



CONFERENCE PROCEEDINGS

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10th cidb Postgraduate Conference

**Towards a better route to enhanced productivity, performance, and
transformation of construction**

**25-27 February 2018
Port Elizabeth, South Africa**

**Editor
Fidelis Emuze**

10TH CIDB POSTGRADUATE CONFERENCE

Edited by
Fidelis Emuze
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25-27 February 2018
Protea Hotel by Marriott Port Elizabeth Marine, Marine Drive, Port Elizabeth, South Africa

PREFACE BY THE CEO OF cidb

The cidb postgraduate conference was initiated to bring together academics, researchers, practitioners and students from the different construction industry disciplines to debate issues of interest. This conference provides a platform to discuss research of interest to the construction industry including the status of the industry and its developmental trajectory as an industry that contributes to national infrastructure, and promotes youth skills development, and empowerment.

Since 2003 the conference has provided a platform for active postgraduate researchers to exchange experiences and observations about the state of the industry and to also provide a knowledge base for the future development of the industry. The focus of the papers presented at the conference have covered areas of construction industry performance, such as health and safety and people in construction; competitiveness of the industry including the development of small and medium contractors; the industry's contribution to socio-economic development and its contribution to employment creation as well as long-term sustainability in the industry.

The cidb postgraduate conference has always focussed on supporting a research agenda that results in the development and transformation of the South African construction industry.

The conference is now recognised as an important event amongst the academic community for facilitating debate, partnerships and knowledge dissemination amongst students and academics across different institutions. It has also made significant contributions to knowledge creation on developmental issues in infrastructure development such as the debates on health and safety, growth of the emerging sector, and impact on government procurement, among others.

Significantly, the cidb postgraduate conference has contributed to the growth of junior academics in our country. From the initial intension of providing a place for potential and up and coming researchers, the conference has grown to become a knowledge partner where industry needs are researched and solved in a collaborative manner with academic institutions.

To date we have professors who first participated in the conference as honours and masters students and have through the years been given a platform to grow to full professors. It is further encouraging seeing that these professors are using the same platform to support the growth and development of their students. This we hope will lead to the continued growth and prestige of the cidb postgraduate conference.

Further growth of the conference is shown by the expansion of its geographic and academic reach. From its humble beginnings as a local conference targeting students and researchers in South Africa, the conference has now grown a global footprint that attracts participants from across the world. It is now recognised as a platform to share research findings by students and academics in countries across the globe and has, over the years, attracted participants from the following countries Botswana, Egypt, Ghana, Kenya, Nigeria, Swaziland and Zambia in Africa; Hong Kong in Asia; England and the Netherlands in Europe, New Zealand and the

Unites States of America. It is our strong belief that the cidb Postgraduate Conference will continue to grow and attain the status of a fully international meeting.

Recognition for the quality of work presented at the conference has come from our professional councils with the South African Construction Project and Construction Management Professional and the Association of Quantity Surveyors awarding continuing development points (CPD) to their professionals for participating in the conference. This is indeed as sign that the humble cidb Postgraduate Conference is making a significant contribution to professional development in the construction industry.

As we celebrate the 10th occurrence of this prestigious event it is our wish as the cidb to see it grow from and strength to strength and to continue making significant contributions to the transformation of our academic institution. The cidb also wishes to congratulate the academics and students who have and continue to deliver outstanding papers, as well as the heads of academic departments in the various universities who have partnered with us through the years to deliver conference.

I would also like to thank the conference organisers, a partnership between Nelson Mandela University and the Central University of Technology, Free State for the hard work and dedication that went into preparing for this celebration. I also wish to acknowledge the conference participants who have been very loyal to the cidb postgraduate conference and wish you all a good meeting.

Mfezeko Gwazube
Acting CEO: cidb
February, 2018

FOREWORD

The organizing committee of the 10th Construction Industry Development Board (cidb) Postgraduate Conference is happy to welcome you to Port Elizabeth, South Africa. The 10th edition of the cidb conference series provides an international forum for researchers and practitioners to put forward progressive ideas on how to advance the performance of the construction industry through the contributions of early career academics. The meeting is a platform where recognized best practices are shared between researchers and practitioners. The conference aims to strengthen industry performance and transformation through a purposive engagement with contemporary discourses. The broad objectives of the conference are to:

- Provide a forum for multi-disciplinary interaction between academics and practitioners;
- Provide an internationally recognised, and accredited conference;
- Disseminate ground-breaking and cutting-edge practices, and
- Contribute to the built environment body of knowledge.

