead of passing on ledgers to the next worker below, till it reaches the</td>
<td>1. Improper operating procedures.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Risk assessment appointed to task was not followed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Incompetent work.</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>5. Gloves were not used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Time constraints caused the injured to be stressed.</td>
</tr>
</tbody>
</table>
The injured was coming off the upper mall deck and making his way towards ground level via an access staircase situated on the south west side of the mall. He was carrying two buckets of equipment with him. As he approached the last flight of stairs just before the landing, he slipped and fell to the ground approximately 1.8m.

<table>
<thead>
<tr>
<th>Accident No</th>
<th>Accident Description</th>
<th>Identified Direct/Indirect Cause</th>
</tr>
</thead>
</table>
| 4           | The injured was coming off the upper mall deck and making his way towards ground level via an access staircase situated on the south west side of the mall. He was carrying two buckets of equipment with him. As he approached the last flight of stairs just before the landing, he slipped and fell to the ground approximately 1.8m. | 1. Inadequate guards.  
2. Incorrect placement of footing.  
3. Carrying large quantities of equipment down access staircase.  
4. Fatigue. |
| 5           | Two members of a scaffolding team were stripping a scaffold. A member of the team passed a standard to the injured that was standing next to him on a scaffold approximately 1.4m high. The injured received the standard with | 1. Injured did not follow safety standards or guidelines.  
2. Injured did not follow operating procedures and methods.  
3. Improper position and posture.  
one hand, while holding a ledger with the other hand. As he turned he lost his balance, the foot of the standard that was in his hand struck against a ledger. His index finger was caught between the foot of the standard and the ledger. He suffered a slight laceration to the top of his right index finger. Due to swelling to the affected area he was taken to the hospital for further treatment.

5. Inadequate work planning.

The multi-causal model as shown in Figure 1 suggested that the key aspects of the five accidents being analyzed and mapped across the hierarchy of influences were as follows, namely:

- Immediate Accident Circumstances;
- Shaping Factors;
- Originating Influences.

Accident 1

Workplace (immediate accident circumstances)
The workplace was a causal factor because there was a need to alter an erected scaffold. The required components in the form of the two-cup replacement standard were not available at the workplace. A local hazard was caused by the loose steel boards.

Work team (immediate accident circumstances)
The work team was a causal factor because there had possibly been a lack of communication between the various parties. While the supervisor had instructed the chargehand to alter the existing scaffold there was no evidence of adequate supervision. It was evident that there was also a lack in training because the workers were not wearing the appropriate PPE and pre-job planning.

Equipment (immediate accident circumstances)
The loose steel boards suggested that the equipment was a causal factor because either the scaffold that was erected was not the correct one for the job or had been incorrectly erected.

Design, specification and supply/availability (shaping factors)
Because the scaffold had to be altered suggests that it might possibly not have been properly designed. Alternatively, it could have been incorrectly erected due to not adhering to the specifications. The required component was not available where it was needed.

Construction Education & Project Management & Risk Management (originating influences)
The accident report noted that a risk assessment had not been conducted for the scaffold modification. Consequently the worker was working at height but did not wear a safety harness or fall arrest system (FAS). Communication of SANS needed improvement.

Accident 2

Work team (immediate accident circumstances)
The action of the deceased was a causal factor since he did not follow improper operating procedures with respect to offloading his tip-truck. He also did not use an additional person to guide or assist him such as a flag person who would have informed him that the tailgate had not opened. The deceased obviously lacked the necessary knowledge/skills required to perform his duties. He failed to recognize the hazards to which he was exposing himself. Pre-job briefing and instruction required improvement.

Equipment (immediate accident circumstances)
The tailgate of the tip-truck malfunctioned. It is likely that the equipment had not been properly serviced prior to using the truck to do the job.

Design (shaping factor)
There was no alternative or manual override to ensure release of the tailgate catch before elevation or an audible and/or visual warning alarm alerting the driver of the malfunction.

Safety culture and risk management (originating influences)
It is evident that the health and safety culture of the organization was poor. If it had been good then the operator would not have acted the way he did. The operator failed to recognize the risks involved in his action.

Accident 3
Work team (immediate accident circumstances)

The action of the injured person was a causal factor as he did not follow the correct operating procedures. It was a display of negligence on his part. There was also a lack in supervision in this case. The injured person was fatigued and lacked focus.

Construction Education & Project Management & Safety Culture (originating influence)

The accident report noted that the aspects highlighted that the workers deviated from the risk assessment. The injured persons seemed to lack training. The pre-job briefing and instruction could be improved. There was a lack of work organization. It is evident that the health and safety culture of the organization was poor. If it had been good then the operator would not have acted the way he did. The operator failed to recognize the risks involved in his action and exposed his fellow workers to possible injury.

Accident 4

Work team (immediate accident circumstances)

The injured displayed negligence as he should not have carried large quantities, especially when he was fatigued.

Workplace (immediate accident circumstances)

The loose materials should not have been kept on elevated platforms as this action posed as a local hazard. A chute could have been used depending on what the equipment was. The lack of handrail presented as a local hazard.

Design & Safety Culture (originating influence)

There were no hand rails on the staircase therefore design specifications require improvement. The task was not analyzed and pre-job briefing and instruction required improvement. It is evident that the health and safety culture of the organization was poor. If it had been good then the operator would not have acted the way he did. The operator failed to recognize the risks involved in his action.

Accident 5

Work team (immediate accident circumstances)

The injured and his fellow worker lacked knowledge/skill by not adhering to safe working procedures. There may have been poor
communication between the two workers. The injured overestimated his ability to hold on to the standard as well as the ledger. There was a lack of proper supervision.

Workplace (immediate accident circumstances)

There was no space for the injured to handle the standard as well as the ledger while at height.

Construction education, safety culture & risk management (originating influence)

The injured person lacked proper training. Pre-job briefing and instruction required improvement and daily task assessments should be done. There was inadequate work planning. It is evident that the health and safety culture of the organization was poor. If it had been good then the operator would not have acted the way he did. The operator failed to recognize the risks involved in his action.

5. CONCLUSION

Using the multi-causal model as a vehicle to conduct the ‘investigation’ of the five selected accidents suggests that the causes of each accident might have been different from those identified in the original investigation reports if this approach had been adopted in the first place. For example, the lack of supervision and poor H&S culture were not identified in the original investigations. These differences would have resulted in different remedial measures being proposed from what were originally proposed. It is likely that because some of the causes were overlooked the proposed remedial measures might not prevent the same or similar accidents from recurring.

The processes utilized by the various companies in the case study focused in the main on construction workers being the primary if not only cause of construction accidents. In recent times many other theories have been developed to explain the true causes of construction accidents such as the Multi-Causal model utilized in this paper. These have included a more comprehensive examination of factors that cause accidents and not just on the trigger event. From the results of this exploratory study, it is evident that if construction companies considered adopting these more effective investigative processes, their focus on the root causes of accidents would shift, resulting in improved corrective measures being introduced and potential recurrences being prevented.

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CAUSES OF BUILDING PROJECTS DELIVERY TIME OVERRUN IN NIGERIA

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ABSTRACT

Purpose: Though much research has been done on construction project time management, however, time overrun and project delivery delay remains prevalent problems in the construction industry globally. This paper evaluates critical factors causing delay and time overrun in building projects in Nigeria, and present possible solutions to minimise the predicament.

Design/Methodology/Approach: Extensive literatures on causes of delays of construction projects delivery are reviewed, and augmented with questionnaires which were distributed to purposively selected construction professionals in Nigeria.

Research Limitation/Implication: Based on literature reviewed, the scenarios in the Nigeria construction industry is a reflection of incidences in the developing countries.

Findings: Critical factors causing construction product delivery delays are identified which include monetary problems during construction and contractors inability to continue financing the project when there is a delay in payment of interim valuation.
Response to conference theme and outcomes: To enhance project performance on delivery time there is a need for adequate fund for the project at onset, also selection of contractor based on financial capability. 

**Practical Implication:** Adequately implementation of the proposed solutions in this paper will not only enhance the contractors delivering its product timely in Nigeria, however, the suggestion will be useful to other developing countries.

**Keywords:** Building project, Clients, Construction industry, Project delay, Time overrun

1. **INTRODUCTION**

Though much research has been conducted on construction project time management, however, time overrun and project delivery delay remains prevalent problems in the construction industry globally. Delay and time overrun are common phenomenon in construction projects: it occurs in developed and developing countries. Hitherto, delay is one of the prevalent problems challenging construction industry in Nigeria. In many instances, construction project time-overrun occurs when the project stakeholders do not adhere to the project planned and scheduled, (Apolot, Alinaitwe and Tindiwensi, 2010). Noteworthy, delay has been known to lead to time and cost overrun with severe consequences, particularly in Nigeria, such as: conflict, claims, abandonment of project, and sometimes, litigation between the parties involved in the building projects, (Sayed, et al, 2003). In Nigeria, public building projects experience delay and time overrun more than private projects.

Typically, building projects involve two or more parties and the work is complex, with interrelated activities which require adequate allocation and assembling of resources, (materials, machines, and manpower), within limited constraints, (budgeted cost, time frame and expected quality). It is common that most building projects in Nigeria fail to achieve the delivery time and cost target. Several authors including Okpala, and Aniekwu, (1998); Elinwa and Joshua, (2001); Ogunsemi and Aje, (2005); and Oyewobi, et al, (2011) stress that construction activities in Nigeria are characterised by time overrun, cost overrun and consequently poor quality products. Also, the study of Odeyinka, and Yusif (1997) revealed that, seventy percent of projects in Nigeria experience delay and consequently time overrun. Thus, these scenarios make it imperative to evaluate and identify the various factors causing time overrun in building projects and to established ways of minimising the perpetual occurrences the time overrun and its effects on the construction product delivery in Nigeria.
2. CONSTRUCTION DELAY AND TIME OVERRUN IN CONTEXT

The issue of delay and time overrun in construction projects have been discussed extensively in much literature, and several factors have been identified as the source of causes. This section explores and presents various principal causes of delay and time overrun in some developing countries, including Nigeria.

The study conducted by Al-moumani, (2000), on construction delay in Jordan, reveals that the main causes of delay in public projects are design changes, weather, site conditions, late deliveries of materials, in addition to economic conditions. Another study conducted on causes of delay, in Jordanian traditional contract project, revealed that the significant factors causes time overrun include owner’s interference, inadequate contractor experience, poor financing and payments system, slow decision making, inadequate planning before the project commences and poor selection of subcontractors, (Frimpong, et al. 2003). However, the major causes of delay and cost overrun in Ghana are payment difficulties, poor contractor management, inappropriate material procurement, poor technical performance and escalation of material prices, (Sambasivan and Soon 2006). In Malaysian construction industry situation, the most important causes of delay are poor planning, poor site management, inadequate supervisory skills of the contractor, delayed payments, material shortage, labour supply, equipment availability and failure, poor communication and rework, (Siddharth, 2010). However, in India instances, the major factors causing delay are changes in scope, alterations, delay in procurement of equipment, shortage of materials, difficulties in transporting equipment, shortage of key personnel during implementation stage, inadequacy in planning, problems in land acquisition and rehabilitation, climatic and environmental factors, in addition to, lack of monitoring, contractual problems, poor performance of consultants, vendors and contractors law and order problems and inadequate infrastructural support, (Pourrostan and Ismail 2011). Also, Shaikh, et al. (2010) revealed 10 most critical factors causing delay in Iranian construction projects and these are poor site management, delay in progress payments by client, change order by client, ineffective planning and scheduling, financial difficulties by contractor, slowness in decision making by client to change order, poor contract management by consultants, problem with subcontractor. However, the factors causing delay in Nigerian construction industry as identified by Elinwa and Joshua (2001) include the mode of financing and payment, improper planning, under estimation of time/duration of projects, frequent changes designs, non-compliance with the conditions of contract, poor site management, and government policy. In addition to, availability of choice of materials, preparation and approval of variation orders, lack of coordination between the contractor and design team. While, Odeh and
Battaineh (2002) grouped the causes of construction delay in Nigeria to three principal factors: (1) client associated factors, (cash flow problem and slow decision on variation orders), (2) Contractor associated factors, (inadequate resources procurement system adopted, inefficiency of contractor’s and site management team, inadequate planning and scheduling of work, inadequate materials management and poor contract coordination), and (3) Consultant associated factors (such as late issuance of instructions, incomplete drawings and late preparation of interim certificates).

Construction project delay affects and has a negative impact on construction performance: time and cost overrun, disputes, litigation and total abandonment of project, (Siddharth, 2010; and Shaikh et al, 2010). In addition, the impact of delay in construction project include lost of interest by stakeholders, blacklist by authorities, waste of money and time, and decline in the contractor’s reputation, (Mansfield, et al 1994). Furthermore, delay often causes claims and disputes, (Sayed, et al 2003). Tumi, et al (2009) summarily classified measures of determining delay damages and compensation to two: non-excusable delay and excusable delays. Non-excusable delays are caused solely by the contractor or contractor’s suppliers and this attracts no relief. While, excusable delay are caused by third parties or incidents beyond the control of both the owner and the contractor, examples are natural disaster, fire, flood and acts of government: in such cases, the contractor is consequently entitled to time extension and the compensation for damages depends on the extent of the damages. However, compensable delays are caused by the owner or owner’s agents; example is: alteration presented by the client and delay on interim payment.

Based on the aforementioned prevalent causes of delay and time overrun, this study evaluates the existence of twenty major factors causing delay and time overrun in Nigeria construction industry.

3. RESEARCH METHODOLOGY, DATA ANALYSIS, FINDING AND DISCUSSION

3.1 Research Methodology

A survey research was adopted for this study using structured questionnaire distributed to construction practitioners (Architects, Engineers, Builders, Quantity surveyors) in Lagos, Nigeria. The questionnaire was divided into three parts namely respondent’s biography, project characteristics and twenty principal delay/time overrun factors in the Nigeria construction industry. Owing to the absence of reliable register of construction practitioners in Nigeria, a non-random purposive sampling was
used to distribute the questionnaires and respondents were requested to base the response on current on-going or past construction projects. A total of 120 questionnaires were distributed to professionals working in Lagos state, Nigeria. Also, due to general apathy to questionnaire survey, the direct face to face method was used to encourage respondents’ participation and thereby improve the response rate. To elicit the degree of influence of delay/time overrun factors, the respondents were asked to rate on the five-point Likert scale from no influence (1) to very high influence (5). Responses were analysed using relative importance index.

3.2 Characteristics of the Respondents

The respondents consist of built environment professionals such as Architects, Engineers, Builders and Quantity Surveyors. For convenience respondents were grouped into roles in the construction industry such as client, consultants and contractors. The analysis of the respondents’ characteristics is shown in Table 1 below which shows average response rate of 55%.

A total of 65 valid responses were returned indicating 12 clients, 18 contractors and 35 consultants.

Table 1: Questionnaire distribution/respondents’ analysis

<table>
<thead>
<tr>
<th>Role</th>
<th>Sent out questionnaire (N)</th>
<th>Returned questionnaires (N)</th>
<th>Response rate (%)</th>
<th>Participants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clients</td>
<td>20</td>
<td>12</td>
<td>60</td>
<td>18</td>
</tr>
<tr>
<td>Contractors</td>
<td>30</td>
<td>18</td>
<td>60</td>
<td>28</td>
</tr>
<tr>
<td>Consultants</td>
<td>70</td>
<td>35</td>
<td>50</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>65</td>
<td>55</td>
<td>100</td>
</tr>
</tbody>
</table>

Over half of the respondents (54%) work as professional consultant, while those working with client and contractor organization make up 18% and 28% respectively (Figure 1). The professions of the respondents as shown in Figure 3 are Quantity surveyors (50%); Builders (25%); Civil engineer (10%) and Architects (15%). Interestingly, 30% of the entire respondents have less than 10 years’ experience while the remaining 70% have over 10
years’ experience in the construction industry (Fig 2). Also, as shown in Figure 4 virtually all the respondents have tertiary education.

![NATURE OF ORGANISATION](image)

*Figure 1: Respondents’ nature of organisation*
Fig 2: Respondents’ Years of construction experience
Figure 3: Respondent's professional background
3.3 Reliability of data

The reliability statistics to validate the data shows a Cronbach's Alpha result of 0.855. This indicates a data reliability of 86%. The data generated from the questionnaire survey were assessed using relative importance method to determine the relative influence index of the various factors causing delay/time overrun. The relative influence index (RII) for each factor (Table 2) was calculated using the following formula:

$$RII = \frac{\sum W}{A \times N}$$

Where W is the weighting given to each factor by the respondents (ranging from 1-5). A is the highest weight (5 in this case), and N is the total number of respondents. The RII value range from 0 to 1 and were used to rank the factors. The higher the value of RII, the more influential is the delay/time overrun factor. As the respondents were divided into three groups (clients, consultants and contractors), three group indices and an overall mean were generated and tested for correlation.
3.3 Discussion of findings

Table 2 is the descriptive statistics showing the mean/ranking of the 20 delay/time overrun factors assessed based on three groups of respondents identified in Lagos, Nigeria. While the mean item scores show a high level of agreement between the three groups in the ranking of delay/time overrun factors, statistical test to confirm whether the agreements are significant is required. Consequently, the Pearson product moment correlation statistics of the mean scores was significant at 1% with value of 0.588, 0.671 and 0.510 for client and consultants, client and contractor and consultants and contractors respectively. This implies that there is a significant agreement among the three respondent groups (clients, consultants, contractors) in the ranking of delay/time overrun factors.

This study classifies delay causing factors into four groups:

Client related factors: Design change, client’s progress payment delay, and client slow decisions,

Contractor related factors: Contractor financing problems, and shortage of materials,

Legal related factors: Legal dispute,

Government related factors: Bureaucracy in government agencies.

Table 2: Delay/Time overruns factors

<table>
<thead>
<tr>
<th>S/N</th>
<th>Delay factors</th>
<th>Clients</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RII</td>
<td>Rank</td>
<td>Mean</td>
<td>Rank</td>
<td>RII</td>
<td>Rank</td>
<td>Mean</td>
</tr>
<tr>
<td>1</td>
<td>Client financial problems during construction</td>
<td>0.96</td>
<td>1</td>
<td>0.96</td>
<td>1</td>
<td>0.97</td>
<td>1</td>
<td>0.96</td>
</tr>
<tr>
<td>2</td>
<td>Delay in contractors progress payment by client</td>
<td>0.95</td>
<td>2</td>
<td>0.91</td>
<td>2</td>
<td>0.88</td>
<td>3</td>
<td>0.91</td>
</tr>
<tr>
<td>3</td>
<td>Contractor financing problems</td>
<td>0.95</td>
<td>2</td>
<td>0.88</td>
<td>3</td>
<td>0.82</td>
<td>6</td>
<td>0.88</td>
</tr>
<tr>
<td>4</td>
<td>Shortage of materials</td>
<td>0.82</td>
<td>4</td>
<td>0.86</td>
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<td>0.63</td>
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a) **Contractor related factors:** Shortage of materials, shortage of craftsmen, shortage of construction equipment, cash problem during construction, lack of personnel training and management support, bad site organization, conflict between contractor and consultants, slow delivery of materials to site, contractor's financing problems and storage problems.

b) **Consultant related factors:** Design error and inadequate supervision.

c) **External factors:** Social and cultural factors, geological problems, rain, legal disputes, bureaucracy in government agencies, civil commotion, strikes, and lockout.

Out of the twenty (20) factors assessed, the three (3) most critical factors causing delay/time overrun in building projects in Nigeria are finance and cash flow based: Client financial problems during construction, Delay in contractors progress payment by client and Contractor financing problems (Table 2). These clearly indicate the importance of finance on timely delivery of building product. The cash flow issues attested the close relationship of finance and delivery time as emphasised by Ogunsemi and Aje, (2005); and Oyewobi, et al. (2011). This fact makes it imperative for the construction participants, (clients, consultant and Contractors), to examine the cost implication of the project, financial capability of the contractors, and financial disbursement modalities critically before the project commences. The delay in payment casual-effect on timely delivery of project in Nigeria is similar to that of Ghana as identified by Sambasivan and Soon (2006), and the Malaysia instances as emphasised by Siddharth, (2010). Most contractors will discontinue work (delay) until interim payment is paid by the client. Contracts financial problems are an issue in Nigeria construction industry as affirm in this study. Many contractors utilize credit facilities to finance contract work: working capital and meeting daily cash requirements. This is because contractors do transfer construction risks by borrowing from financial institutions.

Another critical factor in the Nigeria building industry is shortage of materials on site. This shortage of materials normally occurs due to either by poor procurement system or funding. A significant number of construction materials are sourced locally in Nigeria, while few are imported. Thus, procurement system to be adopted for a project requires critical examination, before the project commences, as affirmed by Sambasivan and Soon (2006), and Siddharth, (2010).

Client’s instigated design changes are common occurrence in building projects. It results in delay and time overrun. Several architects’ are after...
aesthetics and produces complex designs with constructability challenges, which often causes delay and time overrun in projects. Also, client’s construction inexperience often affects project timely delivery due to modifications and alterations of design concept, typically, during construction stage.

5. CONCLUSION AND RECOMMENDATION

This study confirmed that the factors causing delay/time overrun are many and vary from a project to another and a country to the other. However, the critical factors in Nigeria construction industry, as identified in this study are project finances: cash problems during construction, delay in contractors’ progress payment by client, contractors financing problems, and shortage of materials. Thus, consideration should be given to clients and contractors’ financial standing before project execution. Also, there is need for clients to respond timely to interim certificate payments to the contractor to avoid unnecessary construction delay. It is noteworthy that, the selection of the appropriate contractor in respect of finances and financial commitment of construction client will considerably reduce the incidence of delay and time overrun in building projects. This paper affirms the existence of the long-established casual-effect of time overrun in construction industry and in particular Nigeria, and presents the modalities of avoiding the perpetual predicament.

Based on the critical factors ascertained in this paper, and if the propositions are adequately addressed, project delay/time overrun in building projects in Nigeria will be minimal; consequently, will enhance the industry image and client’s satisfaction.

REFERENCES


Energy efficient retrofitting of existing buildings: Costs and Stakeholder misconceptions – A Literature review

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ABSTRACT AND KEYWORDS

Purpose of this paper:
To review current literature on the cost of sustainable retrofitting in the South African Building Industry regarding misconceptions amongst stakeholders with regard to the cost of energy efficient retrofitting; the circle of blame; cost of energy efficient versus conventional retrofitting; the Government's role in development frameworks and incentives as well as findings and recommendations made.

Design/methodology/approach:
A thorough review of approximately 56 prominent sources including journal articles, books, conference papers and internet articles was evaluated over a period of 10 months on the subject.

Problem Statement:
“To evaluate and describe the presumed misconception amongst stakeholders regarding the cost of energy retrofitting of existing buildings”.