The conference theme is

“Towards a better route to enhanced productivity, performance, and transformation of construction.”

The peer reviewed papers in this edited proceedings thus aligns with the theme by addressing various ways in which productivity, performance and transformation could be engendered in the construction industry.

Fidelis Emuze
Academic Programme Chair
Bloemfontein, South Africa
February, 2018

ACKNOWLEDGEMENTS

The preparation and hosting of the 10th cidb Postgraduate Conference is based on the kindness and sponsorship of the Construction Industry Development Board. The contributions of the cidb is supported by the goodwill from the Nelson Mandela University (Mandela Uni.), the Central University of Technology, Free State (CUT), and other helpful individuals. The organising team is grateful to Iruka Anugwo, Clinton Aigbavboa, Ayodeji Aiyetan, Brink Botha, Lance Wentzel, and Olalekan Oshodi for serving as a Session Chair in the conference. The team also recognize the support of keynote speakers in the persons of Dr Rodney Milford, Prof. Theo Haupt, Prof. Gaye Le Roux, Mr. Eric Manchidi, Prof. PD Rwelamila, and Ms Lisa Parkes.

The effort of the International Scientific Committee (ISC), who diligently reviewed both abstracts and papers that were afterward edited by Fidelis Emuze is affectionately appreciated. The voluntary assistance of the ISC led to the published proceedings that satisfy the subsidy criteria of the Department of Higher Education and Training (DHET) in South Africa. I must mentioned the immense support from colleagues at the cidb, starting from Ms Ntebo Ngozwana who spearheaded the organisation of the event. The role of Rodney Milford is also notable, especially in relation to the strategy support required by the conference. At the academic institutional level, the support of Winston Shakantu (Mandela Uni.), and Alfred Ngowi (CUT) are notable. Through voluntary supports, Mariana Botes, Chris Allen, and Katharina Crafford in Port Elizabeth; and Dillip Das, Bankole Awuzie, Benny Ramafalo, Thabiso Monyane, George Mollo, Michael Oladokun, Evelyn Allu, Portia Atoro and Chikerizim Okorafor in Bloemfontein are much-appreciated. It is also important to mention the web support from Leandra Jordaan.

ORGANISING COMMITTEE

John Smallwood (Technical Programme Chair)
Fidelis Emuze (International Coordinator: CIB TG59)
Mariana Botes (Administration – Mandela Uni.)
Portia Atoro (Administration – CUT)
George Mollo (Editorial – CUT)

DECLARATION

The papers in this conference proceedings have been double-blind reviewed at abstract and full paper stages by members of the International Scientific Committee. This process involved comprehensive reading of the abstracts and papers, reporting of comments to authors, modification of articles by authors whose papers were not rejected by the reviewers, and re-evaluation of revised papers to ensure the quality of content. The conference proceedings are made up of papers that have been reviewed by experts in specific fields of construction research. It is declared that multiple institutions contributed majority of the papers in the proceedings.

THE PEER REVIEW PROCESS

To ensure the quality of the conference proceedings is not compromised regarding the need to comply with the criteria for the Department of Higher Education and Training (DHET) subsidy in South Africa, a rigorous two-tier peer review process by no less than two recognized experts was followed. In certain instances, three reviewers were used to assess the quality of a paper. In fact, four papers were subjected to three reviews before a decision was made. The process was implemented by making sure that each abstract was twice blind reviewed with reference to applicability to the conference theme, scientism, originality of research ideas (and data) and extent of contributions to knowledge. Authors, whose abstracts were accepted, after the stage one review, were provided with anonymous reviewers' reports and requested to submit their full papers for the second round of peer review. The review of the full papers followed the two-tier blind review process again. Authors whose papers were accepted after this second review were provided with second anonymous reviewers' comments and requested to submit their revised full papers (camera ready versions of each paper). These final papers were included in the conference programme and the conference proceedings after evidence was provided that all comments were appropriately addressed by the concerned authors. The Easy Chair online system was fully utilized for the peer review of all submissions for the conference.

The submissions were made to:

<https://easychair.org/conferences/?conf=cidb2018>.