Practical Relevance:
The built environment's large carbon footprint requires existing buildings to be part of future green strategies. Stakeholders' misconceptions on cost of energy retrofitting may hamper progress and should be addressed.

Findings:
The review revealed that lack of information resulted in misconceptions on cost of energy retrofitting. The “Circle of blame” is strengthening such misconceptions. Energy retrofitting is costlier than conventional but acceptable returns on investment are often possible. Lack of Government prescriptions, funding and incentives do not stimulate energy retrofitting. Obstacles in pursuing sustainability aims was highlighted and described within the review.
Research limitations/implications:
Empirical studies should evaluate and describedevelopments and trends in the South African building industry, international energy retrofitting trends should be considered and government institutions should be included in the discussion.

What is original/value of paper:
Acknowledgment and understanding obstacles precludes their effective addressing. Current stock of buildings must be included in sustainability strategies. Findings to be valuable to property professionals, developers, owners and legislators

Keywords: Circle of blame, Cost of sustainability, Energy retrofitting, Misconceptions,South Africa.

1 INTRODUCTION

Research indicates that up to 33% of global energy consumption and 15% of global greenhouse gas (GHG) emissions may be linked to buildings. In cities, buildings can account for up to 80% of CO2 emissions according to the Climate Initiative 2006. The built environment is therefore a critical part of the climate change problem – and solution. Most existing buildings were not designed for energy efficiency, but retrofitting with effective products, technologies and systems can result in significantly energy savings (Wafula&Talukhaba, 2010).

Most developed countries and many developing countries have already taken steps towards reducing building sector (GHG) emissions, often with limited impact on actual emission levels. A number of barriers reflecting the nature of the industry may be at the cause of this.

Many small reduction opportunities are typically spread across large numbers of buildings, different stakeholders are involved at various stages in a building's life and have different economic interests in valuating investments in energy efficiency measures. Stakeholders include all parties involved in the design, construction, owning and occupation of the building. Energy efficiency investments are perceived as costly and risky while practical knowledge about implementing energy efficiency measures still persists (UNEP, 2009).

This study evaluated stakeholders presumed misconceptions regarding the high cost of energy retrofitting of existing buildings, investigated thereal benefits of energy retrofitting and indicated how risks involved in energy retrofitting may be managed (Durmus-PedinìandAshuri, 2010).

This is due to the fact that decision makers have few resources to value a retrofit, especially since retrofit returns depend on local factors such as incentives by governments or other organisations and electricity costs. The
lack of commercial retrofit data is further intensified by the proprietary nature of commercial building contracts, such as lease structures and retrofit finance methods. (Benson, et al, 2011, pg.42)

2. LACK OF INFORMATION REGARDING ENERGY RETROFITTING

Detailed information regarding the energy use per building type, climatic zone and the age of building is often difficult to obtain in South Africa, as is the case in most other countries. Some information is available as to overall energy usage (Milford, 2009).

The optimal energy retrofitting option for an existing building requires that the energy efficiency of a building must be analysed. Stakeholders investing in energy retrofitting will require a return on their investment by savings realised on energy cost. A record of the building’s electrical usage is therefore an important factor. Unfortunately records on energy usage are not readily available. Records for government buildings are seldom kept while availability of commercial retrofit data is restricted by the proprietary natures of commercial building contracts with non-disclosure clauses (Benson, et al, 2011).

The lack of records and information makes it difficult to analyse the building’s energy usage and consultants have to find other methods to determine the energy efficiency of a building before advising on retrofit takes place. This process often increases the cost of the energy retrofit.

For stakeholders to decide if energy retrofitting is feasible, they need informative data to indicate what types of energy retrofitting technologies to apply, the cost thereof, the period of return on their investment and if efficient energy saving levels can be reached with the chosen retrofitting option. Benson et al. (2011) concludes that without clear expected gains, building owners are reluctant to commit themselves to investments that have payback periods of fifteen to twenty years. Unresolved uncertainties and risks for stakeholders will often result in reluctant to invest.

The South African green building market is comparatively immature lacking broad empirical studies on the capital cost impact of local green building. However some local studies indicated that the South African property industry can expect cost premiums of a new commercial green building to be between 1% and 10% (SA Commercial property, 2012). In ‘Rands and Sense of Green Building’ Nicola Milne explained that while there seems to be consensus on the environmental benefits of green buildings, there is still a lack of accurate and thorough financial and economic supporting information. (SA Commercial property, 2012).

It is not only lack of useful information that has created a misconception amongst stakeholders, but also the fact that most home and business owners are unaware of the inefficiency of their current building...
stock. They are also unenlightened on which energy efficiency measures will provide them with the biggest return of their investment (Delhagen, et al, 2009).

3 THE ROLE OF THE ‘CIRCLE OF BLAME’

Knowledge about sustainable construction and technology are readily available and the economic benefits of sustainable design and construction are well-documented. However investment in energy retrofitting often suffers due to the misalignment of incentives between building developers, investors and occupants/tenants known as the ‘vicious circle of blame’ (Hartenberger, 2008).

The concept of the “vicious circle of blame” was introduced by David Cadman in 2000, who suggested that investors, occupants, contractors and developers all blame each other sequentially for their own lack of commitment to adopt healthier and/or more resource-efficient real estate practices (Robinson, 2012).

The circle of blame plays a big role in stakeholder misconception to support lack of commitment to more energy efficient real estate practices. Investors will typically only energy retrofit existing buildings once there exists a demand for it that will ensure an acceptable rate of return on investment. Developers and owners have the perception that the market does not value the extra cost and risk associated with the retrofitting of existing building stock. However studies have shown preparedness by occupiers to pay a premium for such buildings (Warren, 2009).

Developers’ financial dilemma has always been one of risk and return. Research however has pointed out that energy retrofitting of existing building stock may reduce investors’ risk. Demand and increasing awareness of climate change will more readily attract and retain tenants for sustainable buildings and thus reduce the development risk (Warren, 2009).

What would probably assist the sustainability movement is substantial evidence linking property value and sustainability, in terms of higher rentals, attracting tenants and reducing costs. (RICS 2008, Accessed: 03 August 2012). Ellison & Sayce (2007) also identified the cause of the circle of blame and the lack of clear financial benefit to sustainable development to be the absence of solid market comparable evidence to support any increase in value.

Breaking the circle of blame in practice was the focus of the RICS conference held in Brussels during the Second EU Sustainable Energy week in 2008 (Hartenberger, 2008). Conclusions resulting from the deliberations at the conference included the emissions reduction potential of renovating exiting building stock whilst creating more jobs and improving occupier satisfaction. Building design needs to support building performance assessment while valuation methods have to allow for
sustainable development options. Stakeholders should strive towards more trans-disciplinary understanding of sustainable development goals. Focussing on mutual stakeholder benefits rather than pushing for their own agendas will assist in breaking down the circle of blame (Yang & Yang, 2009).

Despite the fact that adaptability of existing building stock is considered to be a desirable design characteristic by many in the construction and property industry, Pinder et al, (2011) noted that it has yet to be common practice in South Africa for buildings to be designed with adaptability in mind.

Pinder et al (2011) then concluded that adaptability would become the norm once there is an alignment in the interest of different stakeholder groups. Developers will procure more adaptable buildings because they attract higher prices from investors, who in turn find that they are more attractive to tenants and end-users due to the fact that they are easily adaptable.

This above relationship circle may be further strengthened by other influences. Property valuers should take into account the benefits of adaptability when appraising a property. Industry organisations should encourage their members to think adaptability when procuring, designing or constructing buildings. Developers should be encouraged by planners to develop more adaptable buildings while banks should consider more favourable rates when lending to investors and occupiers because adaptable buildings are seen as less risky (Pinder et al, 2011).

4. THE COST OF ENERGY RETROFITTING

The energy infrastructure of a building is seldom upgraded after the initial construction thereof, although benefits of retrofits such as increased property values, reduced electricity costs, and rent premiums are financially appealing to both property owners and tenants. Direct financial benefits were identified as the primary motivations to energy retrofit a building (Benson et al, 2011).

Despite above mentioned benefits, the perceived high up-front costs often cause stakeholders not to consider energy efficient upgrades (Langdon & Morris, 2007). It may therefore be expected that profit driven investment goals would dictate retrofit decisions: the popular energy retrofits would have low payback periods, low risk and the high return on investments (Benson, et al, 2011).

The extent of capital investment necessary to retrofit buildings at the scale and depth necessary to meet climate requirements, and to achieve potential benefits to the economy, are massive. The cost can however be recovered by reliable and sustainable savings generated from
energy efficiency retrofit over a period of time aligned with the period of benefits (Delhagen, et al, 2009).

Funding is another barrier to energy retrofitting. If a building owner or tenant wants to install energy efficient methods finding funding to do it is not a simple process. Most of the lenders do not have the knowledge to perform an audit needed to develop reasonable rates or contract terms (Brown et al, 2012).

Delhagen et al (2009) named initial cost as one of the most important barriers to investing in energy efficiency in existing buildings. When a stakeholder is interested in making cost-effective energy improvements, suitable financing and incentives can make the investment possible and affordable. Conventional loan programs are not by themselves capable to meet this need and usually require additional funding resources.

Brown et al. (2012) concluded that lack of available capital for retrofit investments and the inability to meet financial payback criteria is cited by building owners as the largest barriers to retrofitting. Approximately 30% of the annual average discretionary spending will be absorbed by the ‘typical’ retrofit. Government and utilities’ rebate programs often require building owners to provide the initial capital investment and undertake the retrofit before applying for rebates. Additionally, rebates may be subject to realised energy efficiency savings.

Capital investments with undesirable payback period of 3 – 5 years affect future years’ budget expenditures is unlikely to be accepted unless the building owner plans to own the building long-term (Brown et al, 2012).

The split incentive problems is one of the key issue that is preventing commercial properties from undergoing energy efficiency retrofits. The incentive issue indeed originates from the terms agreed upon by the lessor and lessee in the lease agreement. The split-incentive problem arises in a net lease, when the landlord is uninterested to minimise utility costs that are otherwise paid for by the tenant and the tenant’s inability to control the overall energy consumption (Benson et al, 2011).

Existing retrofit programs that have the highest levels of both participation and savings have administration, technical assistance, market development, customer service, and financial incentives cost that are close to half of total program costs which are provided by utilities of the government. Programs that try to pay for all expenditures out of savings have very limited application and impact. (Delhagen, et al, 2009, pg.34).

No matter how convincing the case that savings from retrofits will pay for themselves over time, experience has shown that first cost investments barriers are deep, inescapable, and difficult to overcome. To varying degrees building owners tend to have implicitly high discount rates (short planning and investment horizons); owners tend to be cynical of savings projections; allocate a high cost to the “hassle” factor of getting involved with a retrofit project, and, in the case of rental or leased
properties, may be in a “split incentive” situation, in which the party incurring the cost might not receive the benefits thereof (Delhagen, et al, 2009).

Delhagen et al (2009) also suggest that paying for retrofits at the scale required in the future will involve different funding mechanisms for different types of retrofit projects in different markets (residential single-detached homes, multi-family, small business, large commercial, industrial). Combinations of: (a) incentives that buy down the initial cost of qualifying retrofits, and (b) building owner investment, either as cash or financed over terms acceptable for the investment to yield a net positive cash flow be needed.

In South Africa research gaps exist such as the lack of costs estimation data for energy-efficiency retrofits. Financial specialists in organisations do not see energy efficiency retrofits as investments, but rather as facility expenses measured on straight line depreciation scale just like building consumables; hence there is no efficient market guidance for energy-efficient retrofits for buildings in the industry. This is one of the main causes of low sensitivity for energy-efficiency retrofit issues in the maintenance of buildings (Wafula&Talukhaba, 2010).

5. GOVERNMENT FRAMEWORK AND INCENTIVES

In South Africa, energy efficiency policies are implemented throughout various government agencies and departments such as the Department of Minerals and Energy, Department of Public Works, Department of Transport, ESKOM and NERCSA. The challenge is often in the implementation of policy details (Wafula&Talukhaba, 2010).

Local Authorities are the focal point for the implementation of various regulations, standards and codes for energy efficiency in buildings set by the National and Provincial Governments. Local Authorities have a significant impact on property investment and provide a necessary and practical addition to National Government’s efforts. Local Authorities are also mandated by statute to ensure that all construction activities under their jurisdiction can only proceed upon approval by Building Control and Approval Departments (Wafula&Talukhaba, 2010).

The different mechanisms that increase building efficiency include retro-commissioning, building technology replacement and energy performance contracting. Local Authorities can advance these energy efficient goals by including them as best practice guidelines as well as to share and adopt them on municipal infrastructure (Wafula&Talukhaba, 2010).

Urge-Vorsatz et al.(2006) reported that the largest savings in gross electricity demand can be delivered by applying electricity efficiency
measures such as efficient lighting, ventilation and cooling. In the case of building retrofits this account for up to a third of total savings.

The Energy Efficiency Strategy developed by the Republic of South Africa (1995) proposed retrofitting of buildings as a cost intervention with short payback periods, that is relatively low in cost and can be carried out quickly. This strategy proposes the following to make existing buildings more energy efficient:

1. Compulsory standards and audits for energy efficiency in HVAC, lighting and non-electric appliances;
2. Energy management systems for retrofits in the building industry. (Wafula&Talukhaba, 2010).

The introduction of energy efficiency bylaws by Local Authorities could be used to effect regulations for energy retrofits in these areas. It is however, important to note that South Africa's National Building Regulations and Building Standards Act (Act no. 103 of 1977) does not mention anything with regard to energy efficient retrofits. This fact makes it necessary for Local Authorities to legislate bylaws particular to energy efficiency retrofits to guarantee controlled implementation and regulation to derive maximum benefits. (Wafula&Talukhaba, 2010).

Increasing energy prices will continue to be a catalytic driver for improved energy efficiency policies in developing countries. Eskom, the main electricity utility company in South Africa has raised tariffs by nearly 32% over and currently proposing another 16% increase per year for the next 5 years (Engineering news 2012).

Wafula&Talukhaba (2010) reminded that South Africa is at the end of a cheap energy era. The result of this is that retrofits may be a large contributor of construction work in short to medium term. Therefore it is strategic and necessary for South Africa to take advantage of this and use the Local Authorities as the enforcing agents for energy efficiency regulations in buildings.

Regulations and involvement by government also play a major role in changing the misconception of adaptability costs in the built environment. South Africa can borrow a leaf from the EU in terms of the mode of policy implementation, by setting a minimum area space for retrofits which must be certified by the local authorities. To further research and studies in energy efficiency retrofitting results from government retrofits should be published and made available as to inform private investors, developers and tenants (Wafula&Talukhaba, 2010).

The success of the Building Regulations is highly dependent on compliance by the construction industry; therefore there is need for Local Authorities to invest in continuous training and encouragement of Building Control Officers and Built Environment Professionals on the energy efficiency regulations and the application thereof. (Wafula&Talukhaba, 2010).
6. CONCLUSION

This review concluded that the misconception by stakeholders that retrofitting cost are high can be contributed to the fact that there is lack of empirical studies on the capital cost impacts of energy retrofitting. This in turn has an effect on the demand of adapting existing buildings to be energy efficient, due to lack of information available for stakeholders to base their decisions on; the risk is considered too high for them to make decisions on investments where they are unsure of the expected return of the payback period.

The review indicated widespread acknowledgement about the ‘circle of blame’ and the negative effects thereof on energy retrofitting. Low stakeholder demand results due to the fact that developers are only interested in energy retrofitting once there are investors to invest in these projects. However, investors would only invest once there is a demand for energy retrofitting buildings amongst occupiers, which would only demand energy retrofitted buildings once they are available.

Government incentives and implementation of energy efficiency regulations in buildings would increase the amount of concrete information on energy retrofitting and energy efficiency retrofits available, as well as help change the ‘viscous circle of blame’ into the ‘virtuous circle’ which in turn would create an upswing in the demand and supply of energy retrofitted buildings. Government incentives would also encourage the voluntary energy retrofitting of existing buildings before implementation of regulations as the initial costs of energy retrofitting can be high depending on the mechanism used.

By creating an awareness amongst stakeholders of the benefits of energy retrofitting as well as the different mechanisms and technologies that can be used to energy retrofit an existing building as well as the cost thereof and that there are methods that can be implemented that are cost effective with short payback periods. The misconception amongst stakeholders regarding the high cost of adapting their existing buildings to be more energy efficient can be overcome.

The above factors have an influence on the conception and decisions of stakeholders and through the testing of the hypothesis in above sections it became clear that these factors create a misconception amongst stakeholders regarding the cost of energy retrofitting, thus resulting in few energy retrofitting projects being undertaken.
7. RECOMMENDATIONS

The key to implementing successful energy efficiency retrofit regulations is through an appropriate education and outreach programme to raise awareness of the building regulations and control mechanism, in the local authorities. This programme should target developers to making them aware of the economic/financial benefits of energy efficient buildings, and demonstrate the technical options for retrofitting of existing buildings to the technical professionals in the industry. This would in turn help overcome the misconception amongst stakeholders of the high cost involved in energy retrofitting of existing building stock (Wafula&Talukhaba, 2010).

It is recommended that the efficiency and cost effectiveness of available technologies and design approaches be researched to provide stakeholders with proven facts on retrofitting of buildings. Stakeholders in the industry should be approached for information on demand and supply on retrofitting and the willingness of property owners to adapt their buildings. The similarities and the differences of perceptions among industry stakeholders towards sustainable development and retrofitting require more research.

Government incentives and policies and the implementation thereof as well as financial aspects such as green lease options should also be studied.

Research on resilience of towns and cities to make them more adaptable to changing environmental conditions is suggested.

8. REFERENCES


ABSTRACT

Some residential homes in the Cape Peninsula, built on windblown (Aeolian) sand, have suffered structural failure to varying degrees. Severe consolidation settlement has been blamed for the damage. To assess the strength parameters and other influential properties of the sand, a suitable instrument must be calibrated and used in a controlled environment, as results for consolidation settlement can differ vastly. The instrument chosen must also be able to predict unfavourable internal stress conditions.

To solve the problem of varying results, two in-situ testing instruments were chosen that have been used before to predict settlement. Samples were collected from a construction site where settlement problems have been known to exist. Dynamic Cone Penetrometer (DCP) tests were done in the bottom of exposed trial holes and sand samples were removed and exported to the calibration chamber, built at the Cape Peninsula University of Technology in Cape Town. Flat Plate Dilatometer (DMT) test results under controlled conditions were then compared to the results obtained by the DCP.

Pilot study findings have determined that these sands (in their natural in-situ density and level of contamination) pose a risk to dwellings if the
necessary precautions are ignored. Consolidation settlement will occur if low levels of in-situ lateral stresses are present and when relative densities, \(D_R\), drop below 60%.

**Keywords**

Settlement, Aeolian sand, Flat Plate Dilatometer, dynamic cone penetrometer, horizontal stress, liquefaction

**1 PURPOSE**

The ground upon which buildings rest can become the greatest source of risk to their owners. Past investigations (especially in the UK) have uncovered that very little attention is being paid to the geotechnical problems that may lie hidden below the foundations (Egan, 2008). In his findings he states that site information generally was very poor resulting in unnecessary risk to the client, preventing optimisation of the founding solutions.

The geotechnical information provided from a building site must be useful and trustworthy. The classification of the site is important. Potential problems can arise when either the exploratory methods are suspect or results are inconsistent or non trustworthy. A client may face a financial constraint when an unnecessary and expensive foundation solution is proposed. When predicting settlement in, say soft windblown sands, the results may differ vastly. A recent case history between two popular in-situ instruments revealed a difference of about 10% between the predicted vs. the observed settlements using the DMT and as much as 45% with the SPT (Monaco et al, 2006). The research question was: “Can the DMT perform as well against our locally developed DCP”? This paper presents some of the findings after a pilot study was completed using in-situ instruments suitable for the geotechnical analysis of soils. Its aim was to assess local sandy soils and compare the results of predicted settlement only. The instruments of choice were the DMT (see Figure 2.1a) and the DCP.

**2 DESIGN and METHODOLOGY**

Windblown (Aeolian sand) was tested along the popular West Coast region of the Atlantic Beach Golf Estate and the local dunes between Big Bay and the sea side town of Melkbos Strand. DCP tests were done on site. Samples were removed for further laboratory testing inside a purpose made calibration chamber.
The DMT device is a tool used to assess the lateral stresses that are built-up below ground and is useful in deep layered soil with varying degrees of lateral stresses. Also known as “The Marchetti Dilatometer”, after its original designer, Dr S. Marchetti, the DMT is an in-situ testing device, the results of which have been interpreted chiefly through empirical correlations based on the results of field tests.

The DMT device is easy to operate and its application on site is versatile and robust. Figure 2.1b illustrates the DMT operation. The DMT is constructed to yield a stainless steel blade that has a flat, custom fitted circular membrane mounted level on one side. The blade incorporates an inflatable steel membrane. Inflation occurs via nitrogen gas and controls movement up to 1.1 mm. Hydraulic mechanisms are used to drive the DMT blade below the surface and can reach depths beyond 80m if needed.

A stainless steel calibration chamber was designed and built at the Cape Peninsula University of Technology. Sand samples were placed inside the calibration chamber that facilitates easy densification and probe testing. The DMT was used to hydraulically penetrate the layers of sand to incremental depths (up to 800mm). The calibration chamber was partly...
based upon a Dutch designed chamber built at the TU Delft University in Holland (Broere, 2001). The basic construction used at CPUT is shown below in

![Figure 2.2 CPUT Calibration chamber for probe testing](image)

.2a.
The CPUT calibration chamber is a 900mm diameter rigid stainless steel wall calibration chamber which incorporates water inlet and outlets. (Figure 2.2a,b).

The chamber rests upon three air spring-mount actuators (Figure 2.2c). Isolators are used to support and isolate external vibrations and support a vibrating load to prevent its energy from disturbing the surroundings. The actuators allow the chamber to absorb vibration from the two side mounted rotary vibrations and provide stability below. ( 
Figure 2.2 CPUT Calibration chamber for probe testing.

The DMT application formula for calculating settlement in sand is shown below in Equation 2.1. The settlement, \( S_{DMT} \), deduced by Marchetti (1980: 1997) is calculated as follows:

\[
S_{DMT} (\text{mm}) = \sum \frac{\Delta \sigma_v}{M_{DMT}} \Delta Z
\]  

(2.1)

Where \( \Delta \sigma_v \) = change in vertical stress, and is based on Boussinesq’s method for the calculation of stress at the centre of each layer; \( M_{DMT} \) = (constrained modulus) and estimated by the DMT’s interpretive data (the Oedometer modulus is assumed here as an equivalent to the \( M_{DMT} \)) and \( \Delta Z \) = depth below surface. An Oedometer is a laboratory apparatus used to monitor consolidation settlement.
Initial comparative results indicate that the DCP is an instrument that can provide reliable results in these sands for bearing capacity, settlement prediction and stiffness. Correlation formulae using the $D_N$ number of the DCP (mm/blow) were useful in the trial research and geotechnical engineers should be able to feel confident in their prediction of settlement and the classification of the site.

The study was limited to testing fine sand found along the coast of the Western Cape. Tests done in the calibration chamber with the DMT device will be affected by a phenomenon known as “boundary effect”. This is acknowledged but was ignored due to the chamber design (no instrumentation was in place to measure the boundary effect). Nitrogen gas flowing through system was assumed to be constant and that no moisture effect (condensation) has taken place. The sand in the chamber was neither assumed to be consistently dense at all depth intervals, whether it be vibrated or not, under saturation or in a semi-dry state. Further limitations are that the DMT can only predict soil texture that ranges from sand, silt to clay. Coarser soils (gravels) are not assessed. Yet local experience has shown that it is the former that present the most awkward conditions to work in.

3 FINDINGS

3.1 Experimental results

The study established that the DMT is very sensitive to horizontal stress changes, even at small intervals of 100mm depth variation. Practitioners will appreciate this and should be able to predict soil texture accurately. Recent inspection of trial holes in the area of West Beach, Blouberg and the Atlantic Beach Estate revealed a low bearing capacity within the upper drift zone of 1.3 m. Soil bearing capacity values of 45kPa (inside the Atlantic Beach Golf Estate) are not uncommon and were determined with the DCP. Low bearing capacity can be expected in the drift zone because of the varying densities associated with the contamination therein, including spongy organic matter.

Trial holes revealed darker contaminated decaying organic matter that can be expected in the Atlantic Beach Golf Estate. On closer inspection it becomes clear that much of the contamination is charcoaled debris, most likely blown about by the prevailing winds after seasonal fires that occur regularly in the summer months, the fires being fed by the surrounding fynbos and Port Jackson brush. Figure 3.1 below was provided as an example by the NHBRC of homes in West Beach, Blaauwberg, suspected of succumbing to massive amounts of settlement in Aeolian sand.
Consolidation settlement in conditions such as that shown can leave the structure in serious trouble, with cracks appearing in some cases within 2 years after the final build. Similar cracks were identified in homes where contamination was uncovered below foundations, which behaves like a sponge, absorbing water in the wet season and drying out in summer months.

The correlation of the predicted settlement between the DCP and DMT in the chamber was encouraging. The DCP in this case can only provide an indication of soft lenses with low in-situ density, whereas the DMT can determine if the horizontal stress is dangerously low which can be related to the type of soil. This warns the practitioner to take precautionary measures before designing the foundations.

![Figure 3.1 Structural damage due to settlement (NHBRC, 2003)](image)

Table 3.1 below records data from the chamber before and after the vibration of the sands studied.

**Table 3.1. DMT vs DCP for settlement in the CPUT chamber (Neal, 2011)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>West Coast (Big Bay)</th>
<th>Philippi Dunes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre vibration</td>
<td>Post vibration</td>
</tr>
<tr>
<td>SPT&lt;sub&gt;N&lt;/sub&gt;—Blows per 305 mm of a standard 63.5 kg hammer drop</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>DCP settlement (mm)</td>
<td>11</td>
<td>7</td>
</tr>
</tbody>
</table>
3.2 Predicting liquefaction

The more important research findings of establishing when liquefaction may occur in the research sands are clearly seen in Error! Reference source not found.. These graphs include our data as well as that of work done by Youd and Idriss (2001) who established, along with other researchers (Monaco et al, 2005), the relationship between $K_D$ (lateral stress) and CSR (cyclic stress resistance). The compaction range of $\%R = 4\%$ and $67\%$ obtained in the CPUT chamber reveal that hazards may exist for structures with shallow foundations. Both sands researched fall in the zone of liquefiable sands with high fines content. The DMT revealed low in-situ horizontal stresses, ie $K_D < 4.2$ (values below 4.4 are not desirable). The research data, as shown in Figure 3.2 and 3.3 below, places these sands within the liquefiable zone.

![Figure 3.2 DMT- $K_D$ vs CSR values for research dune sands (Neal, 2011)](image)

<table>
<thead>
<tr>
<th>DMT settlement (mm)</th>
<th>14</th>
<th>4</th>
<th>22</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable bearing capacity, $Q_u$ (kPa)</td>
<td>328</td>
<td>400</td>
<td>192</td>
<td>220</td>
</tr>
<tr>
<td>DMT horizontal stress, $K_D$</td>
<td>2.7</td>
<td>3.9</td>
<td>0.8</td>
<td>1.1</td>
</tr>
</tbody>
</table>
4 PRACTICAL IMPLICATIONS

One of the requirements stipulated by authorities before any new construction can be considered is the classification of the site (as far as the ground conditions are concerned). Problematic soils need to be identified, classified and founding solutions suggested for the type of building under scrutiny. There are many methods available to practitioners to classify a site and results may vary, causing confusion.

Although the DMT is expensive its ability to rapidly predict soil conditions deep below the surface is invaluable. The cheaper DCP too can assist the soils engineer in predicting settlement and bearing capacity to acceptable accuracy. The high sensitivity of the DMT in monitoring densification has been demonstrated through several studies. Schmertmann, 1986 and Jendeby, 1992 found the DMT to be twice as sensitive as the CPT (Cone Penetration Test) to densification. The DMT can sense sand liquefiability because of its ability to measure the sudden...
changes in horizontal stress with depth (Schmertmann, 2006). Softer stratum will clearly indicate that the densification of the sands has dropped dramatically and should be investigated. The DMT sensitivity can sense the increase and the reduction of soil pressures and thereby both the positive and the negative range in pressures can be assessed.

The significance of the study is to aid geotechnical investigators in their search for trustworthy data resulting from test work in windblown sand that simulates on-site conditions for shallow foundations. The research will aid construction work in similar Aeolian sand in identifying potentially poor subsoil conditions and steps to avoid possible uncontrolled settlement. No significant literature on the usefulness of the DMT device is currently available in South Africa. Table 3.1 represents the comparative data of two study sands.

A test methodology into how windblown sand behaves under poor site conditions is required, which should include liquefiable conditions. The important aspect of this work is to provide more useful information to the geotechnical database by using a relatively unknown device such as the DMT. This will allow geotechnical engineers to correlate data with other standard test apparatus such as the Standard Penetration Test (SPT) and DCP.

Although the latter apparatus has its own role to play in predicting soil conditions below ground, the DMT device may produce more conclusive results that can highlight a possible problem much sooner than other in-situ tests; for example predicting the pre-stress history of the soils and layer based settlement. This, and along with other important criteria is required to assess possible liquefiable conditions.

The data will be useful to geotechnical engineers who need more information regarding the possibility of collapsible windblown sand. This will lead to better designed foundations and more solid superstructures, thereby limiting the amount of possible cracking and structural failure.

5 REFERENCES

NHBRC. 2003. Courtesy of the NHBRC. Archive data base. Bellville Head Office

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ABSTRACT

Purpose
Managing H&S helps ensure that construction organizations are achieving their H&S objectives. However, the challenge is to determine what needs to be practiced by small and medium construction enterprises (SMEs) at project level. The objective of this paper is to validate the H&S practices that SMEs practice to improve H&S performance at project level.

Research methodology
A mixed method was used to conduct this research. Delphi survey was conducted. After four rounds of Delphi survey using 20 H&S experts a structured questionnaire consisting of five H&S factors and 31 practices was developed. These factors and practices were validated using 216 valid SMEs responses. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.

Findings
Upper management commitment and involvement in H&S, employee involvement and empowerment in H&S, project H&S planning and communication, project supervision and H&S resources and training measured with the 31 practices were uni-dimensional and were retained as H&S practices for SMEs at project level.
Limitations
The use of self-administered questionnaire for SMEs and majority of respondents were from Gauteng province were limitations in this study.

Practical implication
This research study provides the basis of conducting confirmatory factor analysis and structural equation modeling to develop H&S performance improvement model for SMEs at project level.

Value
The findings indicate preliminary evidence for factor validity of the H&S factors that should constitute the H&S performance improvement model for SMEs at project level.

Keywords: Elements, Organizations, Validation

1 INTRODUCTION

Health and safety management refers to the tangible practices, responsibility and performance related to H&S that includes the association between H&S management, climate and culture. Health and safety climate is perceived to be the precise indicator of overall H&S culture while H&S management practices reflect the H&S culture of upper management. Consequently, good H&S management practices are reflected in the enhanced H&S climate of all employees (Mearns et al., 2003). According to Azimah et al. (2009) H&S management will not only resolve H&S challenges but also enhance overall legal compliance. However, legislation by itself is inadequate to address the problems of managing construction workplace H&S (Azimah et al., 2009; Haupt, 2001). Unfortunately there is no consensus of what H&S factors and their practices (measuring indicators) should include that are vital and therefore able to improve H&S performance and reflect the H&S culture of construction SMEs at project level in South Africa.

1.1 Measurement of Construction H&S Performance

Health and safety performance measurement permits the comparison of H&S performance between projects and can be used internally to maintain line accountability for H&S and to pin point problem areas. Health and safety performance measurement can be broadly classified in terms of two
types of indicators, namely lagging indicators and leading indicators or positive performance indicators (PPIs) (Flin, et al., 2000). These are for example project supervision, project H&S planning and employee involvement in H&S. Leading indicators can either be subjective or objective indicators (Grabowski, et al., 2007). Unfortunately the construction industry continues to rely heavily on traditional lagging indicators such as accident and workers compensation statistics (Mohamed, 2002).

When using leading indicators thorough and constant surveillance is required than when using lagging indicators (Hinze, 2005). The real value of using leading H&S indicators on construction projects is that changes can be made and interventions introduced early to address the weakness before there is an accident. The use of leading indicators instead of lagging indicators is increasingly advocated in construction industry.

1.2 Challenges Facing Small and Medium Construction Enterprises

The South African SME sector is described as largely underdeveloped and lacking the managerial and technical skills and sophistication enjoyed by larger well established contractors (Department of Public Works (DPW), 1999). Small and medium construction enterprises are left on the periphery of the mainstream economy and do not participate fully in the economies of developing countries which are dominated by large contractors (Dlungwana and Rwelamila, 2003). Conditions that have to be contended with include lack of resources for training contractors, poor procurement systems, lack of management capacity and lack of available resources to equip managers to operate their businesses effectively. The lack of awareness of what specific H&S legislation was relevant to SMEs is a further challenge (Vickers et al., 2003). These challenges could exacerbate the current state of poor H&S performance of SMEs globally.

1.3 H&S Status of the South African Construction Industry

While recent South African government initiatives to improve safety and quality performance on construction sites have reduced accidents, construction sites continue to be among the most dangerous workplaces in the economy and rework levels remain comparably high (Construction Industry Development Board (CIDB), 2004). About 160 deaths occurred on construction sites in 2007/2008 (CIDB, 2008). The construction industry was ranked third after mining and transportation with 74 deaths recorded on site in 2003 (CIDB, 2004). These statistics are inclusive of SMEs.

The continuing poor H&S performance of the construction industry in the form of fatalities, injuries, and diseases, the number of large-scale
construction accidents, and the general non-participation by key project stakeholders such as clients and designers, provided the catalyst for a new approach to construction H&S in the form of consolidated construction H&S legislation such as the Construction Regulations of 2003. This framework required new multi-stakeholder interventions (Smallwood and Haupt, 2005). However, according to CIDB (2004) there was very limited commitment to complying with basic requirements, let alone promoting a culture of H&S. SME contractors could barely maintain their tools and equipment and regarded H&S interventions as luxury items. Even where protective clothing and equipment were provided, workers often avoided their use.

Improvement of the standard of H&S performance of construction SMEs could inevitably be helped by continuous monitoring and review of their H&S performance.

2 HEALTH AND SAFETY FACTORS

Many studies have indicated the importance of upper management commitment and involvement in H&S to improve performance (Fernandez-Muniz et al., 2007; Aksorn and Hadikusumo, 2008; Teo et al., 2008).

Worker involvement and empowerment in H&S has been identified as important and influential to H&S performance improvement (Fernandez-Muniz et al., 2007). For H&S performance to improve, employees need to be empowered and involved in H&S by, for example, being able to refuse to do dangerous and unsafe work, (Occupational health and safety Act, 1993; Teo et al., 2008; Agumba and Haupt, 2008). Workers should further be involved in developing H&S policy, providing written suggestions on H&S, being kept informed of the provisions of H&S plans, being involved in H&S inspections, being consulted when the H&S plan is compiled, and being involved in the development of H&S rules and safe work procedures (Teo et al., 2008; Agumba et al., 2008).

For SMEs to further improve their H&S performance, upper management and their workers need to adhere to the proper implementation of H&S management system (H&SMS). The system might constitute of a number of factors namely:

- Appointment of H&S staff has been found to be important, to influence H&S performance outcome (Sawacha et al., 1999; Findley et al., 2004). The employment of at least one staff member with H&S training on each project was advocated by Ng et al., (2005).

- Formal and informal written communication in the form of, for example, written circulars or brochures that inform workers about the risks associated with their work and the preventive measures to reduce risk is necessary to improve H&S performance (Health and Safety Executive (HSE), 2008; Sawacha et al., 1999).
Formal and informal verbal (oral) communication is important to improve H&S performance (HSE, 2008; Fernandez-Muniz et al., 2007). Various forms of this type of communication include providing clear verbal instructions to both literate and illiterate employees about H&S, H&S information verbally communicated to workers before changes are made to the way their work activities are executed, organizing regular meetings to verbally inform workers about the risks associated with their work and organizing regular meetings to verbally inform workers about the preventive H&S measures of risky work.

H&S resources are important in improving H&S performance in construction sites (Abudayyeh et al., 2006; Fernandez-Muniz et al., 2007). Project planning of H&S has been found to improve H&S performance and involves procedures to evaluate risks and establish necessary H&S measures to avoid accidents and includes organized planning in case of emergencies (Fernandez-Muniz et al., 2007).

Project supervision is an internal concept that verifies the extent to which goals have been fulfilled, as well as compliance with internal norms or work procedures (Fernandez-Muniz et al., 2007; Aksorn, et al., 2008; Trewthewy, 2003). Training in H&S is fundamental to any organization that is eager to improve H&S performance (Sawacha et al., 1999; Fernandez-Muniz et al., 2007).

H&S policy is necessary it includes proper implementation of H&S management system, written in-house H&S rules and regulations for all workers reflecting management concern for H&S, principles of actions to achieve H&S and objectives to be achieved (Ng et al., 2005; Fernandez-Muniz et al., 2007).

The challenges and the current state of poor H&S in the construction industry in South Africa and lack of comprehensive set of H&S factors that constitute H&S culture in South Africa construction industry, advocates for better measures for monitoring and assessing H&S performance in SMEs projects to reduce occupational accidents, injuries, illnesses and fatalities in their projects. The overarching research question is:

What are the H&S factors and their H&S practices that will be used to monitor H&S performance at project level of SMEs?

3 PROBLEM STATEMENT

Based on the above discussion and gap, so far there has been little research of H&S factors that can be more closely tied to the H&S culture of SMEs at project level in South Africa construction industry. In order to get a better understanding, there is need to identify and validate appropriate H&S factors or leading indicators that will depict the H&S culture of construction...
SMEs, that are perceived, to improve H&S performance by reducing accidents, injuries, fatalities and illnesses.

In order to achieve the stated research question the following specific objective was set:
- To validate the factors of H&S practices using the exploratory factor analysis.

4. RESEARCH METHODOLOGY

A mixed method design was used for this study where the questionnaire was developed from relevant literature and four rounds of Delphi survey with 20 H&S experts who started and eventually 16 H&S experts completed the iterations. The experts established the SME questionnaire administered to upper management personnel of SMEs to establish their H&S practices at their project level. The SMEs were presented with 31 H&S practices addressing five H&S factors. They rated the practices using five point likert-scales indicating their level of agreement.

Other parts of the questionnaire were designed to profile the participants in terms of their: gender, position in the company, level of experience in the construction industry and the number of years in the current organization. Following the questionnaire pre-testing with eight upper management personnel or those who were knowledgeable of H&S practices in their organizations, the final refined version of the SMEs questionnaire was presented to 1,450 conveniently sampled SMEs using email and drop and collect of which 228 questionnaires were returned and 216 were deemed eligible for analysis using Statistical Package for Social Sciences (SPSS) version 20 to analyze the demographic data and perform the exploratory factor analysis (EFA) to determine the factor structure of the H&S practices, extracted using maximum likelihood and PROMAX rotation.

5 RESULTS AND DISCUSSIONS

5.1 Descriptive statistics on demographic information

The result indicates that 28.70% of respondents were owners, whereas 26.38% were given other titles e.g. H&S representatives, site agents etc. 14.81% were owner/managers, project managers 11.57% and 11.11% were managers and majority of respondents were male i.e. 86.11% and 13.42% of respondents were female. This result concurs with previous study of Agumba et al., (2005) that construction industry is male dominated.

The result further indicate that majority i.e. 61.11% of respondents were African/blacks, with 30.09% respondents being whites, whereas 3.24% were Asian / Indian and 3.24% of respondents were coloured.
The majority of respondents 31.94% indicated that they had 6-10 years of experience in the construction industry, whereas only 3.70% of respondents had over 36 years of experience in the construction industry. The result also indicates that 18.52% of the respondents had less than 6 years of experience in the construction industry. The result further indicates that majority that is 79.63% of respondents had over 6 years of involvement in the construction industry, whereas 28.24% of the respondents had a matric qualification, and 12.97% of having basic schooling and some had no qualification. 58.35% of respondents had post-secondary school qualification.

The majority that is 37.04% of the SMEs were sub-contractors, 35.19% were general contractors, whereas specialist contractors accounted for 9.72% and civil contractors were the minority 4.17%. The result indicates that SMEs are involved in different kinds of businesses.

90.74% of the respondents chiefly conducted their businesses in Gauteng province despite other contractors in other provinces being sampled. This corresponds with economic reports that Gauteng province is the economic hub of South Africa.

5.2 H&S factors for performance improvement

In the following section, the reliability and the validity of the proposed H&S practices obtained from literature review and Delphi survey are analysed and the results for each H&S factor is tabulated below;

5.2.1 Worker involvement and empowerment in H&S

The result in Table 0025.1 indicates that the corrected item-total correlation were greater than the suggested cut-off value of 0.30 (Nanually et al., 1994) suggesting that the practices are good measures of the factor and the Cronbach alpha is greater than 0.70 (Nanually et al., 1994) indicating internal reliability. The Kaiser-Meyer-Olkin (KMO) of 0.819 with Bartlett’s Test of Sphericity of p<0.000 were also obtained, indicating consistency with the recommended KMO cut off value of 0.60 and Bartlett’s Test of Sphericity of p<0.05 suggested by Hair, et al., (2010), this results suggests that factor analysis can be conducted with the data.

<table>
<thead>
<tr>
<th>Table 0025.1 Worker involvement and empowerment in H&amp;S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eigen value 3.079</td>
</tr>
<tr>
<td>% of variance 61.577</td>
</tr>
<tr>
<td>Cronbach-alpha 0.842</td>
</tr>
<tr>
<td>KMO 0.819 p&lt;0.000</td>
</tr>
<tr>
<td>H&amp;S practices</td>
</tr>
<tr>
<td>Factor loading</td>
</tr>
<tr>
<td>Corrected item total correlation</td>
</tr>
<tr>
<td>Our workers are involved in the production of 0.863</td>
</tr>
<tr>
<td>0.757</td>
</tr>
</tbody>
</table>
Proceedings 7th Built Environment Conference
28 – 30 July 2013
Cape Town, South Africa

Exploratory Factor Analysis of Health & Safety Management practices in small and medium enterprises in the South African Construction Industry

<table>
<thead>
<tr>
<th>H&amp;S policy</th>
<th>0.839</th>
<th>0.770</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our workers help in developing of H&amp;S rules and safe work procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our workers are consulted when the H&amp;S plan is compiled</td>
<td>0.814</td>
<td>0.714</td>
</tr>
<tr>
<td>Our workers are involved in H&amp;S inspections.</td>
<td>0.598</td>
<td>0.563</td>
</tr>
<tr>
<td>Our workers can refuse to work in potentially unsafe, unhealthy conditions</td>
<td>0.458</td>
<td>0.444</td>
</tr>
</tbody>
</table>

All five practices in Table 0025.1 expected to measure the factor employee involvement and empowerment loaded together on this factor. An Eigenvalue of 3.079 and factor loadings attained were greater than 0.458 for all the items and concurs with the recommended value of 0.40 recommended by Hair et al., (2006). The factor employee involvement and empowerment explains 61.557% of the variance in the data. Therefore, sufficient evidence of discriminant validity is provided for this construct. This result concurs with Fernandez-Muniz et al., (2007). The item that loaded highly on this factor was “Our workers are involved in the production of H&S policy”.

5.2.2 Upper Management Involvement and Commitment in H&S

The result in Table 0025.2 indicates that the corrected item-total correlation were greater than the suggested cut-off value of 0.30 (Nanually et al., 1994) suggesting that the practices are good measures of the factor and the Cronbach alpha is greater than 0.70 (Nanually et al., 1994) indicating internal reliability. The Kaiser-Meyer-Olkin (KMO) of 0.890 with Bartlett’s Test of Sphericity of p<0.000 were also obtained, indicating consistency with the recommended KMO cut off value of 0.60 and Bartlett's Test of Sphericity of p<0.05 suggested by Hair, et al., (2010), this results suggests that factor analysis can be conducted with the data.

<table>
<thead>
<tr>
<th>Table 0025.2 Upper management commitment and involvement in H&amp;S</th>
</tr>
</thead>
<tbody>
<tr>
<td>H&amp;S practices</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>I/We communicate regularly with workers about H&amp;S</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>I/We actively monitor the H&amp;S performance of the projects and workers.</td>
</tr>
<tr>
<td>I/We encourage discussions on H&amp;S with employees</td>
</tr>
<tr>
<td>I/We regularly visit workplaces to check work conditions or communicate with workers about H&amp;S</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
I/We actively and visibly lead in H&S matters by e.g. walk through the site etc. 0.672 0.600
I/We take responsibility for H&S by e.g. stopping dangerous work on site etc. 0.667 0.598
I/We ensure that the H&S equipment is bought e.g. hardhats, overall etc. 0.618 0.566
I/We conduct toolbox talks with the workers regularly 0.604 0.555
I/We accord workers H&S training when there is less work in the project. 0.491 0.476
I/We reward workers who make extra effort to do work in a safe manner. 0.465 0.432
I/We encourage and support worker participation, commitment and involvement in H&S activities. 0.452 0.415

All nine items expected to measure upper management commitment and involvement loaded together on this factor. Eigenvalue of 5.107 and factor loading greater than 0.452 for all the items were established and are reported in Table 0025.2. The factor loadings were greater than the recommended value greater than 0.40 recommended by Hair et al., (2006). The factor upper management commitment and involvement explains 46.427% of the variance in the data. Therefore, sufficient evidence of discriminant validity is provided for this construct. This result concurs with Fernandez-Muniz et al., (2007). The H&S practice that loaded highly on this factor was “I/We communicate regularly with workers about H&S”.