The conference was also hosted on the web through:

<http://www.cut.ac.za/cidb-postgrad-conf/>

The statistics shown below indicate that full papers originated from eight countries:

Country	Authors	Submitted	Accepted	Acceptance rate
Ghana	6	2	2	1
Israel	1	1	1	1
Kenya	1	0.33	0.33	1
Nigeria	7	4.83	3.83	0.79
South Africa	89	52.7	48.7	0.92
Swaziland	1	1	0	0
United Kingdom	7	1.63	1.63	1
Zimbabwe	1	0.5	0.5	1

The members of the International Scientific Committee (ISC) were not involved in the review related to their own authored or co-authored papers. The role of the editor was to ensure that the final papers integrated the reviewers' comments and position the papers into the final order as captured on the Table of Contents. A total number of 92 submission were received through the abstract and paper submission stages. However, only 55 papers were accepted for inclusion in the proceedings. This statistic results in an acceptance rate of 59.8% / rejection rate of 40.2%. The total reviews conducted by scholars at the paper review stage stand at 132 with four papers. The inclusion a paper in the proceedings is predicated on acceptance consensus from the reviewers. All rejected papers failed the acceptance litmus test.

Best wishes,

A handwritten signature in black ink, appearing to be 'F. Emuze', with a long horizontal line extending to the right.

Fidelis Emuze
Academic Programme Chair
Bloemfontein, South Africa
February, 2018

INTERNATIONAL SCIENTIFIC COMMITTEE

The peer review exercise for the 10th cidb Postgraduate Conference was expedited through the voluntary contributions of scholars from various international institutions. The editor sincerely appreciate the contributions of all reviewers listed below:

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HOSTS

Department of Construction Management



Department of Built Environment



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THE AMOT ATRIUM - AN EXEMPLAR FOR SUSTAINABILITY

Anja (HJ) Holtzhausen¹

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Identifying architecture fulfilling sustainability criteria through specialist rating bodies such as LEED (Leadership in Energy and Environmental Design) is a global trend. Increasing urban density makes sustainability in high-rise architecture imperative. The design and technology of the Amot Atrium Building (Tel Aviv) achieved sustainability targets through several technologies. One of the first office buildings in Israel to achieve the Platinum Building Design and Construction: Core and Shell status from LEED by completion in 2016, the Amot Atrium sports a variety of sustainable architectural elements. An in-depth look at the building's context to provide sustainable solutions is given. Mechanised envelopes ensure a regulated internal environment in the extreme heat and humidity of Tel Aviv. Intelligent townplanning and provision for easy access to alternative transport is discussed, as are water use policies, essential in the drought-stricken semi-arid environment of Tel Aviv. Energy efficiency through the use of alternative energy and mechanised daylighting and ventilation ensuring occupant comfort are examined. Sustainability exemplars provide benchmarks for designers. LEED can be seen as the foundation for country specific rating systems such as the GBCSA (Green Building Council of South Africa) and the GBCA (Green Building Council of Australia). Lessons learned from the Amot Atrium can be applied to South Africa. Various climatic regions may require different technologies for achieving sustainability and the Amot Atrium is specific to a Mediterranean climate. Examining criteria for buildings to achieve high ratings of sustainability provide motivation for designers to achieve similar or better levels of excellence. The assessment of the framework will determine its adaptability in the construction industry context.

Keywords: Sustainability, Sector Transformation

INTRODUCTION

The Amot "Atrium" is an icon in the Ramat Gan area of Tel Aviv with its angled "head" peeking at you around corners, and over neighbouring buildings. The name is derived from the four story high Atrium lobby with a sculptural stair element by Architect Oded Halaf.

I had the opportunity to be in communication with Daniel Alon Aloubafia, the Environmental Engineer of Alfa Sustainable Projects on the issue of building design, principles, practice and sustainability. The purpose of the professional team was to achieve quantifiable and innovative outcomes for their client, Amot Investments Ltd., a high-end real estate investment holding company, and priding themselves in using the latest technology available in their buildings. The team engaged its project stakeholders at the outset of the project in a collaborative manner to develop sustainability objectives in clear and measurable terms. The team's goal was to deliver a commercially viable solution which clearly demonstrated a reasonable approach to the environment while strengthening the urban fabric of Ramat Gan.

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The certification process involved pre-certification in 2013, a design phase submittal, and a construction phase submittal to LEED.

TEL AVIV CLIMATE

Tel Aviv is a Mediterranean city with high temperatures and an average annual relative humidity of 71% (ASHRAE Inc, 2005). As found by Olgyay (1963), the Thermal Neutral Zone for humans is between 25 and 30 degrees C with a relative humidity of between 30 and 65% as shown in the bioclimatic chart. The hot period in Tel Aviv can last up to 8 months (From March to October).

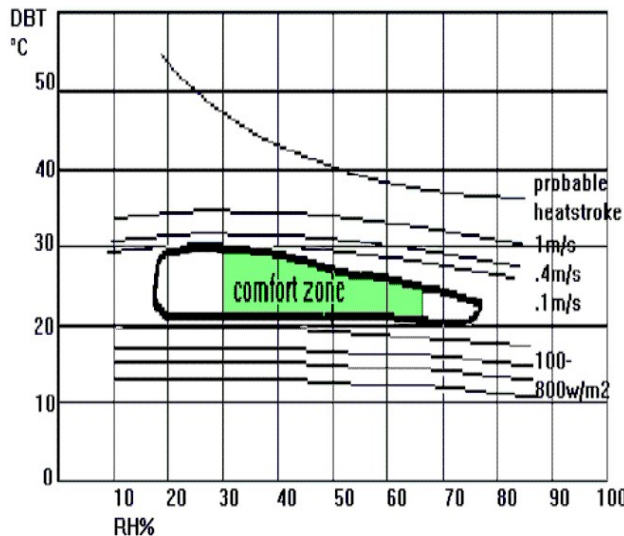


Figure 1: Bioclimatic chart (adapted from Olgyay, 1963)

The mild winters have limited daylight and occasional strong winds. Achieving thermal comfort in Tel Aviv requires the reduction of relative humidity, and cooling for most of the year.

SUSTAINABLE FEATURES OF THE AMOT ATRIUM

Urban connectivity.

The building received high scores on its site selection, development density, community connectivity and alternative transportation.

The building is situated on a previously developed site, and has the following existing basic services within a 800m radius from its entrance: Bank, Place of Worship, Convenience Grocery, Library, Medical Office, Park, Pharmacy, Restaurant, School and a Theatre. The building is 370m from the main railway centre, and the first bus stop is approximately 50m from the entrance.

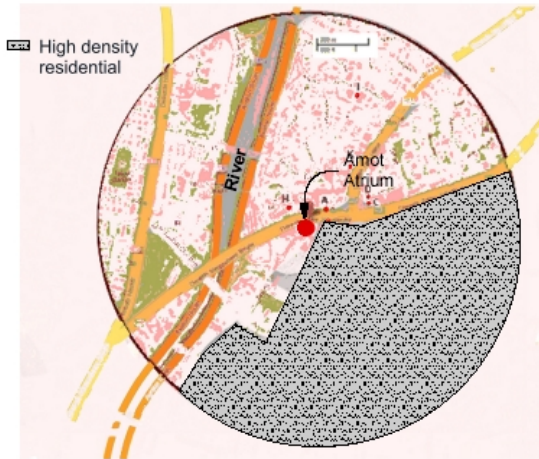


Figure 2: Plan view showing 800m radius around the building

One of LEED's criteria for urban connectivity is the proximity to residential areas with a density of over 10 units per acre. Within the 800m radius from the entrance, the Amot Atrium is in proximity to 200 acres with an average density of 15 units per acre.

Ample secure parking was provided for bicycles, and the bicycle parking is well used. The cyclists have the opportunity to shower at the gym that is part of the building. Access to disabled people is provided for via wide ramps and lifts where required. The

The heat island effect was reduced by providing eight stories of underground parking, ensuring a 100% underground parking area. LEED certification requires preferential parking for electric vehicles, and the Amot Atrium still has to provide charging points for electric vehicles. Amot Investments Ltd. (2016) states that the building is on the Green Visit Route that is part of the Green Construction Education group

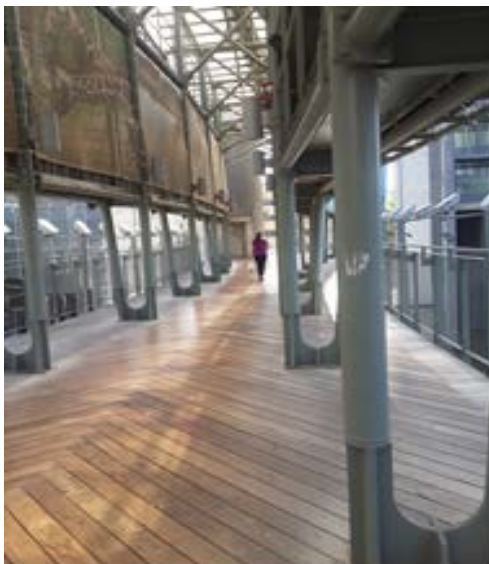


Figure 3: Pedestrian bridge over busy street with lifts to the Amot Atrium

Innovation in design.