5.2.3 Project H&S planning & communication

The result in Table 0025.3 indicates that the corrected item-total correlation were greater than the suggested cut-off value of 0.30 (Nanually et al., 1994) suggesting that the H&S practices are good measures of the factor and the Cronbach alpha is greater than 0.70 (Nanually et al., 1994) indicating internal reliability. The Kaiser-Meyer-Olkin (KMO) of 0.764 with Bartlett’s Test of Sphericity of p<0.000 were also obtained, indicating consistency with the recommended KMO cut off value of 0.60 and Bartlett’s Test of Sphericity of p<0.05 suggested by Hair, et al., (2010), this results suggests that factor analysis can be conducted with the data.

Table 0025.3 Factor project H&S planning and communication

<table>
<thead>
<tr>
<th>H&amp;S practices</th>
<th>Factor loading</th>
<th>Corrected item total correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our firm uses procedures to identify possible H&amp;S dangers on site</td>
<td>0.833</td>
<td>0.749</td>
</tr>
</tbody>
</table>
I/We include H&S in our projects program  
I/We consider H&S when layout of site is done  
I/We organize regular meetings to verbally inform workers about the risks and preventive measures of their work.

All four practices in Table 0025.3 expected to measure the factor project H&S planning and communication loaded together on this factor. An Eigenvalue of 2.786 and the factor loadings attained were greater than 0.665 for all the practices and concurs with the recommended value of 0.40 recommended by Hair et al., (2006). The factor project H&S planning and communication explains 69.644% of the variance in the data. Therefore, sufficient evidence of discriminant validity is provided for this construct. This result concurs with Fernandez-Muniz et al., (2007). The H&S practice that loaded highly on this factor was “Our firm uses procedures to identify possible H&S dangers on site”.

5.2.4 Project supervision

The result in Table 0025.4 indicates that the corrected item-total correlation for each practice were greater than the suggested cut-off value of 0.30 (Nanually et al., 1994) suggesting that the practices are good measures of the factor, whereas Cronbach alpha is greater than 0.70 (Nanually et al., 1994) indicating internal reliability of the element. The Kaiser-Meyer-Olkin (KMO) of 0.868 with Bartlett’s Test of Sphericity of p<0.000 were also obtained, indicating consistency with the recommended KMO cut off value of 0.60 and Bartlett’s Test of Sphericity of p<0.05 suggested by Hair, et al., (2010), this results suggests that factor analysis can be conducted with the data.

Table 0025.4 results indicate that all six practices expected to measure the factor project supervision loaded together on this factor. An Eigenvalue of 3.640 and the factor loadings attained were greater than 0.666 for all the practices and concurs with the recommended value of 0.40 recommended by Hair et al., (2006). The factor project supervision explains 60.662% of the variance in the data. Therefore, sufficient evidence of discriminant validity is provided for this construct. This result concurs with Fernandez-Muniz et al., (2007). The practice that loaded highly on this factor was “I/we allow supervision of work by staff trained in H&S”.

Table 0025.4 Factor project supervision

<table>
<thead>
<tr>
<th>Factor</th>
<th>Eigen value</th>
<th>% of variance</th>
<th>Cronbach-alpha</th>
<th>KMO</th>
<th>p&lt;0.000</th>
<th>Factor loading</th>
<th>Corrected item total correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H&amp;S practices</td>
<td>3.640</td>
<td>60.662</td>
<td>0.868</td>
<td>0.868</td>
<td>p&lt;0.000</td>
<td>0.786</td>
<td>0.722</td>
</tr>
<tr>
<td>I/we allow supervision of work by staff trained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Proceedings 7th Built Environment Conference  
Exploratory Factor Analysis of Health & Safety Management practices in small and medium enterprises in the South African Construction Industry  
Cape Town, South Africa  
28 – 30 July 2013  
5.2.5 Health and safety resources and training

The result in Table 0025.5 indicates that each corrected item-total correlation were greater than the suggested cut-off value of 0.30 (Nanually et al., 1994) indicating that the practices correlate well in the factor and the Cronbach alpha is greater than 0.70 (Nanually et al., 1994) indicating internal reliability. The Kaiser-Meyer-Olkin (KMO) of 0.801 with Bartlett’s Test of Sphericity of $p<0.000$ were also obtained, indicating consistency with the recommended KMO cut off value of 0.60 and Bartlett’s Test of Sphericity of $p<0.05$ suggested by Hair, et al., (2010), this results suggests that factor analysis can be conducted with the data.

All five practices in Table 0025.5 expected to measure H&S resources and training loaded together on this factor. An Eigenvalue of 3.281 and the factor loadings attained were greater than 0.708 for all the practices and concurs with the recommended value of 0.40 recommended by Hair et al., (2006). The factor H&S resources and training explains 65.628% of the variance in the data. Therefore, sufficient evidence of discriminant validity is provided for this construct. This result concurs with Choudhry et al., (2007). The practice that loaded highly on this factor was “I/we provide correct tools, equipment to execute construction work”.

<table>
<thead>
<tr>
<th>H&amp;S practices</th>
<th>Factor loading</th>
<th>Corrected item-total correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/we provide correct tools, equipment to execute construction work.</td>
<td>0.783</td>
<td>0.724</td>
</tr>
<tr>
<td>I/we ensure that workers are trained to do the work safely</td>
<td>0.771</td>
<td>0.706</td>
</tr>
<tr>
<td>I/We ensure our workers are properly trained to take care and use personal protective equipment</td>
<td>0.763</td>
<td>0.691</td>
</tr>
<tr>
<td>I/we conduct induction of all workers on H&amp;S before</td>
<td>0.751</td>
<td>0.698</td>
</tr>
</tbody>
</table>
commencing work on a particular site
I/We buy hardhats, gloves, overall etc. for workers 0.708 0.639

6 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STUDY

The results of this study are encouraging and suggest that EFA is a valid and reliable process to determine the dimensionality of the H&S factors. The results therefore concur with the study of Fernandez-Muniz et al., (2007). It can be indicated that the 31 H&S practices categorized under upper management commitment and involvement in H&S, employee involvement and empowerment in H&S, project H&S planning and communication, project supervision and H&S resources and training are considered to be reliable and valid. The 31 H&S practices can be practiced by South Africa SMEs to improve their H&S performance at project level. Furthermore, these H&S factors and practices further suggest the H&S culture at project level of SMEs in South Africa.

Further research is advocated in order to conduct structural equation modeling in developing H&S performance improvement model for SMEs at project level to determine the influence of these H&S factors on H&S performance outcome; namely reduction in accidents, injuries, fatalities, illnesses and absenteeism.

7 REFERENCES


Exploratory Factor Analysis of Health & Safety Management practices in small and medium enterprises in the South African Construction Industry


The impact of legislation on procurement practices-The case of South Africa

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ABSTRACT AND KEYWORDS

Purpose of this paper
The purpose of this paper is to review various pieces of legislation that affect procurement in South Africa; and examine how procurers of construction projects take these into account in practice.

Design/methodology/approach
Four public organisations were selected for the purpose of case studies. The procurement documents of each organisation were examined using documentary analysis and analysed using content analysis. The main piece of evidence analysed is specific mentions of the various pieces of legislation in the tender documents and the aspect of construction to which the legislation applies. This data was then interpreted qualitatively.

Findings
18 pieces of legislation that affect procurement and supply chain management were identified. Not all of them are mentioned explicitly in the procurement documents examined although their applicability may be implied. The content analysis shows the most mentioned pieces of legislation in procurement documents are the Broad-Based Black Economic Empowerment Act 2003; Competition Act 1998; Preferential Procurement Policy Framework Act, 2000; Auditor general Act 1995 and the CIDB Act 2000.
Originality/value of paper
An empirical framework for understanding the relationship between theory and practice of legislation affecting procurement in South Africa has been developed for construction researchers and practitioners.

Keywords: case study, content analysis, legislation, procurement, South Africa, supply chain management.

1. INTRODUCTION

Procurement is the process which creates, manages and fulfils contracts relating to the provision of goods, services and construction works or disposals, or any combination thereof (ISO 10845-1, 2010). In this paper, the relationship between procurement and various pieces of South African legislation affecting procurement is examined in a construction industry context. The research here builds upon an earlier seminal study by Watermeyer (2011) on the fundamentals of the South African regulatory environment for procurement and how to satisfy the Construction Industry Development Board (CIDB) requirements in terms of applicable legislation. A detailed examination of the Public Finance Management Act (PFMA) 1999 and the CIDB’s (2010) Standard for Uniformity in Construction Procurement also reveals various pieces of South African legislation that impact on the procurement of construction work. Watermeyer (2011) identified eight primary pieces of legislation that impact on construction work; and ten secondary pieces of legislation affecting construction procurement in South Africa (see Table 1). The purpose of this research was to see how these 18 pieces of legislation translate into practice and capture how various procurers of construction work in the public sector apply these legislations in the formulation of their procurement and tender documents.

2. LITERATURE REVIEW

Procurement refers to the general process through which the acquisition of goods, services, utilities and works takes place. It is a key process in the delivery and maintenance of construction works as organisations invariably require goods and services from other organisations to satisfy their needs. Procurement activities take place in both the public and private sector and common principles of value for money tend to generally apply although the private sector is not bound by certain laws that public procures would need to uphold in their procurement process.
Table 1: Pieces of legislation that regulate procurement in South Africa

<table>
<thead>
<tr>
<th>Description</th>
<th>Acts (various pieces of legislation)</th>
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<tbody>
<tr>
<td></td>
<td>• Preferential Procurement Policy Framework Act, 2000 (Act No 5 of 2000)</td>
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<td></td>
<td>• Local Government Municipal Systems Act, 2000 (Act No 32 of 2000)</td>
</tr>
<tr>
<td></td>
<td>• Construction Industry Development Board Act, 2000 (Act 38 of 2000)</td>
</tr>
<tr>
<td></td>
<td>• Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003)</td>
</tr>
<tr>
<td><strong>Secondary pieces of legislation affecting procurement</strong></td>
<td>• The Conventional Penalties Act (Act 15 of 1962)</td>
</tr>
<tr>
<td></td>
<td>• Arbitration Act (Act 42 of 1965)</td>
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<tr>
<td></td>
<td>• Auditor – General Act (Act 12 of 1995)</td>
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<td></td>
<td>• Public Protector Act (Act 23 of 1994)</td>
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<tr>
<td></td>
<td>• State Information Technology Agency Act (Act 88 of 1998)</td>
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<tr>
<td></td>
<td>• Competitions Act (89 of 1998)</td>
</tr>
<tr>
<td></td>
<td>• Protected Disclosure Act (Act 26 of 2000)</td>
</tr>
<tr>
<td></td>
<td>• Promotion of Access to Information Act, (Act 2 of 2000)</td>
</tr>
<tr>
<td></td>
<td>• Promotion of Administrative Justice Act (Act 3 of 2000)</td>
</tr>
<tr>
<td></td>
<td>• Electronic Communications and Transactions Act (Act No. 25 of 2002)</td>
</tr>
</tbody>
</table>

The paper by Watermeyer (2011) provides a detailed account on the pieces of South African legislation affecting procurement and supply chain management. There are primary pieces of legislation that govern procurement by organs of state (national and provincial departments, municipalities, constitutional entities and public entities) (see Table 1). Other pieces of legislation that also have an impact on procurement by organs of state are outlined in Table 1. The Draft Treasury Regulations for public entities issued in terms of the Public Finance Management Act, 1999 regulations indicate that accounting officers or accounting authorities within organs of state are responsible for the procurement system within their own institutions.

2.1 Primary pieces of legislation

The various primary pieces of legislation impact on construction procurement, in terms of what it does in respect of procurement and supply chain management, are summarized as follows. The Constitution of the Republic of South Africa, 1996 (Act No 108 of 1996) is applicable to all organs of state. It provides procurement objectives and establishes government’s policy for preferencing; and establishes requirements for the award of contracts to be lawful, reasonable and procedurally fair. The Promotion of Equality and the Prevention of Unfair Discrimination Act, 2000 (Act 4 of 2000) is applicable to the state and all persons (natural or juristic person). It prohibits the state or any person from discriminating unfairly against any person on the grounds of race or gender through the denial of
access to contractual opportunities for rendering services or by failing to take steps to reasonably accommodate the needs of such persons.

The Preferential Procurement Policy Framework Act, 2000 (Act No 5 of 2000) is applicable to all organs of state (state owned enterprises). It establishes the manner in which preferential procurement policies are to be implemented. The Local Government: Municipal Finance Management Act, 2003 (Act No 56 of 2003) is applicable to municipalities and municipal entities. It establishes a regulatory framework for supply chain management which includes procurement within municipalities and municipal entities. The Local Government Municipal Systems Act, 2000 (Act No 32 of 2000) is applicable to the local sphere of government. It establishes a framework for the establishment of service delivery agreements involving competitive bidding processes.

The Construction Industry Development Board Act, 2000 (Act 38 of 2000) is applicable to all organs of state involved in procurement relating to the construction industry. It establishes the means by which the Board can promote and implement policies, programmes and projects, including those aimed at procurement reform, standardisation and uniformity in procurement documentation, practices and procedures within the framework of the procurement policy of government.

2.2 Secondary pieces of legislation

The various primary pieces of legislation impact on construction procurement, in terms of what it does in respect of procurement and supply chain management, are summarized as follows. The Conventional Penalties Act (Act 15 of 1962) provides for the enforceability of penalty stipulations, including stipulations based on pre-estimates of damage. The Arbitration Act (Act 42 of 1965) provides for the settlement of disputes by arbitration tribunals in terms of written arbitration agreements and for the reinforcement of the awards of such tribunals. The Auditor – General Act (Act 12 of 1995) requires that the Auditor General reasonably satisfy himself or herself that satisfactory management measures have been taken to ensure that resources are procured economically and utilised efficiently and effectively. The Auditor General has wide powers to investigate and enquire into procurement matters and related control. He is furthermore obligated to report his findings either to parliament or a provincial legislative, as relevant.

The Public Protector Act (Act 23 of 1994) permits the public to raise issues and empowers the Public Protector, acting as an ombudsman, to investigate, report on and take the necessary remedial action on any conduct in state affairs or in the public administration, that is alleged, or suspected to be improper or to result in any impropriety or prejudice. Information or evidence that suggests criminal activity is referred to the South African Police Services and the Director of Public Prosecutions. Non-
compliance with tender procedures that render expenditure irregular or unauthorized is referred to the Auditor General. The State Information Technology Agency Act (Act 88 of 1998) empowers the State Information Technology Agency to act as a procurement agency in respect of information technology requirements in accordance with state procurement policy regarding the provision of data processing services; training; application software development and maintenance services; technical, functional and business advice and support; and related management services.

The Competitions Act (89 of 1998) prohibits the following between parties: a) restrictive horizontal practices which have the effect of substantially preventing or lessening competition in a market or involves directly or indirectly fixing a purchase or selling price or any other trading condition; dividing markets by allocating customers, suppliers, territories, or specific types of goods or services; or collusive tendering. b) restrictive vertical practices which have the effect of substantially preventing or lessening competition in a market or establish a minimum resale price. The Protected Disclosure Act (Act 26 of 2000) makes provision for the protection of employees in both the public and private sector who disclose information in good faith regarding unlawful or irregular conduct to the Public Protector, Auditor General or a person or body established for this purpose in terms of the Act. Protects those employees who "blow the whistle" on corrupt practices, The Promotion of Access to Information Act, (Act 2 of 2000) gives effect to the rights provided for in the Bill of Rights in Section 32 of the Constitution (Act 108 of 1996), namely that everyone has the right of access to information held by the state and any information that is held by another person that is required for the exercise or protection of any rights. It also sets out the procedures pertaining to the obtaining of records in both public and private sector, the grounds for refusal of access to information, mandatory disclosures in the public interest, and appeals against decisions of information officers of certain public bodies.

The Promotion of Administrative Justice Act (Act 3 of 2000) establishes fair administrative procedures, permits those affected by unfair administrative action to request reasons for such administrative action within 90 days of, or when they became aware of, such actions and requires administrators to respond within 90 days of receipt of such requests. (Administrative actions are presumed to be have been taken without good cause where an administrator fails to respond within the prescribed period). It also provides for procedures for the judicial review of administrative actions and remedies in proceedings for judicial review including the prohibition of an administrator from acting in a particular manner, setting aside the administrative action, correcting the defective action and the ordering of the administrator to pay compensation. The Electronic Communications and Transactions Act (Act No. 25 of 2002) establish legal requirements for data messages and the communication of data messages.
2.3 Constitutional imperatives for procurement

The South African Constitution (Act 108 of 1996) requires that the public procurement system be fair, equitable, transparent, competitive and cost effective. These requirements establish societal goals or outcomes for the procurement system. Procurement processes, procedures and methods need to be developed around these system requirements. This necessitates that the terms “fair, equitable, transparent, competitive and cost effective” be interpreted.

Fair: The process of offer and acceptance is conducted impartially without bias, providing timeous access to the same information. Terms and conditions for performing the work do not unfairly prejudice the interests of the parties.

Equitable: The only grounds for not awarding a contract to a tenderer who satisfies all requirements are “blacklisting”, lack of capability or capacity, legal impediments and conflicts of interest.

Transparent: The procurement process and criteria upon which decisions are to be made are publicized. Decisions (award and intermediate) are made publicly available together with the reasons for those decisions. It is possible to verify that criteria were applied.

Competitive: The system provides for appropriate levels of competition to ensure cost effective and best value outcomes.

Cost effective: The system is standardized with sufficient flexibility to attain best value outcomes in respect of quality, timing and price, and least resources to effectively manage and control procurement processes.

3 RESEARCH DESIGN AND METHODS

The research is exploratory in nature. The main question relates to how legislation affecting procurement is applied in the practice of construction procurement. This required a method that provides a depth of understanding and hence the reason a case study approach was chosen. Also, procurement involves the extensive use of documents and much of the requirements of an employer tend to be clearly stated in the documents. For this reason it was decided to employ a documentary analysis method in which procurement documents will be examined in detail. The examination of actual procurement documents will also offer a higher degree of ecological validity of the research findings and enable a content analysis of the written information to be carried out.

The specific procurement documents examined as part of the data collection are summarized in Table 2. Due to the exploratory nature of the study, four public sector organisations were selected more or less arbitrarily for the purpose of case studies. Thus procurement documents from four organizations were accessed namely: University of the Witwatersrand.
For each document the main evidence examined and analysed was specific mentions of the various pieces of legislation summarized in Table 1 in the procurement documents. The aspect of the project or procurement process to which each piece of legislation applies was also examined. A content analysis method was used to carry out the analyses. Content analysis has been widely used to carry out theory-based research in various fields of study. It is a strategy that can usefully be adopted to explain why certain content exists within a particular constituency. “Content analysis classifies textual material, reducing it to more relevant, manageable bits of data” (Weber 1990). This is done to be able to make sense of particular phenomena, detect trends relative to frequency, consistencies, and be able to explain effects and behaviour. However, it must be noted that content analysis is not only about picking out themes or pieces of content quantitatively, rather, it also includes “…interpretations of latent content” (Graneheim and Lundman 2004:1). This is through creating thematic areas and sub-themes where appropriate and reviewing the data sets for ‘traces’ of latent content in the same. Before embarking on the thematisation process, the text needs to be “…read through several times to obtain a sense of the whole” (ibid 2004: 5).

In this study, where there was direct or express reference to specific legislation in one of the case documents, then the same formed a theme against which the other cases were analysed. Otherwise themes were developed from latent references where appropriate.

4 DATA COLLECTION AND RESULTS

Four cases are examined and analysed (see Table 2). The organizations involved in the research are University of the Witwatersrand (Case 1); Gauteng Province Department of Finance (Case 2); Council for Scientific and Industrial Research (Case 3); and Transnet (Case 4). The research was based on documentary analysis and specific application of the relevant legislation in the tender documents of the organizations.

In each case, the procurement documents were read in full in the first instance. This made it possible to capture the full scope of the contents of the documents for a content analysis to be carried out. The main piece of evidence analysed is specific or explicit mentions of the various pieces of legislation in the various procurement documents. In all cases, direct quotations from the procurement documents relating to the mention of each piece of legislation were recorded. Thereafter, this was examined and analysed to ascertain how the legislation applies in the procurement process. The specific number of times each Act is mentioned to in the procurement documents have also been examined and summarized.
Table 2: Application of primary pieces of legislation in construction procurement

<table>
<thead>
<tr>
<th>Description of cases</th>
<th>Summary of case studies</th>
<th>Pieces of legislation and Methodology</th>
<th>Application of legislation in the procurement process (Content analysis)</th>
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<td>Case 4</td>
<td>Transnet procurement documents for renovation of office complex in Bethal including civil and electrical works Request for Quotation</td>
<td>Local Government: Municipal Finance Management Act, 2003 (Act No 56 of 2003)</td>
<td>This piece of legislation is mentioned three times in the procurement documents in relation to the manner of the organization’s dealings with tenderers, prohibiting and preventing unfair discrimination, equality and diversity.</td>
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<tbody>
<tr>
<td>This piece of legislation is mentioned 3 times in relation to the CIDB Standard for Uniformity in Construction Procurement and best practices recommended by the CIDB.</td>
<td>This piece of legislation is mentioned 2 times in the procurement documents in relation to CIDB contractor grading and tender eligibility.</td>
<td>This piece of legislation is mentioned 7 times in relation to the second phase of evaluation i.e. commercial evaluation based on price and preference (BBBEE) points.</td>
<td>Not mentioned</td>
<td>Not mentioned</td>
<td>Not mentioned</td>
<td></td>
</tr>
<tr>
<td>This piece of legislation is mentioned once in the procurement documents in relation to the CIDB registration certificate.</td>
<td>This piece of legislation is mentioned once in the procurement documents in relation to the National Treasury Registry for Tender Defaulters, directors convicted by a court of law, corrupt practices.</td>
<td>This piece of legislation is mentioned 7 times in relation to the functionality, price and B-BBEE aspects of the tender evaluation.</td>
<td>This piece of legislation is mentioned 5 times in the procurement documents in relation to fraud or corruption on the part of Transnet's employees, improper conduct influencing, bribery, corruption, fraud, or any unethical conduct on the part of bidders/Transnet employees, allegations of fraud, corruption or other unethical activities.</td>
<td>This piece of legislation is mentioned once in the procurement documents in relation to penalties for failure to achieve the contract participation goal relating to the granting of a preference; failure to pay a bursary to the University.</td>
<td>This piece of legislation is mentioned once in the procurement documents in relation to penalties for delay in connection with the agreed completion time of each phase.</td>
<td>This piece of legislation is mentioned 3 times in the procurement documents in relation to dispute resolution by arbitration by the Chairperson for the time being of the Association of Arbitrators of the South Africa (AFSA).</td>
</tr>
<tr>
<td>This piece of legislation is mentioned 2 times in the procurement documents in relation to penalties for failure to achieve the contract participation goal relating to the granting of a preference; failure to pay a bursary to the University.</td>
<td>Not mentioned</td>
<td>Not mentioned</td>
<td>This piece of legislation is mentioned 3 times in the procurement documents in relation to the arbitration procedure as set out in the Rules for the Conduct of Arbitrations Fifth Edition 2005 published by the Association of Arbitrators (Southern Africa).</td>
<td>Not mentioned</td>
<td>Not mentioned</td>
<td></td>
</tr>
<tr>
<td>This piece of legislation is mentioned once in the procurement documents in relation to the CIDB registration certificate.</td>
<td>This piece of legislation is mentioned 4 times in the procurement documents in relation to financial statements required to be signed by the auditor (in the case of companies) or the accounting officer (in the case of close corporations) the owner (in case of sole proprietors). Also, audited records relating</td>
<td>This piece of legislation is mentioned 2 times in the procurement documents in relation to valid BBBEE certificate (as prescribed in the BBBEE Act), proof of annual turnover from the company's accountant or auditors.</td>
<td>This piece of legislation is mentioned 3 times in the procurement documents in relation to the CIDB registration certificate.</td>
<td>This piece of legislation is mentioned 3 times in the procurement documents in relation to the conviction of a preference; failure to achieve the contract participation goal relating to the granting of a preference; failure to pay a bursary to the University.</td>
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<tr>
<td>Legislation</td>
<td>Mentions</td>
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<tr>
<td>Public Protector Act (Act 23 of 1994)</td>
<td>Not mentioned</td>
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<tr>
<td>State Information Technology Agency Act (Act 88 of 1998)</td>
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<tr>
<td>Competition Act (Act 89 of 1998)</td>
<td>This piece of legislation is mentioned 9 times in the procurement documents in relation to the competitive negotiation Procedure.</td>
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<tr>
<td>Protected Disclosure Act (Act 26 of 2000)</td>
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<tr>
<td>Promotion of Access to Information Act, (Act 2 of 2000)</td>
<td>This piece of legislation is mentioned once in the procurement documents in relation to subcontractors promptly providing the Contractor with any information which might affect the health and safety of any person at work or any person who might be affected by the work of such a person at work or which might justify a review of the health and safety plan.</td>
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<tr>
<td>Electronic Communications and Transactions Act (Act No. 25 of 2002)</td>
<td>This piece of legislation is mentioned once in the procurement documents in relation to electronic &quot;Invoices&quot;. To expedite payment invoices should be submitted or emailed in a single printable pdf document (including all attachments) to the Project Administrator</td>
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<th>Legislation</th>
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<tr>
<td>Public Protector Act (Act 23 of 1994)</td>
<td>Not mentioned</td>
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<tr>
<td>State Information Technology Agency Act (Act 88 of 1998)</td>
<td>Not mentioned</td>
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<tr>
<td>Competition Act (Act 89 of 1998)</td>
<td>This piece of legislation is mentioned 12 times in the procurement documents in relation to collusive bidding (or bid rigging), possible imposition of administrative penalties as contemplated in the Competition Act No. 89 of 1998.</td>
</tr>
<tr>
<td>Protected Disclosure Act (Act 26 of 2000)</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Promotion of Access to Information Act, (Act 2 of 2000)</td>
<td>This piece of legislation is mentioned 2 times in the procurement documents in relation to disclosures to other bidders directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.</td>
</tr>
<tr>
<td>Electronic Communications and Transactions Act (Act No. 25 of 2002)</td>
<td>This piece of legislation is mentioned 3 times in the procurement documents in relation to the Register for Tender Defaulters can be accessed on the National Treasury’s website, and publication of invitation to bid in the Government Tender Bulletin.</td>
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<tr>
<th>Legislation</th>
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<tr>
<td>State Information Technology Agency Act (Act 88 of 1998)</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Competition Act (Act 89 of 1998)</td>
<td>This piece of legislation is mentioned once in the procurement documents in relation to declaration by tenders that they have not participated in any collusive practices with any bidder or any other person regarding this or any other bid.</td>
</tr>
<tr>
<td>Protected Disclosure Act (Act 26 of 2000)</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Promotion of Access to Information Act, (Act 2 of 2000)</td>
<td>This piece of legislation is mentioned 18 times in the procurement documents in relation to disclosure to any other company any confidential details to the Quotation received, i.e. pricing, delivery, proper and secure storage of all the information</td>
</tr>
<tr>
<td>Electronic Communications and Transactions Act (Act No. 25 of 2002)</td>
<td>This piece of legislation is mentioned once in the procurement documents in relation to the creation of an online BBBEE Registry (<a href="http://www.dti.gov.za">http://www.dti.gov.za</a>) to provide a central and standardized source of the BBBEE status of all entities, and to facilitate the flow of this information amongst entities by providing a unique Profile Number (UPN) per each listing</td>
</tr>
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</table>

- To the performance of the supplier.
- Not mentioned
6 DISCUSSION

A case study of procurement documents used by four organisations has been carried out. 18 pieces of primary and secondary legislation were identified from an earlier work by Watermeyer (2011) to develop a conceptual framework for the data collection. In a number of ways, it is reasonable to suggest that nearly every piece of national and local legislation may impact on procurement activities. However, the 18 pieces of legislation identified are significant and future research is needed to help identify additional pieces of legislation that impact on procurement and supply chain management. The Draft Treasury Regulations for public entities issued in terms of the Public Finance Management Act, 1999 regulations has a specific section relating to construction procurement and this will have significant impact on construction procurement processes once the process of reviewing comments on the draft PFMA Regulations issued in terms of Notice 1005 of 2012 in Government Gazette 35939 of 30 November 2012 is complete and the regulations are promulgated.

The data examined and analysed are based on the application of relevant pieces of legislation in tender documents. This includes request for proposals, request for information, request for tenders, and request for quotations. In practice there are significant similarities between these documents and the purpose of issuing them is basically to invite suppliers to quote for work or express interest in work. The relevant legislation applies in all instances and hence they constitute an appropriate data set for the research.

Out of the 18 pieces of legislation identified the most recent one was published in 2004 i.e. almost 10 years ago. In recent years three key themes to have developed in relation to procurement are sustainability, technological innovation, standardisation and internationalisation (see for example, BS 8903: 2010; BS 8534: 2011; Liu and Wilkinson, 2011; Liu et al., 2011; ISO 10845: 2010; Phillips et al., 2008). Countries like the UK have seen the enactment of the Climate Change Act (2008) to incentivize sustainability. These developments probably suggest the need for new and targeted legislation to incentivize new developments in relation to procurement generally and construction procurement specifically in order to achieve best value and greater alignment with current national needs.

The content analysis showed that the most mentioned pieces of legislation across all four organisations are the Broad-Based Black Economic Empowerment Act 2003 (35 times); Preferential Procurement Policy Framework Act, 2000 (20 times); Competition Act 1998 (22 times); Auditor general Act 1995 (12 times) and Construction Industry Development Board Act 2000 (7 times). This shows a heavy emphasis on the need to address historical imbalances in the procurement processes. Going forward into the future, with greater and more balanced distribution of opportunities for people of all backgrounds, a heavy emphasis on these
legislations may no longer be necessary and a sustainable mechanism and legislative infrastructure will need to be put in place to reflect future needs.

7 CONCLUSIONS

The research aim was to examine the connection between theory and practice of legislation affecting procurement in South Africa focusing particularly on construction procurement. Four public sector organisations were selected for the purpose of case studies and their published procurement documents in 2012-13 were examined and analysed using content analysis. The literature review revealed 18 pieces of legislation that affect procurement and supply chain management. The examination of procurement documents was done to ascertain evidence of specific mentions of any of these pieces of legislation in the documents and the context of its application. The research findings show that not all of the pieces of legislation are mentioned explicitly in the procurement documents for construction projects although their applicability may be implied. To avoid ambiguity, it may be better to state explicitly in procurement documents all relevant legislation contractors need to be aware of particularly those that may have an impact on the commercial aspects of the construction contract. The content analysis shows that the most mentioned pieces of legislation across all four organisations are the Broad-Based Black Economic Empowerment Act 2003 (35 times); Preferential Procurement Policy Framework Act, 2000 (20 times); Competition Act 1998 (22 times); Auditor general Act 1995 (12 times) and Construction Industry Development Board Act 2000 (7 times). Through this paper, a useful empirical framework for understanding the application of legislation affecting procurement in construction has been developed. The paper also helps to illuminate the relationship between theory and practice of legislation affecting construction procurement in South Africa, specifically within the public sector.

8 ACKNOWLEDGEMENT

Special thanks to Bryne Mandlenkosi Phungula for his immense assistance in the data collection phase and review of procurement documents.

9 REFERENCES


Watermeyer, R. (2011) *Construction procurement: satisfying the CIDB requirements, Understanding the fundamentals of the South African regulatory environment for procurement*

A study of Construction Plant and Equipment Health Risks in the KwaZulu-Natal Construction Industry

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ABSTRACT

Purpose of this paper
The research aims to investigate how the construction road contractors perceive health risks associated with plant and equipment and how construction worker health can be improved in road construction.

Design/methodology/approach
An observation study was conducted on three road construction sites within KwaZulu-Natal. During visits to these, Health and Safety (H&S) site documentation such as plant maintenance log books, plant certifications as well as safe work procedures were examined. A structured interview was conducted with construction road contractors of the three sites that were observed.

Findings
H&S procedures with regards to the operation of construction plant and equipment were in most cases not adhered to in road construction in KwaZulu-Natal. Furthermore, it was observed that plant operators were not sufficiently trained in H&S before handling plant and equipment.
Research limitations/implications
The research is restricted to road construction projects in the province of KwaZulu-Natal. Three sites were selected to obtain relevant information for the purposes of the study.

Practical Implications
H&S training is paramount including the implementation of H&S procedures. This will improve project performance and the overall South African construction industry.

Originality/Value
The study analysed key risks involved in the use of plant and equipment, the nature and severity of accidents and hazards and health risks related to the KwaZulu-Natal road construction industry. Previous studies have focussed on the use of an excavator and not on the Tractor Loader Backhoe (TLB), Bobcat and Dezzi Loader, and particularly in the KwaZulu-Natal province road construction industry.

Keywords
Construction Plant and Equipment, Health and Safety, Health Risks, KwaZulu-Natal

1 INTRODUCTION
Despite the implementation of H&S regulations and contractual standard conditions, the construction industry continues to rank as one of the most hazardous work environments (CIDB, 2009; Agumba and Haupt, 2012). H&S statistics provided by the South African Department of Labour state that between the period of 2004/05 to 2007/08, there had been an increase in accidents with 160 fatalities and approximately 400 non-fatal accidents (CIDB, 2009). According to Agumba and Haupt (2012) in South Africa occupational accidents and diseases account for approximately 3.5% of the gross domestic product (GDP).

The poor H&S performance has raised awareness by a range of stakeholders such as clients and designers. For example, the national government has also become involved given the increased rate of construction related accidents and fatalities (Smallwood and Haupt, 2005). Plant and equipment were considered potential contributors of H&S risks and hazards in South African construction (CIDB, 2009).

When contractors undertake construction projects, exposures to H&S risks are inevitable but preventable. Contractors entering into a contract automatically accept the risks associated with that contract, making H&S risks one of the important risks which contractors acquired when...
undertaking a construction project. While all project stakeholders, namely clients, project managers, engineers, quantity surveyors and architects, should be involved in mitigating H&S it is generally the contractor that is expected to contribute most to project H&S. H&S risks affect the success of the construction project with respect to project parameters such as cost, quality, time, and client satisfaction. The absence or inadequacy of H&S risk management structures furthermore influenced the project parameters, productivity and time among other project parameters. (Smallwood & Haupt, 2005; CIDB, 2004).

This research specifically examines the health risks involved in the operation of Tractor Loader Backhoes (TLB), BobCats and Dezzi Loaders in the construction of roads. This focus was of particular relevance given that there has been limited research conducted in this particular area. Previous research had focused primarily on the H&S risks associated with the use of excavators, and not on road construction (Edwards and Holt, 2010; Edwards and Holt 2008). This study identified health risks that contractors face, factors that prevented them from implementing health mechanisms and how they mitigated health risks associated with plant and equipment.

2 REVIEW OF LITERATURE

2.1 H&S legislation on the use of Construction Plant and Equipment

The Construction Regulations 2003 promulgated under the Occupational Health and Safety Act 85 of 1993 stipulated that construction vehicles and mobile plants on site were to be regularly serviced and maintained. These regulations also stipulated that operators had to be trained for the machinery which they operated. Furthermore, the contractor had to ensure that all systems were in place such as adequate edge protection, that the construction site design was safe and construction H&S risks were either reduced or eliminated (Republic of South Africa, 2003).

2.2 Health risks associated with the use of Plant and Equipment

Due to increasing mechanisation of construction, outputs have become more consistent and resulted in increased productivity (Edwards and Holt, 2010). The prevention and mitigation of health risks associated with plant and equipment have therefore become imperative. The mere fact that the majority of accidents causing injuries or death involve the use of construction plant and equipment makes it important to note that their use can become hazardous and dangerous. Health risks (Edwards and Holt,
2009) involving the operation of plant and equipment on construction sites are included in Table 2.2.

<table>
<thead>
<tr>
<th>Health Risks</th>
<th>Nature &amp; Severity</th>
</tr>
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<tbody>
<tr>
<td>Burns</td>
<td>Injury or Death</td>
</tr>
<tr>
<td>Central Nervous System (CNS)</td>
<td>Damage to brain</td>
</tr>
<tr>
<td>Dust inhalation</td>
<td>Death by Asphyxia</td>
</tr>
<tr>
<td>Electrocution</td>
<td>Cardiac Arrest Death</td>
</tr>
<tr>
<td>Exposure to hazardous chemical substances</td>
<td>Internal Injuries</td>
</tr>
<tr>
<td>Fatalities</td>
<td>Death</td>
</tr>
<tr>
<td>Fatigue/exhaustion,</td>
<td>Lose consciousness</td>
</tr>
<tr>
<td>Musculoskeletal injuries</td>
<td>Fractures, Muscle Injuries</td>
</tr>
<tr>
<td>Noise induced hearing loss</td>
<td>Permanent Deafness</td>
</tr>
<tr>
<td>Respiratory System</td>
<td>Chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>Sunburn/sunstroke/dehydration</td>
<td>Sunstroke can lead to a heart attack and death</td>
</tr>
<tr>
<td>Whole body (WBV) and Hand Arm Vibration (HAV) Hazards</td>
<td>WBV can lead to damaged spine. HAV can lead to neurological diseases</td>
</tr>
</tbody>
</table>

2.3 Nature and Severity of Exposures to Health Hazards

Burns usually affect the skin and for someone to sustain burns to more than 40% total body surface would usually lead to death. Central Nervous System (CNS) severities could lead to damage to a part of the brain and could lead to serious consequences. Dust inhalation depends on the quantity absorbed and could lead to death by asphyxia. Electrocution can result to death if high current passes through the heart. If hazardous chemicals are inhaled they can cause internal injuries. Fatalities are considered highly severe. Fatigue can cause an operator to collapse and cause accidents. Musculoskeletal injuries manifest as fractures, tendons and muscle injuries (BC Work Safe, 2008). Respiratory injuries include Chronic Obstructive Pulmonary Diseases (COPD) which can lead to death. Sunstroke and dehydration could result to an individual to collapse on site (Paoletti et al, 2009; Kingu, 2013). Whole body (WBV) consequences include; damage to spine, lumber scoliosis and disc disease. Hand Arm Vibration (HAV) Hazards can result in vascular and neurological diseases (Best Practice – Vibration at the Work Site, 2010). Refer to Table 2.2.
2.4 Importance of mitigating health hazard exposures

Since infrastructural development is a SA government priority, infrastructure installations will increase. The use of construction plant and equipment is deemed to be paramount to ensure sustainable infrastructural development. With the necessity for infrastructural development, the use of mechanisation in construction is more economical as project stakeholders are seeking to lower costs, maintain consistency and increase productivity (Edwards, 2003). The societal cost of accidents and fatalities is disheartening and this in itself should serve as an alarm to prevent construction accidents and fatalities (Manu et al., 2011). It is therefore important that health risks resulting from construction activities should be avoided and mitigated. As a result there would be significant improvements in terms of contractors meeting project objectives without compromising the health of their employees.

3 RESEARCH METHODOLOGY

Three sites were visited to conduct observations of construction activities involving plant and equipment. Suitably qualified persons responsible for the H&S aspects with regards to plant and equipment used on site were interviewed. Refer to Table 3.1 for more details of the sample studied.

Table 3.1 Site Information

<table>
<thead>
<tr>
<th>Participant H&amp;S Qualifications</th>
<th>Site I</th>
<th>Site II</th>
<th>Site III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Management Training Course (SAMTRAC)</td>
<td>H&amp;S Officer</td>
<td>Legal liability, First Aid, Fire Training, Safety Management Training Course (SAMTRAC)</td>
<td>B Tech in Construction Management. No H&amp;S Qualifications but H&amp;S officer was appointed</td>
</tr>
<tr>
<td>First Aid, Fire Training</td>
<td>Contractor</td>
<td>First Aid, Fire Training, Safety Management Training Course (SAMTRAC)</td>
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</table>

<table>
<thead>
<tr>
<th>Site Characteristics</th>
<th>Site I</th>
<th>Site II</th>
<th>Site III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthworks and layer works</td>
<td>H&amp;S Officer</td>
<td>Earthworks and, layer works</td>
<td>Contractor</td>
</tr>
<tr>
<td>Road rehabilitation</td>
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</tbody>
</table>
3.1 Data Collection

Data was collected by means of structured interviews on site as well as non-participant observational studies. Participants were informed about the nature of the study. An observation spread sheet was used to take notes about the H&S issues encountered during construction activities on site. Video footage of the machinery in operation as well as photographs of the sites were taken. Additional information was obtained from project managers and plant operators. A demonstration of how the plant should be correctly used was also given for a better understanding on the risks involved in their operations.

4 DATA PRESENTATION AND ANALYSIS

Data obtained from interviews was analysed using content analysis. Relevant and recurring themes were extracted and analysed. Observations on the three sites were based on notes and recordings taken on the sites during visits.

4.1 Interviews

Interview questions had the following categories which were analysed and discussed, namely General, Risk and Risk Management, Compliance, Training; and Mitigation and Prevention of H&S risks. Please refer to Appendix A for Interview questions.

4.1.1 General

The majority of persons involved with management of the site had obtained H&S training. This training mainly consisted of the following courses, namely: Applying Safety, Health and Environment (SHE) practices in the workplace, Introduction to Samtrack, First Aid as well as Fire Fighting and Evacuation training. The most commonly used plant was the Tractor Loader Backhoe (TLB) followed by the BobCat and Roller Wheels. Other machinery used included the Dezzi Loader, Kalmar’s Hyster and the Mobile Pump.
4.1.2 Risk and Risk Management

All sites had either a H&S officer or H&S representative present to manage the H&S risks on their sites. Participants on all of the three sites concurred that machine failure and the incompetence of the operator were the major causes of H&S risks. Another source of H&S risks originated from operators being under the influence of alcohol. H&S officers on site performed Risk Assessments and Analysis including Environmental Risk Assessments before commencing with work. Only one site had encountered an accident since project commencement. The contractor from site III stated that, “some staff did get burnt on their limbs from hot bitumen which is transferred through the pumps”.

4.1.3 Compliance

Respondents agreed that basic H&S regulations relative to proper use of plant and equipment were followed on their sites. The safety officer from site I expressed, “there is a safety culture, safety comes first”. However a common theme was that sometimes they encountered staff members who were not in possession of their plant operation certificates or had forged certificates. They had also encountered operators handling plant and equipment under the influence of alcohol or during bad weather conditions when visibility was compromised. The main reasons given for non-compliance were mainly financial and workers negligence. Companies wanted to reduce costs by not sending their operators for courses or updates on plant operation courses. Another way which companies reduce costs was by subjecting their workers to unhealthy and unsafe working conditions for the purpose of increased productivity. Two out of the three site participants concurred that negligence was a common reason for H&S non-compliance (see Table 4.1.3). Nevertheless, plant and equipment maintenance check lists were provided for the operator or plant inspector to complete on a daily basis before plant operation in all three sites.

<table>
<thead>
<tr>
<th>Table 4.1.3 Reasons for H&amp;S Non-compliance</th>
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<tbody>
<tr>
<td>Non-compliance</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>Financial</td>
</tr>
<tr>
<td>Negligence</td>
</tr>
<tr>
<td>Stubbornness</td>
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</tbody>
</table>
4.1.4 Training

On all the sites, management had taken H&S courses such as First Aid and Evacuation training. However, not all staff members had taken these H&S courses. The participant from site three admitted to not having gone through any H&S courses. This construction manager had been working in the construction industry for six years. However all site operators had undergone H&S training.

4.1.5 Mitigation and Prevention of Health Risks

Negligence of operators and poor or lack of plant and equipment maintenance was regarded as the major reason why plant and equipment related accidents occurred. This was followed by lack of supervision, operator training as well as limited funding to maintain proper usage. To prevent H&S risks related to plant and equipment from occurring, managers had ensured that daily toolbox talks were carried out with operators. Environmental Impact Surveys including the daily checking of all plant and equipment on site were conducted. Induction training as well as a Risk Assessment were also carried out on the three sites. The reporting and investigating process of the three sites included a forensic investigation, barricading the incident area, statements from eye witnesses, statements from operators, photographs as well as mechanical checks. The next stage was to report the incident to the South African Department of Labour.

4.2. Observations

Observations related to plant and equipment were conducted based on the study objectives namely; i) health risks that contractors faced, ii) the nature and severity of these health risks; and iii) factors that prevented health risks from being prevented or mitigated.

4.2.1 Site I:

i) Risks involved the movement of the TLB and the Bob Cat throughout the site. Ground workers use the same road as the one for moving vehicles and therefore workers are exposed to the risk of being hit by construction vehicles. Refer to Figure 4.2.1.

ii) Dust Inhalation and Fatigue were likely for workers and operators to experience as well as Exposures to Chemical Substances such as diesel. Other exposures included Sunburn, Sunstroke and Dehydration, which had been experienced on site.
iii) The site H&S officer was present on a daily basis and involved with the daily activities of the site. The majority of the operators and ground workers had their Personal Protective Equipment (PPE) which included a reflective jacket.

![Figure 4.2.1 Tractor Loader Backhoe (TLB) excavating material](image)

### 4.2.2 Site II

i) Visibility on this particular site was compromised because of poor housekeeping. There were piles of sand, gravel, broken bricks, and other construction materials. There was unlevelled ground in some parts of the site which made it harder and dangerous for moving vehicles, more especially the TLB, which risked tipping over. There were trenches on the edges of the compacted road which were demarcated.

ii) Dust Inhalation, Fatigue, Sunburn and Dehydration were a common occurrence on site. These were regarded to be severe when they occurred.

iii) Management was very strict about all persons on site having appropriate (PPE). The H&S officer ensured that plant and equipment were checked before operation as well as during the day. All persons before entering the site had to undergo induction training.

### 4.2.3 Site III

i) Trucks, Dezzi loaders as well as the Kalmar’s Hyster were in constant motion and reflective jackets were compulsory when workers were on site. Ground workers risked being hit by moving vehicles.
ii) Burns and Chemical Exposures were common occurrences and had moderate to major severity when they occurred. Musculoskeletal Injuries were more likely to occur due to constant movement of construction vehicles and plant. Site mobile plants and vehicles moved at a speed between 20 to 60 kilometres per hour and injuries could be quite catastrophic if a ground worker were to be hit or if an operator fell from or under a moving vehicle.

iii) The H&S officer was generally dissatisfied with the way the site was being managed in terms of H&S. This was mainly because of unnecessary obstructions to moving vehicles and to ground workers. These obstructions included empty bottles, cartons and plastics on the roadway and near site offices.

5. DISCUSSION OF FINDINGS AND RECOMMENDATIONS

The findings from the study suggested that there were significant H&S skills shortages because H&S management was often disregarded or became a “nice to have” component of a project. It had also been learnt that experience in the industry did not translate into effective H&S management because one of the construction managers had six years’ experience in the construction industry and yet could not manage the site effectively in terms of H&S. The construction manager with less than three years’ construction experience had a better site environment in terms of H&S. However this particular construction manager had undergone H&S training. It is therefore paramount for the managers to undergo H&S training courses. With respect to Risk and Risk Management, the presence of a H&S officer or H&S representative on site reduced the rate of accidents and injuries. This fact also ensured there was effective H&S risk management which encouraged workers and operators to adhere to H&S regulations. The H&S officer checked that plant operation certificates were updated and maintenance records were kept. Exposure to H&S risks such as, for example, sunburn, sunstroke, dehydration, fatigue, chemical substances, dust inhalation and burns should be kept at a minimal. These were commonly experienced on the majority of sites. Serious exposures in terms of severity included burns, fatalities and musculoskeletal injuries. The construction contractor should therefore concentrate on ways of mitigating and preventing exposure of workers to the health risks and injuries from occurring. In terms of contractors mitigating and preventing plant and equipment related H&S risks, the following are recommended, namely:

- Sufficient funding should be allocated for plant and equipment maintenance. This amount should be budgeted and set aside before commencement of a construction project.
• H&S supervision and training that includes toolbox talks, induction training as well as PPE registration should be provided daily; Construction companies should ensure that staff and operators are sent for plant and equipment operation training courses.
• Environmental Impact Surveys, Risk Assessments, including the daily checking of all plant and equipment on site should be conducted.
• The procedure for reporting and investigation of an incident should include ways in which the incident can be prevented in the future.
• An effective medical surveillance program should be implemented on sites for plant and equipment operators. This program should include an optometry certificate, an age declaration and a cardiac condition report.
• The road contractor should ensure that sufficient drinking water is available on site to encourage workers to drink water regularly to prevent dehydration. Sun protection ointments should be provided to prevent or reduce exposure of staff, ground workers and operators to sunburn.
• Drivers of vehicles and plant operators should be considerate by being cautious when driving and operating plant and equipment.

6 CONCLUSION

H&S regulations were complied with to ensure the H&S of operators, staff and workers on road construction sites. When these H&S regulations are violated, exposure to H&S risks escalates thereby increasing the rate of skills shortage due to injury and loss of lives. The study revealed that a major factor in reducing the accident and fatality rate was the strengthening of H&S education and training; which was also seen as vital for the effective implementation of H&S regulations on site. Contractors should eliminate the perception that there is saving of costs through ineffective or lack of H&S management. There should be an increase of external H&S inspections to combat H&S negligence; as well as the implementation of severe penalties for H&S non-compliance. An example of a penalty can include closing down the site by the South African Department of Labour, if the site is considered to be unsafe. Furthermore, infrastructural development undertaken by the South African government includes increased plant and equipment output. Investments impelled in infrastructural projects will be better employed when H&S management systems are adhered with regards to plant and equipment use. This makes the study of construction plant and equipment health risks paramount to ensure the subsistence of the construction industry.
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Smallwood, J and Haupt, T., 2005, The need for construction health and


How does the enhanced legal status of electronic communication impact on communication procedures in standard form construction contracts?

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ABSTRACT

Modern methods of communication within the built environment have brought forth a new cognitive process that participants in this environment should undertake when communicating. This cognitive process should include an enhanced forethought when emailing, Facebooking, SMSing, Tweeting and phoning because what is said/typed when using these platforms, could have a binding effect. The Electronic Communications and Transactions Act, Act 25 of 2002 (hereafter referred to as the ECT Act) has enhanced the legal status that modern communication platforms uphold. This has resulted in standard contract conditions that offer parties some protection as to the method of communication acceptable, but in contrast leaves parties vulnerable to the effect that unintentionally conveyed information could have.

The ECT Act increased the legal status of all modern means of communication. Modern means of communication include telephonic communication, fax mail, email and recording devices. Thus, in an ever-changing built environment, participants should not only dedicate more time to ensure that information conveyed does not have legal implications, except if so intended, but that the information conveyed is unambiguous, grammatically correct and formulated professionally. Modern platforms to a large degree comply with the ECT Act's definition of 'in writing'; hence the importance of unambiguity, grammar and professionalism, since the information conveyed using these modern platforms can become a legal document.

Keywords: built environment, construction contracts, ECT Act, electronic communication, notices
1. PREAMBLE AND BACKGROUND

1.1 Introduction

The built environment is a diverse environment with various role players and individuals from different professions such as architects, engineers, subcontractors, tradesmen, foremen, construction managers, quantity surveyors and more. Unambiguous communication between these parties, as well as an enhanced awareness of the legal status that modern means of communication uphold, is therefore extremely important, because, as with all revolutions in history, the information revolution has brought with it fundamental changes in the way that people communicate with each other. One can argue that no revolution in history has changed our society and commercial practices more quickly or more dramatically than the information revolution.

Emailing has been commercially available since 1993, but the uptake was slow from a business perspective and it was only after a further 10 years that emailing was regarded as one of the main stream forms of communication. Since then its growth has been exponential to the extent that for most practices and businesses it has become the de facto method of communication, and is currently, without doubt, the most preferred tool of communication. However, this may soon change as cell phones with appropriate media applications are becoming increasingly popular as a mode for communication. Who knows what the world of communication will look like in the next decade and thereafter?

To illustrate this point the following example is given. The High Court (HC) rules of South Africa have been amended so that from the end of July 2012, parties will be able to serve documents or notices on each other via facsimile or electronic mail. Prior to the Amendment\(^1\), documents had to be served on the other party's physical address or the physical address of the party's attorneys. A new Rule 4A has been added and provides that all subsequent documents which do not fall under Rule 4(1)(a) can be served in a variety of manners, including via facsimile or electronic mail. Rule 4(1)(a) regulates the service of any documents initiating proceedings and accordingly this new amendment does not apply to the service of any documents initiating proceedings which must still be carried out by the Sheriff of the court. However, from the end of July 2012 it will no longer be necessary to serve subsequent documents through the Sheriff of the court and they can be emailed, faxed, hand delivered or posted by registered post.

\(^1\) The Amendment was published by the Department of Justice and Constitutional Development in Government Gazette No. 35450 on 22\(^{nd}\) June 2012.
1.2 Brief discussion of the ECT Act

The main objective of the ECT Act\(^2\) is to ‘enable and facilitate electronic communications and transactions in the public interest’. ‘Electronic communication’ is defined in the ECT Act as “a communication by means of data messages”. In addition, ‘data’ is defined as “electronic representations of information in any form”. ‘Transaction’ is defined as “a transaction of either a commercial or non-commercial nature”, and includes the provision of information and e-government services. The ECT Act does not limit the operation of any law that expressly authorises, prohibits or regulates the use of data messages.

The ECT Act recognises that an increasing number of transactions are carried out by means of electronic data interchange. Similarly the courts have kept abreast with online world changes such as was illustrated by Judge Esther Steyn in the case \(\text{CMC Woodworking Machinery v Pieter Odendaal Kitchens}\)\(^3\), where she made legal history when a service was judged to have been legally issued via Facebook, being the first judgment of its kind in South Africa. Judge Steyn stated that “changes in the technology of communication have increased exponentially and it is therefore not unreasonable for the law to recognise such changes and to accommodate [them]\(^4\).” She further expressed that “Facebook and social media platforms should be utilised as an effective tracing tool in the future”.

The ECT Act provides that information is not without legal force merely because it is wholly or partly in the form of a data message\(^5\). A data message is data that is generated, sent, received or stored electronic means\(^6\). A data message will meet the legal requirement that the document must be in writing if it is accessible in a manner usable for subsequent reference\(^7\). This requirement simply means that one must be able to use the document again later. Therefore if one can save the document or print it, the requirement will be fulfilled. Hence, an email message that can be stored on a computer will comply with this requirement. The ECT Act further provides that an agreement is not without legal force and effect merely because it was concluded partly or in whole by means of data messages\(^8\). This provision for all practical purposes places agreements concluded through data messages on the same level as agreements concluded on paper (Coetzee, 2004).

The reception theory is adopted in so far as the ECT Act provided that an agreement concluded between the parties by means of data messages is

\(^2\) The Electronic Communications and Transactions Act, Act 25 of 2002
\(^3\) CMC Woodworking Machinery (Pty) Ltd v Pieter Odendaal Kitchens (case no. 6846/2006) 3 August 2012 (5) SA 604 (KZDHC)
\(^4\) At para 2
\(^5\) Section 11(1)
\(^6\) Section 1
\(^7\) Section 12
\(^8\) Section 22(1)
concluded at the time when and place where the acceptance of the offer was received by the offeror\textsuperscript{9}. There is no requirement that receipt of data messages has to be acknowledged in order to be legally effective \textsuperscript{10}. This fact is of great significance when dealing with the differences between standard form construction contracts such as the JBCC and FIDIC with regard to their respective ways of dealing with notices etc. later in this paper.

1.3 Stating the problem

With a rapidly changing environment leaning towards a paperless environment, has the construction industry been able to accommodate for these changes? Has electronic communication resulted in an easy flow of information or has the industry resisted this change? Do standard construction contracts make provision for electronic communications? How should electronic communications be recorded as to be presented as evidence in court? Can a simple email with an electronic signature at the bottom conclude that a notice by either party has been given or a variation in a contract has been instructed? As mentioned hereinbefore the ECT Act has enhanced the various platforms of electronic communications, but some confusion still exists.

A research report in partial fulfilment of the requirements for the honours degree in quantity surveying at the University of Pretoria that was submitted by P C Conradie in 2012 and supervised by the author of this paper, entitled *Electronic communication, emailing and the legal status thereof within the construction industry*, has been used as basis for research results in this paper. Additional content has been added by the author to provide a more complete answer to the main problem stated hereunder.

The main problem stated in the research report is: “Participants within the built environment are generally unfamiliar with the ECT Act and as a result doubtful of the legal status that these modern forms of communication uphold”. From the main problem three sub-problems were identified, of which only one is relevant to the topic of this paper and will be dealt with in section 3 of this paper by making use of selected information contained in the research report and by adding additional content as stated.

1.4 The Sub-problem selected

How does the ECT Act impact the means of issuing a notification or variation in a contract?

\textsuperscript{9} Section 22(1)

\textsuperscript{10} Section 26(1)
1.5 The relevant Hypothesis

An electronic communication holds legal status to such an extent as to alter the original contract.

1.6 Importance of the study

Electronic means of communication is part of everyday business, but insufficient thought has gone into the legal status that electronic communication holds when communicating in the construction industry. The study done is of significant importance to inform participants of the legal standing of electronic forms of communication on building projects.

Furthermore, when parties draft a contract, the means of acceptable communications should be carefully considered. Clauses containing “electronic means are deemed acceptable” may be too general and specific forms of communications should now be targeted as to protect parties from unnecessary disputes arising.

1.7 Research methodology

The primary data for the research report\textsuperscript{11} was gathered through the use of published and unpublished literature, as well as articles, the ECT Act and the Internet.

Secondary data for the research report\textsuperscript{12} was collected through a structured questionnaire. Participants consisted of quantity surveyors from different sectors, with varying years of experience.

The data were statistically analysed and processed for quantitative results. Results would ideally be used to determine any correlation between the relevant variables. The outcome of the study (findings and conclusions) could then be used in making recommendations and drawing conclusions.

2. How do standard form construction contracts such as the JBCC and the FIDIC differ in their approach when dealing with communication and claim notification procedures?

\textsuperscript{11} Conradi, PC. Electronic communication, emailing and the legal status thereof within the construction industry, 2012

\textsuperscript{12} Id.

Proceedings 7th Built Environment Conference 28 – 30 July 2013
2.1 Introduction

Construction contracts contain numerous clauses requiring the service of notices by the parties, or their representatives, at various junctures during the life of the contract. What happens if the notice provisions are not followed precisely? Was the notice served properly and timeously? These, and related other questions, are assuming greater significance in the current economic climate where parties will be more willing to exploit errors to extract commercial advantage. On occasion, administrative mistakes such as serving a notice wrongly may provide a route out of an unprofitable contract. Construction contracts must therefore contain clear and unambiguous notice provisions, which will assist the courts that are regularly asked to interpret notice clauses and whether or not such provisions have been followed correctly and whether the notices have been validly served.

2.2 The JBCC, 6th edition

The JBCC, 6th edition, defines a notice as "A communication issued by either party, the principal agent and/or agents to the other party or any agent, to record an event, request outstanding information and/or where suspension and/or resumption of the works, or termination of this agreement is contemplated". The notice can be delivered in a number of ways and one is deemed to have been received where:

- Hand delivered – on the same working day as delivery;
- By registered post - delivered seven working days after posting; and
- Sent by electronic mail – one working day after transmission.

This clause is very important in that it deals with formation of the contract and actual delivery in terms of the law. The notice provisions must be read together with clause 1.2.6 which gives meaning to the word 'deemed'. A notice will be deemed to be delivered if substance of the form has been adhered to.

Clause 23 will be used as an example on how the JBCC deals with serving of notices and outlines defined circumstances under which the contractor can apply to the principal agent to extend the date for the practical completion of the project. It is important to note that the defined circumstances that give rise to such a request by the contractor are limited to adverse weather conditions, force majeure, contract instructions etc. In the event that one of the aforementioned circumstances arises the contractor shall give the principal agent notice within 20 working days of
becoming aware, or ought reasonably to have become aware of such delay, of the intention to submit a claim for the revision of the date of practical completion, failing which the contractor shall forfeit such claim.

The practical implication of this clause is that the contractor must ensure that the principal agent actually receives the notice; failure to do that implies that the contractor shall forfeit a revision to the date of practical completion and this can have serious monetary implications. It is highly advisable to review contract provisions and serving of notices strictly in accordance with the contract to avoid possible disputes. The fundamental lessons are that it is wrong to think that notice provisions are a mere formality. They are very important and close attention must be paid to the specific wording of the contract.

From the above it is stated clearly that if the contractor fails to adhere to the stipulated time periods to notify the principal agent of claims for additional time or money, he forfeits his right to claim. This was proven in the Grahamstown High Court judgment15 on 17 May 2012 which serves as a reminder that Courts are strict in requiring claims procedures set out in building contracts to be followed.

Facts of the case

Radon Projects (the contractor) was employed by NV Properties (the employer) in terms of JBCC Principal Building Agreement (May 1998 Edition).

Prior to practical completion being reached, the contractor submitted numerous extensions of time claims in terms of clause 29.1. In most instances the principal agent failed to adjudicate the claims, or otherwise rejected them. Clause 40 of the 1998 edition of the JBCC Agreement provides that a disagreement between the employer and contractor must be determined by the principal agent within 10 working days of a request. Such decision is final and binding on the parties unless a further dispute notice is given within 20 working days. The contractor failed to give the required notice to challenge the principal agent's decisions in terms of clause 40 in relation to the disputed claims which had been referred to him.

The employer argued that the principal agent's decisions were final and therefore there was no 'arbitral dispute' between the parties.

Compliance with clause 29

This issue was referred to the Court for decision.

The Court recorded that:

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15 NV Properties (Pty) Ltd v Radon Projects (Pty) Ltd. (2012) ...
Before a disagreement on the issue of time delays can arise, the party seeking an extension of time must comply with clause 29.

The purpose of the time bar set out in clause 29 was introduced to counter the practice which previously prevailed where claims for extensions of time were only submitted after the intended date for practical completion had already passed and when the contractor was in ‘penalty time’.

The contractor is obliged to establish as soon as possible whether or not it is entitled to a revision of the practical completion date in order to decide whether to accelerate the works or to face the possibility of paying penalties.

The Court held:

Thus, in respect of those claims wherein the contractor has not complied with clause 29, especially clauses 29.4 and 29.5, the First Respondent has forfeited those claims and there is thus no ‘arbitral dispute’.

2.3 The FIDIC

The FIDIC dedicates an entire clause to deal with communication procedures during contract execution:

1.3 Communications: Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices and requests, these communications shall be:

(a) In writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Appendix to Tender; and

(b) Delivered, sent or transmitted to the address for the recipient’s communications as stated in the Appendix to Tender. However:

(i) If the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

(ii) If the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.
The FIDIC thus requires all communications to be reduced to writing in order for it to be binding upon the parties. It also specifies which type of delivery is accepted but does not give a time bar after which delivery is deemed to have taken place.

The claim notification procedure required in terms of the FIDIC contracts is expressly stated in clause 20.1:

20.1
Contractor's Claims: If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable as and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Sub-Clause shall apply...

Under the FIDIC a claim will only become an entitlement if the Contract parties strictly follow the procedures, which means in most cases:

- To give a notice of a claim
- To give particulars of the claim (in time)
- To wait for Engineer's approval or disapproval
- To negotiate and settle the claim
- To wait for Engineer determination (in case of failure to reach settlement)
- To refer a dispute to the DAB (in case of dissatisfaction)

This Notice is important because:

- Everyone involved becomes aware that there is an event or circumstance where extra time or payment may be owed to the contractor
- Proper contemporary records must then be kept and agreed, to avoid future argument
- Alternative measures may also be possible to reduce the effects
- The matter may possibly be resolved at an early date
- If the event or circumstance turns out to be of insignificant effect then it is necessary to follow up the notice with a formal claim.
2.4 Summary

At this point, after having discussed how the two standard form contracts deal with and provide for claim notification procedures, it becomes apparent that the clauses in each of the above mentioned forms are similarly structured, in that each set out the need for notice within a limited period and states the consequence of failure to provide that notice. The specified communication procedures dictated by the various standard form contracts generally differs only in the amount of specific details to be given on what constitutes a communication in terms of the contract.

The JBCC simply states the accepted form of transmission and the time period after which delivery is assumed.

The FIDIC specifically states that any communication should be in writing and also list examples of acceptable forms of communication.

It can be said that both the JBCC and FIDIC contracts set out clear, balanced and enforceable set of procedures, rights and obligations which, if competently managed and administered, will protect the employer, contractor and subcontractors alike.

3. NOTICES, CONTRACT INSTRUCTIONS AND RELEVANT CASE STUDIES

3.1 Introduction

The discussion in this section will focus on the procedural process of serving of notices, when notices need to be issued and what the preferred medium and the format should be. The importance of notices is of great essence in construction projects as to allow the parties involved to be aware of cost and time issues and to allow for necessary amendments to the program as well as funds in their respective budgets. See in this regard Hawkins & Others v Enviroserve Waste Management where the Supreme Court of Appeal found that the engineer had been negligent in failing to construe the letter by the contractor as a notice in terms of clause 50 of the General Conditions of Contract for Works of Civil Engineering Construction, 6th Edition (1990) (the GCC).

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16 Hawkins & Others v Enviroserve Waste Management (2009) 2 of SA 319 (SCA)
3.2 Discussion/Interpretation

3.2.1 The ‘in writing’ rule

Finsen (2005:114) has defined ‘in writing’ as “… includes drawings, faxes, email, telegrams and magnetic tapes and computer discs in which words and drawings may have been electronically recorded and are capable of being converted to text and drawings on paper or other similar media.” It is clear that Finsen in his definition of ‘in writing’ complied with the definition of ‘Data messages’ of the ECT Act, which reads as follows:

‘Data message’ means data generated, sent, received or stored by electronic means and includes:

a) voice, where the voice is used in an automated transaction; and
b) a stored record.

3.2.2 Contract instructions

Finsen (2005: 114) also emphasises the importance for contracts to insist on all contract variations to be in writing, as this is a contractual obligation in most standard contracts, except if waived by the employer himself. Should no written instruction be received by the principal agent, the contractor is not obliged to carry out any instruction, as he will not be entitled to payment without a written instruction.

The JBCC edition 5 has defined a contract instruction as meaning “… a written instruction signed and issued by or under the authority of the principal agent to the contractor”. The ECT Act requires that the word ‘signed’ be properly defined by parties, or as a default, will have to comply with an ‘advanced electronic signature’ as per Section 37 of the ECT Act. Since no method of signature is described, Section 13 (1) of the ECT Act states that an advanced electronic signature at the bottom of a data message will be regarded as being undersigned. But since no method of undersigning has been specified within the JBCC edition 5 agreement, one can uphold the contrasting requirement for an electronic signature as provided for in Section 13 (3) of the ECT Act, as long as the requirements are met. These requirements are firstly that parties involved can be identified, and secondly, that the method of communication was appropriate to the circumstances.

The JBCC edition 6 however, has redefined the definition of a contract instruction as follows: “… an instruction issued by or under the authority of the principal agent to the contractor, which may include drawings and other construction information”. This definition to some extend lacks the words ‘written’ and ‘signed’ as included in the previous edition, but sub-clause 17.5 clearly states that “Oral instructions shall be of no force or effect”, which makes it unnecessary to repeat such wording in the definition. Except for
record purposes, a written requirement has the purpose of creating a phase in which the agent issuing the instruction can put thought into the instruction, bearing in mind cost as well as time implications.

JBCC (2000) has published an advisory note on contract instructions, suggesting that the principal agent should, when construction commences, discuss an appropriate procedure for requesting, issuing and recording contract instructions.

3.2.3 Notices

Loots (1995: 580) defines a notice as “… a formal written document required by the appropriate conditions of contract to advise the employer and/or his consultants of the circumstances giving rise to a claim”. A notice further has the purpose of enabling the professional team or agents involved including the employers, to evaluate the situation and the problem concerned.

Loots (1995: 580) continues by emphasising that a further purpose of a notice would be to specify the form and nature of the records that are required to be kept, and to enable the employer and his team to examine the evidence then available and, thereafter, at the time it becomes available.

The conditions and terms within the contract that parties agree to, will guide parties involved under which circumstances notifications are required by either party. Notifications are time-barred and should the contractor fail in submitting due notice, claims will be without legal force.

As discussed hereinbefore electronic mail is in some standard contracts ‘deemed’ to be received within a certain amount of days, but the ECT Act states quite boldly that an electronic mail will only be legally received when the electronic mail complies with the following extract from section 23 of the ECT Act:

“A data message is regarded as being received when the data message enters an information system designated or used for that purpose by the addressee, and the data message is complete and is also able to be retrieved by the addressee”.

Acknowledgement is further also not a request as to define ‘received’. This might explain why the term ‘deemed received’ is so often used in construction contracts. It would be highly recommended that construction contracts include a clause for “acknowledgment requested by receiving party” as this would clarify ‘received’ and comply with the ECT Act.

The built environment, where notices are constantly issued, should be informed of the legal status of serving notices, as the case of CMC Woodworking Machinery v Pieter Odendaal Kitchens demonstrated that

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17 JBCC, 6th ed. Sub-clause 1.2.6
18 Supra., footnote 3
South African courts are willing to adapt, leaving participants who are uninformed about the legal status that modern forms of communication uphold, in a ‘legally dangerous’ position. The question that comes to mind is that if a service can be issued via Facebook, how would courts rule if the same case would present itself within the built environment regarding notices?

3.2.4 Time barring

Time barring is enforceable and the case of *Alfred McAlpine & Son v Transvaal Provincial Administration*\(^{19}\) has held this statement. The case of *Barkhuizen v Napier*\(^{20}\) has further placed emphasis on the fact that contracting parties should comply with time limitation clauses. Claims submitted without timely notices given as stated in the contract data, will in most cases be of no legal force.

The ECT Act in this regard can be of some assistance to contractors, as corresponding electronic mails with the employer’s representative may give rise as to whether or not the dialogue between the two parties would be interpreted as such notice.

The ECT Act permits evidence to be submitted in supporting statements by either party. The ECT Act, Section 11 (1), reads as follow: “Information is not without legal force and effect merely on the grounds that it is wholly or partly in the form of a data message.”

Therefore it can be argued that good practice would be if parties, before a contract is signed, decide on a prescribed method as well as format in which notices shall be issued.

3.3 Summary

Bearing in mind the discussion concerning notices, and the enforceability of time-bar provisions as sanctioned by the Constitutional Court, prudent record-keeping to keep track of potential claims is strongly advised. Furthermore, contractors should develop a keen appetite to submit notices timeously of their intention to claim. Once an entitlement to claim is lost as a result of a contractor failing to submit its notice within the stated period, it will be forfeited.

The contractor is well advised to keep a daily check on the progress of the contract, or it will stand to lose vital resources in the form of additional time and money.

\(^{19}\) Alfred McAlpine and Son (Pty) Ltd v Transvaal Provincial Administration 1974 (3) SA 506 (A)
\(^{20}\) Barkhuizen v Napier (CCT 72/05)
3.4 Testing of Hypothesis

The selected hypothesis assumed that: “An email holds legal status to such an extent as to alter the original contract”. Rhoodie (2012) explained whether email correspondence is enough to vary the terms of a contract, as follows:

“In terms of Section 13(1) of the ECT Act, the signature of a person is required by law and if laws do not specify the type of signature, the requirements in a data message are met if an ‘advanced electronic signature’ is used. Section 13 (2), made subject to Section 13 (1), provides that an electronic signature is not without legal force and effect merely on the grounds that it is in electronic form. Section 13 (4) provides that where an ‘advanced electronic signature’ has been used, such signature is regarded as being a valid electronic signature and to have been applied properly, unless the contrary is proved.

Section 12 of the ECT Act further provides that the requirement in law that a document must be in writing, is met if the document is in the form of an email. It follows that a requirement imposed by parties that a document must be in writing is met if the document is in the form of an email. Therefore, email communication purporting to vary the terms of a contract fulfills the first condition of the non-variation clause that any variation to the contract must be in writing.

With regard to the second requirement of the non-variation clause that the parties must sign the document that purports to vary the contract, the ECT Act’s definition of ‘electronic signature’ reads with the definition of ‘advanced electronic signature’, is wide enough to cover the situation where the author of an email signs the email off by insertion of his name to constitute his signature.

Section 13(2) of the ECT Act clearly states that an electronic signature is not without legal force and effect on the grounds that it is in electronic form. This means that an electronic signature, as defined by the ECT Act, is sufficient to fulfill the second requirement of the non-variation clause that the document must be signed by the parties.”

In conclusion, it is clear that the ECT Act is so interpreted by Rhoodie (2012) that email correspondence between parties would indeed vary the terms of a written contract, but must meet the requirements of Section 13 of the ECT Act.

In the research report respondents were asked to answer the following two questions on the legal status of emails:

1. **What the legal strength of an email would be to give notice to parties in the contract?**

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21 Supra, at 1.5
22 Supra, footnote 11
In their response 5% of respondents indicated that an email has ‘no legal status’, 56% chose the option ‘only if in good faith’, and 39% acknowledged that an email would ‘comply completely with all legal requirements’ of a notice. From Figure 3.1, it is clear that the 95% of participants acknowledged that an email does have some legal status, although the larger portion felt that it would only be on good faith and not by the inherent legal status of the email as to conclude a notification.

![Pie chart](image)

**Figure 3.1** – What is the legal strength of an email to give notice to parties in a contract?

2. What the legal strength of an email would be if it was sent to another party in the contract, to bring a contract instruction into existence, if only via an email and not as an attached signed document?

In their response 44% of the respondents indicated that an email has ‘no legal status’ regarding variations, 39% chose the option ‘only if in good faith’ and 17% acknowledged that an email would ‘comply completely with all legal requirements’ of a variation (Figure 3.2).

An observation would be that 39% more respondents thought an email has no legal status to vary the terms in a contract, than that of a notice. This indicates that participants are still fixed in the traditional way of how variations are supposed to be issued. But Roodie’s interpretation,\(^\text{23}\) clearly illustrates that an email does in fact hold such legal status as to conclude a variation.

\(^{23}\text{Supra, at 3.4}\)
Figure 3.2 - What is the legal strength of an email to bring a contract variation into existence?

4. Conclusion

Most standard form of contracts provide for notices to be given of an event or circumstance which, for instance, is likely to delay completion of the works or result in additional cost. The notices are typically followed by a detailed claim which must be submitted within a default period of time, otherwise the claim may be refused. The manner in which a construction contract manages the timing of the delivery and receipt of notices is therefore extremely important.

The JBCC makes use of a deeming provision with regard to these timing issues and states that notices given “shall be deemed to have been received” within certain time periods after having been sent. The time periods depend on the method of notice used (hand delivered, electronic mail or registered post). Given the significant consequences of establishing the correct timing of the delivery of a notice in terms of the JBCC, it is necessary to consider the legal implications of such deeming provisions. The default common law position is clear:
The obligation to give notice implies reciprocally that such notice must be received. In the absence of a deeming provision notice will not be deemed to have been given until such time as it is received\(^{24}\).

The learned judge made it clear that this default position may be amended by the parties inserting a deeming provision into the agreement between the parties. The JBCC does exactly this. However, deeming provisions regarding receipt of notices can have no more consequence than to create a presumption in favour of the sender of the notice. Such presumption may be rebutted by the alleged recipient\(^{25}\). Legally then, it is open to a party disputing receipt of a notice to adduce evidence in that regard and rebut the presumption. The deeming provision assists the sender of the notice in that, when making a claim or suing on the basis of the notice, the sender is relieved of the onus of proving that the notice was received. The deeming provision is thus useful in construction contracts which are likely to involve many notices.

In section 2 of this paper a comparison is made between the handling of notices in the JBCC with that in the FIDIC where it is pointed out that the latter contract contains no deeming provision. It is only with respect to notices delivered by hand that the FIDIC is prescriptive with regards to proof of receipt. Sub-clause 1.3(a) states that communications shall be:

\[\text{...in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any agreed systems of electronic transmission as stated in the Appendix to Tender (emphasis added)}\]

The underlined words clearly indicate that, if delivered by hand, the notice must be proven to have been received. If sent by mail or courier, the absence of a deeming provision has the result that the default common law position as set out above will apply. If the parties stipulate that any forms of transmission (for example facsimile or email) are acceptable but they do not insert a deeming provision, then it is submitted that the receipt of such electronic notices will be dealt with in terms of the ECT Act.

Thus, while the FIDIC contract is silent with respect to the uncertainty which the JBCC contract attempts to remedy, legislation exists to deal with such uncertainty. It therefore appears that while deeming provisions may serve to be useful in limiting the ambit of disputes with respect to notices and therefore allow the parties to deal with the merits of claims, they can never deal with the issue of notice receipt conclusively. It remains open to a party to challenge the averment that a notice was received. The deeming

\(^{24}\) Total South Africa (Pty) Ltd v Nedcor Bank Ltd (1997) 3 All SA 562 (W) at 564

\(^{25}\) BMW Financial Services (SA) (Pty) Ltd v Harding and Another (2007) 4 All SA 716 (C) para 14
provision merely deals with the issue of the onus of proof. Where the parties have failed to deal with the complexities arising out of notice delivery in their agreement, the ECT Act will assist in providing some certainty.

In conclusion, electronic communication empowers parties throughout the world to apply their specialised skills more effectively and speedily within a project. But, there lies a ‘legal danger’ with this trend as hereinbefore described. Knowledge of the legal status of such methods of communication is still in the development stages, and appropriate application of legal knowledge is often lacking as to the legal implications these methods of communication hold. It is therefore imperative for the parties to the contract to ensure that clear guidelines with respect to how electronic communication will be dealt with during the execution of the contract be established at the onset of the contract.

5. List of references


Rhodie, L. 2012. Email correspondence: enough to vary the terms of a contract. Johannesburg.

Exploring communication effectiveness among construction project role players

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ABSTRACT

Purpose of the Paper: This study investigated the effectiveness of communication on construction projects.

Research Design: The research utilised primarily open-ended questionnaires to collect perceptions and experiences among 6 groups of respondents namely clients, project managers, quantity surveyors, architects, engineers and contractors.

Research limitations/implications: The study was limited to a small sample of construction projects in Johannesburg. Future research may include other geographical areas and could use a wider sample in order to assess whether similar results would emerge and which could be more generaliseable.

Findings: The study found that the communication abilities of various role players in the construction industry and standard of communication as well as communicated documents are average. Further, information is fairly
timely communicated to different project team members while uptake of technological improvements in communication is not yet optimised.

**Response to conference theme and outcomes**: This study demonstrates that enhancing communication effectiveness among project role players is required to improve project success and contribute to the overall sustainability of the construction industry.

**Practical implications**: The study highlights that there is room to improve communication among construction role players and to exploit technological innovations for project communication purposes to contribute to overall project success.

**Originality/value**: The paper explores the perceptions and experiences of various construction industry role players on the effectiveness of selected communication aspects. It shows that communication is still very much taken for granted yet it is an area with potential to enhance the success of construction projects, particularly uptake and adaptation of technological innovation.

**Keywords**: Communication management, construction projects, information management.

### 1.0 INTRODUCTION

Communication is perhaps one of the most important processes during the design and construction phases of projects. For a project to be successful, a sustainable communication system is needed to issue instructions, solve problems, take decisions and distribute important information to all role-players and stakeholders (Knipe, van der Waldt, van Niekerk, Burger & Nell, 2002). There are many role-players on construction projects, all with different levels of education and experience in the construction industry, and therefore effective communication management is necessary to ensure that all relevant information reaches the correct role-players at the right time (Project Management Institute, 2007). Information needs to be conveyed on time and at the right level and is an ongoing process throughout the life cycle of the project (Steyn, Basson, Carruthers, Du Plessis, Pienaar, Prozesky-Kuschke, Van Eck & Visser, 2008).

In recent years, there have been constant efforts to shorten construction periods through the implementation of new and improved materials and construction technologies but little attention is given to the channels through which those improvements have to travel. The lack of communication between the different role-players on a construction project...
is one of the main reasons for time delays. Research shows that about two-thirds of the construction glitches that exist on construction projects today are triggered by insufficient communication and insufficient sharing of information (Mohamed & Steward, 2003). Therefore this study aimed to investigate the effectiveness of communication on construction projects. The objectives included examining the perceptions and experiences of industry stakeholders relating to the following: (i) communication abilities of various industry role players (ii) standard of communication and communicated documents (iii) timely provision of information and iv) uptake of technological improvements in communication.

There should be effective communication among the client, the design team, the specialist consultants and the contractor as well as the end user of the building throughout all the phases of the project to ensure the success of project. The study enhances our understanding of the communication areas that still need improvement with the view to contributing to better project performance and consequently to the sustainability of the construction industry.

2.0 Literature Review

Communication management forms the link between people, ideas and information which are necessary for a project to be successful. It is important for everyone involved in a project to be aware of how the communication one generates, affects the project as a whole (Project Management Institute, 2000). Effective project communication contributes to the correct information being transferred to the correct person at the correct time through the most cost-effective way (Kerzner, 2009). Ongoing communication between stakeholders is important for success (Best, 2010). Despite successful project planning or successful project teamwork, effective communication is imperative to exchange information, minimise risks and to ensure expected project outcomes. Effective communication ensures successful co-ordination and integration of complex projects (Steyn et al., 2008). Through communication, information is shared and distributed, ideas get exchanged and the attitude, behaviour and understanding of team members are influenced (Burke & Barron, 2007).

Emmitt and Gorse (2003) note that efficiency in building projects depends on the quality of the relationships between the client, professionals, contractor and sub-contractors. Similarly, Keeling (2000) opines that communication determines the quality of relationships, the level of satisfaction as well as the degree of success or failure of a project. The absence of effective communication is the reason for problems and conflict situations (Keeling, 2000). A successful project depends on honest and open communication between the client, architect and building contractor.
throughout the duration of the construction project (De Jonge, 1986). Effective monitoring of a project depends on good communication between team members, the project manager and the stakeholders (Young, 2003). According to Chan and Chan (2005) and Gilleard and Gilleard (cited in Toor & Ofori, 2008), professional construction workers need to be equipped with multi-cultural communication skills to be able to work effectively in a multi-cultural environment.

Construction is one of the most information-dependent industries, with its variety of forms of information which include detailed drawings and photos, cost analysis sheets, budget reports, risk analysis charts, contract documents and planning schedules (Project Management Institute, 2007). The volume of information produced and exchanged during a project lifetime is massive even for a small-sized construction project. Well-timed and correct information is imperative for all project members as it forms the basis on which choices are made and physical progress is achieved (Tam, 1999). Faster decision-making, improvement of quality, savings in cost and the improvement in project teamwork, are all evidence that prompt document and information transfer is beneficial to organizations (Mohamed & Steward, 2003).

For many years the construction industry suffered because information was either difficult to access, incomplete or out of date. The majority of construction business procedures are severely based upon old-fashioned means of communication such as face-to-face meetings and the exchange of paper documents in the form of technical drawings, specifications and site instructions (Mohamed & Steward, 2003). The need to increase the effectiveness of these procedures through the exchange of substantial volumes of information at high speed and at fairly low cost has long been generally acknowledged by the industry.

Technological developments and progress over the last few decades have introduced a number of computer-generated communication media, which offer new ways to convey messages that were not possible in the past. Through the use of digital communication that exists today, documents can be delivered and transferred almost immediately at a much lower cost than in the past (Mohamed & Steward, 2003). Technology such as web-conferencing, instant messaging and document sharing sites are essential in providing an information rich communication environment for team members who cannot have face-to-face meetings (Reed & Kinght, 2010).

Essential to the organization of any major construction project is the flow of project information amongst the professionals, many of whom have conflicting priorities and intentions (Craig & Sommerville, 2006). The different professions use their own distinctive methods to take on tasks but to take these tasks on competently, the professions become dependent on information supplied by others. Furthermore, information delivered is
seldom available in the format that is suitable for all users. The different professions rarely, if ever, recognize the requirements of others and in some cases the information is so incompatible that the recipient sees the next process as being how to re-construct the information delivered (Craig & Sommerville, 2006). Organizations claim that new tools help to make team communication clear and transparent and improves the overview of design information which is both crucial for design improvement and preventing design failures due to obsolete and contradictory information (Den Otter & Emmitt, 2007).

According to, Brandon, Betts and Wamelink (1998) technological improvement has always focused on distinct uses in the fields of visualization, intelligent systems, and communications technologies. Visualization technologies are based around computer-aided design, multimedia and more recent developments in virtual reality. Recent developed computer-aided virtual environment (CAVE) enables the designers to test products and buildings before they are built (Emmitt & Gorse, 2003). Progressive intelligent systems accepting knowledge-based systems, artificial intelligence, case-based approaches and neural technology have been studied, developed and eventually implemented by some organizations in the construction industry (Brandon et al., 1998). The use of 3D visualization techniques can simplify the process to reach common understanding across interdisciplinary organizations (Bouchlaghem et al., 2005).

However, despite research being done on various technological innovations, organizations are not making as much use of them as the developers would have hoped Brandon et al. (1998). Brewer and Gajendram (2011) also point out that despite building information modelling’s (BIM) ability to envisage virtual construction of a facility prior to its actual physical construction, in order to reduce uncertainty, improve safety, work out problems and simulate and analyse potential impacts, it is yet to gain widespread acceptance and usage in the architectural, engineering and construction sector. Although a lot of information technology applications and tools have been part of the construction industry for many years, many construction contractors still rely on the old faithful methods of communication namely personal contact, telephone conversations and paper documents (Mohamed & Steward, 2003).

3.0 APPROACH OF THE STUDY

The study utilised twenty-nine (29) questionnaires, distributed to consultants, clients and contractors in the construction industry in Gauteng using purposive sampling. Seventeen (17) completed questionnaires were
received, representing a 59% response rate. The respondents consisted of 64% consultants (i.e. project managers, architects, quantity surveyors and engineers), 18% contractors and 18% clients. The respondents had reasonably sufficient years of experience in the industry. A large percentage of respondents (41%) had 5 - 10 years’ experience followed by the second-largest group (29%) which had 15 - 20 years’ experience, 18% had more than 20 years’ experience while only 6% had less than 5 years and between 10 - 15 years’ experience respectively. In terms of educational qualifications, the majority of the respondents had relevant construction industry qualifications namely; 82% had a degree, 12% had a diploma and 6% had only a matric certificate.

The analysis of the data consisted mainly of descriptive statistics to reflect the frequency distribution and central tendency of responses. For each response to a question or statement, mean scores were determined based on the 5 point likert scale ranging from 1 to 5. 1= poor, 2= below average, 3= average, 4= good, 5= excellent. The findings are presented and discussed in the next section.

4.0 RESULTS

The respondents were asked to indicate their assessment of the communication abilities relating to oral, written and contractual communication of the following different stakeholders in the construction industry. Figure 1 indicates that with regards to the oral communication ability, the Project Manager and Quantity Surveyor scored the highest mean at 3.82 each while the Engineer scored the least (3.29). In terms of the written communication ability, it was found that the Quantity Surveyor scored the highest mean of 3.88 and the Engineer scored the least at 3.29. For contractual communication, the Project Manager achieved the highest score of 3.82 and the Architect scored the least (3.24).
However, overall, the results show that all the mean scores were above the 3.0 midpoint (average range). This suggests that the respondents were in general fairly positive about the oral, written and contractual communication abilities of the different role-players in the construction industry. The reason for this is probably because all the role-players in the construction industry use all three types of communication in their different professions every day. As indicated in the literature, the ability of role players to communicate effectively to other parties plays a vital role in achieving the objectives of a project. Multi-cultural communication skills are essential for one to work effectively in a multi-cultural environment. It is notable that none of the scores were in the range 4 -5 (good to excellent). This suggests that there is room to improve communication abilities across the board.

Figure 2 indicates the standard of communication and communicated documents of the different role-players in the construction industry in terms of responses to a scale of 1 (poor) to 5 (excellent).
The results in figure 2 show that all the mean scores were above the 3.0 midpoint score and were in the average range (3 – 4). The Quantity Surveyor scored the highest mean score of 3.88 and the Project Manager scored the lowest (3.28). Participants were fairly positive with regards to the standard of communication and communicated documents of the different role-players in the construction industry. Similarly, none of the scores obtained reached or exceeded 4.0 (good). This finding highlights that there is scope to improve the standard of communication and the communicated documents by all role players. As projects are becoming more complex, all role players involved should strive to enhance their standard of communication as well as the communicated documents to match the level of complexity. Literature highlighted that communication affects the quality of the team relationships and degree of success of projects.

Figure 3 shows the perceptions of respondents relative to the timely provision of information by the different role-players in the construction industry on a scale of 1 (poor) to 5 (excellent).

All the role players achieved mean scores ranging between 3 and 4 (average), with Project Managers scoring the highest (3.82) and Architects scoring the lowest (3.12). The participants were fairly positive with regards to the timely provision of information by the different role-players in the
construction industry. The results were all above the 3.0 midpoint score but below 4.0 (good) which means that there is room for improvement. This is because well timed and correct information is imperative and the basis on which choices and decisions are made.

![Figure 3: Timely provision of information](image)

Figure 3: Timely provision of information

Figure 4 indicates the perceptions of respondents relative to which role-players cause time delays on projects if timely communication does not take place from their side. The findings show that Architects are the most likely (46%) to cause delay of a project if no timely communication on their part and the Quantity Surveyor and Engineer both had the lowest percentage (0%). The group called "other" consists of the following: the Client together with the Architect (6%), the Client together with the Engineer (6%), the Architect together with the Engineer (12%), the Client together with the Project Manager, Architect and Engineer (6%) and the Whole Team (6%). The respondents also agreed that the Project Manager was responsible for ensuring effective communication takes place.
The respondents also provided reasons for their answers as follows. They explained that all details are based on the Architects’ design and all consultants rely on them to provide design information as well as changes to the design in time. Further, it was stated that lack of construction communication would delay the building process and construction projects without Architects’ construction drawings, no building can proceed. The respondents also pointed out that without proper drawings and details from Architects, buildings can be erected defectively which causes problems in the long run. They also reasoned that Architects & Engineers (6%) design the key design aspects of projects. Without a design, inaccurate documents will be produced and no construction will happen. If drawings and information are not received timely, the programme will fall behind. It was also argued that the client (6%) makes the final decision about everything and yet in many cases the client does not know what they want. Although the whole team only scored (6%), the respondents indicated that the whole project team needs to provide timely information otherwise delays will occur because all information on projects is crucial. If any team member e.g. the Quantity Surveyor does not provide cost information timely, it can affect the
project negatively. Therefore, communication should not be taken for
granted.

When asked about the overall utilization of up-to-date technology
within their own professions in the construction industry, it was found that
88% of the respondents indicated that up-date technology was being
utilized and 12% said it was not. The respondents elaborated on the most
up-to-date technology utilized in their respective professions. Those results
are summarized in Table 1.

Table 1: Up-to-date technology currently utilized within professions

<table>
<thead>
<tr>
<th>Profession</th>
<th>Technologies Utilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>E-mail, scanning, document management system, MS Office, MS Projects. Wireless communications, Smart phones, Laptops, Tablets, CCS, WinQS, SAP &amp; CAD</td>
</tr>
<tr>
<td>Project Manager</td>
<td>MS Projects, CCS, MS Office, WinQS, E-mail</td>
</tr>
<tr>
<td>Architect</td>
<td>Autodesk &amp; Revit</td>
</tr>
<tr>
<td>Quantity Surveyor</td>
<td>WinQS, DimensionX, Digitizer, Adobe Acrobat</td>
</tr>
<tr>
<td>Engineer</td>
<td>AutoCAD, MS Office, FTP websites, Synergy, Dropbox, Tablets, Notebooks</td>
</tr>
<tr>
<td>Contractor</td>
<td>MS Office, MS Projects, CCS, WinQS, Revit, Synergy, Dropbox, Laptops</td>
</tr>
</tbody>
</table>

The respondents also that the main reason for not fully utilising up
to date technology is that usually there is not enough time available to
implement new technology which has not yet been tested and proven to work. They emphasised that software manufacturers must do proper trial runs on all new software available for organizations within the construction industry before putting them on the market. It was also suggested that the use of Notebooks and Tablets for contractors on site could be beneficial for project communication. The respondents were fairly positive with regards to the utilization of up-to-date technology within the different professions in the construction industry. However, there is scope to improve and optimise the use of technology for project communication. As literature indicates, despite technological advancement, the uptake and usage in the construction industry remains quite conservative.
5.0 Conclusions and Recommendations

The communication abilities of the role players in the study as well as the standard of communicated documents were found to be average. In addition, the role-player most likely to cause projects delay if timely communication does not take place from their side was found to be the Architect due to the reason that that the whole design process largely starts with the Architects and without a proper design, no construction can take place. According to the study, the responsibility of managing communication on construction projects to ensure that effective communication takes place lies with the Project Manager. However, based on the literature review and the findings, it can be argued that the whole project team should ensure that they communicate timeously as all information contributes to the success of the project and ultimately to the sustainability of the Construction Industry.

The respondents reacted fairly positively to the up-to-date technology used in the construction industry and rated it average. However, the average results obtained are indicative of the need to improve communication on construction projects. Successful implementation of an information management system can minimise problems in connection with timely communication and the standard of documentation can also improve because the different role-players will spend less time communicating and more time focussing on the actual work. For each project, team members should be encouraged and be willing to adopt new practical and effective communication technologies. Designers need to make more use of 3D modelling to communicate design to all stakeholders to enhance understanding of numerous stakeholders’ viewpoints and help develop a more holistic approach to design and construction. The use of project database internet will encourage cheaper and faster transfer of information among role players.

The study was limited to a relatively small sample and single geographical location, therefore a wider survey with larger sample is recommended to get more generalizable results. In addition, further research should be conducted on the communication responsibilities of different role players on construction projects and different technological communication media available to different professions with a view to enhancing communication.

7.0 References


ABSTRACT AND KEYWORDS

Purpose of this paper
Design Tender and Build (DTB) as well as construction procurement has been mentioned in many studies however there appears to have a wide gap about the reason why design tender and build is more preferred than other construction procurement system. The research paper presents the findings that design, tender and build is the most preferred construction procurement system in the South African construction industry and also to explore why there a lack of knowledge on general construction procurement systems particularly in the Gauteng Johannesburg area of South Africa.

Design/methodology/approach
Both qualitative and quantitative approach was adopted for carrying out the exploratory research based on questionnaires survey. The survey involved construction professional employees and contractors from within construction and professional firms and companies from the Gauteng construction industry.

Findings
The questionnaire survey revealed that design tender and build is the most
preferred procurement system in use in Gauteng today with reference to the table 6. Generally there is a great lack of knowledge and awareness regarding construction procurement, however DTB is more so used on projects due to legislative acts that restrict the use of alternative procurement.

Research limitations/implications
The research study is exploratory in nature and limited to Gauteng province, South Africa.

Practical implications
The paper makes a contribution to existing knowledge on the traditional design, tender and builds construction project delivery system among construction professionals, clients and contractors. This paper furthermore presents recommendations to construction professionals and clients on how to choose the best / alternate construction procurement system for a project.

Keywords:
Procurement System, Design Tender, Construction Industry, Construction Project, Construction Design and Tender,

1. INTRODUCTION

Construction project procurement has been described as an organized methods or process and method for clients to obtain or acquire construction products or more likely in this context it refers to the choice of construction procurement strategies. In parts of the world such as Australia, Malaysia and New Zealand the traditional form of construction procurement has been criticised because of its chronological flow of activities. DT&B is seen to be a lengthier route to pursue in comparison to other procurement systems which are designed to shorten the entire project delivery system especially in today’s world of escalating sophistication and intricacy of building projects. However, a change in trend of utilising alternative project delivery systems has not transpired in South Africa yet.

On any construction project it is important to choose the accurate procurement system, contractor, contract documentation and suitable form of contract for the construction of the project (SC Quantity Surveyors, 2009). However, in South Africa only one form of procurement mostly used, suggesting that there is no system that adopts the best and most suitable options available or there is a lack of awareness on the benefits that accrues from other systems. In simple terms, procurement is the method used to obtain construction projects and it is essential for the client to make
the correct choice of construction procurement methods. There is wide range of procurement systems available leaving consultants with an important role in building procurement selection as choosing the right procurement method is vital to the success of a building project (SC Quantity Surveyors, 2009).

The needs of a client differ considerably with regard to certainty of price, cost limits, time requirements, difficulty of design and many other factors. The traditional procurement system remains by far the most popular method. The traditional structure for project procurement is seen as a sequential method because the employer takes his scheme to an advanced stage with his professional team before appointing a contractor. A Quantity Surveyor is awarded the responsibility to give guidance on design costs and budgets, prepare bills of quantities, check tenders, prepare valuations and advise on the value of variations. The focus of this study unpacks the traditional form of procurement, evaluates it and attempts to prove that it is by far the most preferred procurement delivery system within the South African construction industry.

2. PROBLEM STATEMENT

The choice of building project delivery systems available to clients today is so wide that the need for objective, disciplined and appropriate method of selection is required (Masterman, 2002). Other procurement systems offer an array of advantages when compared to that of design tender and build, yet design tender and build seems to remain the most preferred procurement system. The problem therefore is to: investigate why design tender and build is the most preferred procurement system in South Africa within the Gauteng construction industry. Furthermore, the research aims to investigate why alternative procurement strategies are not being pursued.

3. LITERATURE REVIEW

3.1 Procurement Systems and Tendering

Procurement is the method used to deliver construction projects. The Oxford dictionary defines procurement as: “obtaining or acquiring with care or effort”. Clients that decide to go ahead with a construction project are faced with the daunting task of acquiring the construction work needed. This is a challenging task as it involves a high level of financial obligation, various risks, the difficult nature of construction and the perception that the construction industry underperforms. Approximately forty years ago procurement only encompassed a few methods, whereas today a wider variety of strategies have been developed and used (Ashworth, 2002). The
Construction Industry Development Board (CIDB) refers to Procurement as: the procedure that creates manages and fulfills contracts. Procurement is concerned with establishing and documenting requirements; soliciting tender offers from the private sector to provide supplies or services / to construct or maintain infrastructure / to undertake disposals; awarding contracts to successful tenderers; monitoring that which was contracted to be provided is certainly provided; and paying contractors for executing their contracts (CIDB, 2006).

The primary objective of developing a construction procurement system is to recognize procurement activities and ends when the contract is concluded. The commencement of the procurement method is to identify the need for procurement. This must not be undertaken in isolation from the project characteristics, client teams or infrastructure planning (CIDB, 2006). It has been accepted that one of the main causes for the construction industry’s poor performance is the inappropriateness of the procurement systems that have been chosen for the construction projects (Maison, 2006). Rising complexity of buildings, the need for greater financial management, the need to reduce design and construction periods and the increasing burden of contract administration have put pressure on the clients to seek alternative approaches to the traditional method (Maison, 2006). Masterman (2002) classifies project procurement systems into numerous categories based on the relationship and critical relations between the design and those having construction responsibilities. The categorization of the various procurement systems are as follows: Separated and Cooperative System; Integrated System; Management Oriented System; and Discretionary Systems (Bennett, 2003).

The different building procurement systems present different methods, processes and procedures of designing and construction of projects for the client. These different systems also prescribe the distinction of the organizational structure of the project teams in terms of role, responsibility and authority (Rashid, Taib, & Ahmad, 2006). It is crucial in the early stages of a project to weigh up the strengths and weaknesses of different project procurement strategies as establishing an appropriate strategy can often mean the difference between success and failure. Various procurement routes will be unsuitable for certain types of projects and clients. Familiarity with standard construction procurement strategies can significantly help in the understanding of the different legal, financial and commercial opportunities that each strategy can present (Shaik, 2008).

In “Separated Procurement System” the responsibilities of design, tender and build is separated and awarded to different parties within the construction project. Within this system there is only one procurement system and is referred to as “the traditional method” by Masterman (2002). Most clients implement their projects by means of a main contractor with the design and supervision being carried out by an architect assisted by...
other specialist consultants (engineer, quantity surveyor etc...) (Bennett, 2003). Within this method, the owner is contracted to a design team that performs preliminary planning and executes design work. After the design is completed a construction team/company is selected and the owner enters into a contract with the contractor who will construct the project. The contract for design work is separated from that of the construction work. An important characteristic is that all of the project’s design work must be completed prior to solicitation of tenders and no construction work can begin until a successful tenderer has been selected. Thus, the term design–tender–build implies a strict and sometimes time-consuming project (Bennett, 2003).

The main elements of the project implementation process are the design and construction phases. Within these systems, the responsibility of the main elements of the project implementation process lies with separate organizations. These include, but are not limited to, design consultants, quantity surveyors and building contractors. The client will have to deal with all the project team members and is responsible for the funding and eventual operation of the facility. The traditional system, well known as Design-Tender-Build fits within this category (Hardesty, 2005). The tendering is the list of processes to produce, display and administer tender documents by client or consultant. It also involves action to perform bidding (tendering) by interested contractors in order to win the contract by responding to tenders with their capabilities and skills. The tendering period begins with tender preparation and ends with the completion of the tender (Rosmayati M, 2010).

### 3.2 Traditional Design Tender and Build

![Diagram of Design-Tender-Build process]

The design-tender-build project delivery system is the traditional method that has been used for many years in both public and private construction projects. It is the project delivery system that is most broadly used today. The design-tender-build practise is a well understood delivery system in which risk is minimized through the owner’s firm control of both the design and construction phases. The design-tender-build process gives checks and balances between the partakers in the construction project (Hardesty, 2005).

<table>
<thead>
<tr>
<th>Bid/tender</th>
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</table>

**Table 1:** Various aspects of design tender and build (traditional procurement design tender and build)
Time
It is suitable for both public and private clients to control the stipulated overall time for the construction projects. All the operations are subject to considerable scrutiny and governed by fairly strict parameters especially in government funded development agencies.

Competition
In most circumstances, selective or competitive tendering is obtained after the production of a tender document with a completed detailed design. Negotiated tenders will reduce a competitive element.

Responsibility
It is a clear cut division of design and construction works. The client will engage different architects or engineers to design the works and they will take full responsibility for construction of the works from the pre-tender stage until the completion stage.

Price Completion
This method allows certainty in cost and time before commitment to build. There will be a clear accountability and cost monitoring at all stages.

Price Certainty
Design will be completed during the tender stage and it will establish a high level of price certainty except for the fluctuations in the cost of labour and materials.

Quality Level
This will produce the highest quality of work. The project is usually competitively tendered to a contractor before work begins on a lump sum basis. The design will be completed before the commencement of construction and thus the quality of work will be higher. Each process of construction is undertaken by different parties having varied expertise in the building team.

Complexity
It is suitable for reasonably complex projects. It is because each phase of construction works will be conducted by parties having different expertise.

Controllable Variation
The design will be prepared before the tendering process and variations can be kept to the minimum.

Risk Avoidance
The risks are generally fair and balanced amongst the parties to the contract.

Government Projects
The construction of 13 nucleus hospitals in the whole of peninsular Malaysia was procured by the turnkey method which is similar to the traditional method. The main advantage of this concept is that early completion could be achieved, while incorporating flexibility in design that would cater for future expansion of the hospitals.

(Hashim et al, 2006)

4. RESEARCH DESIGN, APPROACH & METHODOLOGY

Both qualitative and quantitative approach was adopted for the research study. The secondary data collection involved a detailed review of literature,
relating to the topics mentioned in the problem statement. The structure of the primary data collection tool was guided by the findings within the literature review. Primary data was obtained by means of distribution and collection of 50 structured questionnaire surveys within chosen samples and unstructured interviews within the Johannesburg region. The construction of the questionnaire sections and items was guided by the existing literature on the subject. The responses to each of the items on the questionnaires were based on agreement, severity and five point likert scale of frequency. Sample participants for this research were selected by random means within selected areas of Johannesburg for construction professionals, companies, firms and building contractors. The intended respondents of the questionnaires were: Project or Contracts Managers, Construction Managers, or any employees possessing relevant experience on projects. The respondents’ sufficient work experience was required to ensure a fairly reliable data collection on why design tender and build is the most preferred construction procurement system in South Africa.

5. FINDINGS AND DISCUSSION

The following section provides key research findings on: general particulars of the respondents; most preferred procurement system; and awareness about procurement system.

5.1 General Particulars of Respondents

The respondents’ responses were different owing to a number of factors like: position, experience in years, specialization, and size of the construction projects. The questionnaire survey findings as shown in Table 2, revealed that a majority (45.45%) were Quantity Surveyors (QS), while 15.15% were construction and project manager. Nevertheless, Architects formed 12.12% of the respondents.

Table 2: Construction profession position of respondents

<table>
<thead>
<tr>
<th>Position Type</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client / Owner</td>
<td>3.03%</td>
</tr>
<tr>
<td>Construction / Project Manager</td>
<td>15.15%</td>
</tr>
<tr>
<td>Quantity Surveyor</td>
<td>45.45%</td>
</tr>
<tr>
<td>Architect / Designer</td>
<td>12.12%</td>
</tr>
<tr>
<td>Engineer</td>
<td>9.09%</td>
</tr>
<tr>
<td>Contractor</td>
<td>6.06%</td>
</tr>
<tr>
<td>Other, please specify</td>
<td>9.09%</td>
</tr>
</tbody>
</table>
The findings relating to the professional background is agreement with the general conventional knowledge the QS is more responsible in the determination of choice when choosing a procurement system.

Further findings relating to the respondents’ working experience showed that 42.42% of the respondents’ have less than 5 years’ experience, while a simultaneous percentage of 15.15% had both 5-10 years and 11-15 years’ experience and a cumulative percentage of 27.27% had between 16-20 years and above experiences.

Also, further findings relating to the average size of construction projects handled by the respondents revealed that 36.36% had and current working on projects over R90 million, while 21.21% are simultaneously working on projects with a contract sum of between R15 – R30 million and between R30 – R90 million.

5.2 Most Favoured Procurement System

The analysis of responses and results for the most favoured procurement system confirm that traditional design tender and build is the most preferred procurement system in South Africa with a 76.92% rating as indicted by the respondents. This is followed by the design and build procurement system as shown in Table 3.

Table 3: Most preferred procurement system in use.

<table>
<thead>
<tr>
<th>Procurement System</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design tender and build</td>
<td>76.92%</td>
</tr>
<tr>
<td>Design and build</td>
<td>15.38%</td>
</tr>
<tr>
<td>Management construction</td>
<td>7.69%</td>
</tr>
<tr>
<td>Other, please specify</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Furthermore, the questionnaire asked the respondents’ the procurement system which takes preference for their clients. Responses relating to this revealed that DTB (68.57%) was the most preferred amongst their clients.

Table 7: Construction procurement system preference for respondents’ clients need / priority’s?

<table>
<thead>
<tr>
<th>Procurement System Preference</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional (design, tender &amp; build)</td>
<td>68.57%</td>
</tr>
<tr>
<td>Integrated (design &amp; build)</td>
<td>8.57%</td>
</tr>
<tr>
<td>Management (management construction)</td>
<td>22.86%</td>
</tr>
<tr>
<td>Discretionary (PPP, BOOT, BOT etc…)</td>
<td>0.00%</td>
</tr>
<tr>
<td>Other, please specify</td>
<td>8.57%</td>
</tr>
</tbody>
</table>
Findings from the questionnaire survey of construction professions, as reported, is consist with other scholar work, such as the work of Hardesty, (2005), which found that DTB process gives checks and balances between the construction stakeholders, which is the reason while most clients in South Africa preferred the system. Likewise, DTB gives price certainty, better quality compliance, risk avoidance, and lesser design complexities. Whilst, in other procurement systems, these factors are not a consideration, hence, they are not implementing other procurement systems.

5.3 Procurement System Awareness

The analysis of responses confirm that there is a great lack of information regarding construction procurement by clients due to the failure of construction professionals’ educating and making them aware of their range of choice and alternatives. The following are the key findings about the procurement system awareness:

Table 9: Procurement Systems Awareness

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Key Questions</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you think that clients are sufficiently educated on the construction</td>
<td>13</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>procurement system options available to them at inception of a project?</td>
<td>(39%)</td>
<td>(58%)</td>
<td>(3%)</td>
</tr>
<tr>
<td>2</td>
<td>Do you think that the clients’ professional representatives</td>
<td>15</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>(construction managers, principal agents etc.) advise their clients</td>
<td>(45%)</td>
<td>(39%)</td>
<td>(15%)</td>
</tr>
<tr>
<td></td>
<td>adequately on the best suitable construction procurement system to adopt for</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a particular construction project?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Do you think that professionals tend to suggest/use the system that would</td>
<td>20</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>best suit them?</td>
<td>(61%)</td>
<td>(21%)</td>
<td>(18%)</td>
</tr>
</tbody>
</table>

Table 10: Feel from respondents, whom do they associate the responsibility of client awareness regarding procurement selection.

<table>
<thead>
<tr>
<th>Designations / Positions</th>
<th>Respondents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction / Project Manager</td>
<td>29</td>
<td>40.85%</td>
</tr>
</tbody>
</table>
From the key findings, it is evident that majority of the respondents preferred for traditional "design tender and build" procurement system on their current projects. This gives a clear indication and confirms that the traditional form of procurement is favoured in Gauteng, South Africa by a large amount. The respondents also agreed that they had met the requirements for quality when using the traditional approach in procurement, and also favoured the traditional approach of procurement system. The research study highlights that there was a lack of sufficient knowledge by clients to help them independently chose a procurement route. The research findings also highlight that “the procurement system is dependent on the type of client”, some client need not be educated on the procurement system and it is therefore the obligation of the professional team to take this duty upon themselves but fulfilling their duty towards their client. A majority of respondents agreed with the fact that construction professionals do suggest to clients the procurement system that best suits them. The research study also highlights about the specific roles and responsibilities one is expected to play in enlightening the client on the options of selection of procurement system. The following being the hierarchy level in order of preference: Construction / Project Manager, Quantity Surveyor, Architect / Designer, Engineer and Contractor.

### 7. CONCLUSION & RECOMMENDATIONS

The research findings establish that DTB is the most preferred procurement method used in the Gauteng construction industry. Not only is DTB most common amongst past projects but amongst current projects as well, DTB has the best cost, time and quality performance factors hence why DTB is a favoured procurement strategy. There is also a great lack of knowledge from clients regarding alternative procurement systems therefore forcing clients to one familiar route. It would be in the best interest for any professional to lean towards a particular procurement system that they are familiar with to safe guards both the client and himself. Hence in Gauteng the most familiar project is by far “Design Tender & Build”.

<table>
<thead>
<tr>
<th>Role</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity Surveyor</td>
<td>18</td>
<td>25.35%</td>
</tr>
<tr>
<td>Architect / Designer</td>
<td>13</td>
<td>18.31%</td>
</tr>
<tr>
<td>Engineer</td>
<td>8</td>
<td>11.27%</td>
</tr>
<tr>
<td>Contractor</td>
<td>2</td>
<td>2.82%</td>
</tr>
<tr>
<td>Other, please specify</td>
<td>1</td>
<td>1.41%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>71</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
Both short and long term initiatives are required to improve the procurement approaches. There is an immense need to improve construction procurement education amongst both clients and construction professionals. Moreover better connection and interaction between client and consultants is indicated for a more helpful procurement selection process. It is suggested that the involved parties consume their own objectives by bearing in mind only the client’s planned project objectives. This can be achieved through the use of a construction project manager who acts as a controlling implementer for the client and participants. Several techniques exist for the selection of procurement methods. The choice of a procurement system is currently so wide and projects are becoming so complex, yet the South African construction industry lags behind, and still predominantly implements the traditional approach.

If there are ways of avoiding risks to a project at inception without having to change the structure of “traditional” procurement methods then a risk analysis that can be implemented during inception will sure make any procurement method more dynamic. The most important aim of a construction contract is to apportion the risks and responsibilities, the procurement method used on a project can have an effect on the apportioning of the risks between the client and the contractor. A pricing strategy options like “cost plus target contracts” incorporated into DTB can see the risk of a project moving away from the client with the result of the client paying slightly more (premium) for the project. This may perhaps avoid variation orders (with cost implications) on a project, hence all risks need to be identified and reduced or avoided from the beginning of the project.

11 REFERENCES


Technology Malaysia.


Rashid, R., Taib, I., and Ahmad, W., 2006. Effect of Procurement Systems on the Performance Of Construction Projects. *University Technology Malaysia, Department of Quantity Surveying Faculty of Built Environment*.