A pioneer in hot climates, the double skin curtain wall system developed by Alfa Sustainable Projects Ltd., assists with cooling the building envelope in summer and reduce heat loss in winter. The outer glazing is flush with the frame, providing a smooth appearance from the outside of the building. A low iron content removes the

green tint while increasing the light transmission, brightness and clarity. The glass is printed to hide the mechanism of the shading, providing a neutral exterior façade

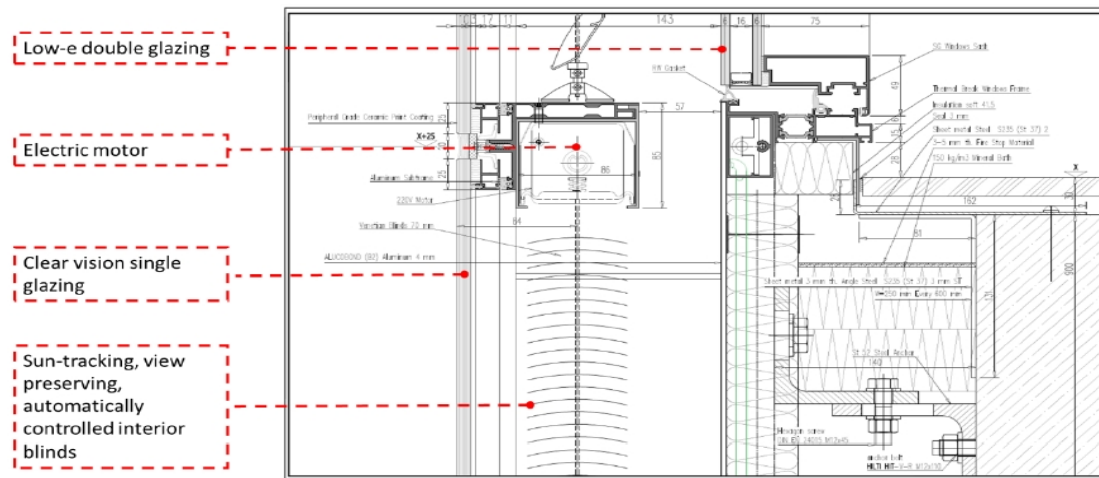


Figure 4: detail section of double skin window

Computational Fluid dynamics (CFD) tools were used to optimize the double skin façade design. The double skin curtain wall is cooled by stack effect combined with extraction fans at the top of the building. Air is taken in at the bottom of the skin through a synthetic polymer filter and moved through the cavity to the top of the building. 22volt motors control the 70mm venetian blinds inside the cavity that are linked to a sun-tracking system to optimise cooling and daylighting.

Daylight, occupancy volume and fresh air detectors are used to assist in achieving thermal comfort. The Venturi effect between the first and second layers of glazing was initially considered but discarded in favour of the current solution. The Venturi effect can be explained with fluids accelerating when moving through a narrower space.

The author could not access any precise figures of the actual energy saving by the double skin curtain wall.

Indoor quality

The planning of the project is aimed at delivering at least 97% of the leased spaces with a line of sight to an external view. The post-occupancy air quality tests provided results that 30% more fresh air is provided than the ASHRAE 62.1 standard for office indoor air quality, and all the paints, sealants, adhesives, carpets and chairs comply with the Volatile Organic Compound (VOC) limit. Most Israeli offices fail to meet the VOC limits. Daylighting is manually controllable in 55% of the spaces, and 77% of the spaces has occupancy detectors. Tenants have the opportunity to manage their power consumption with the presence of sub-metering.

Elevator design

According to Bannister, Bloomfield and Chen (2013), 8.4% of a highrise building's base energy (excluding tenants lights and energy) use is attributed to its lifts. A cabled lift consists of a car, machine, and a counterweight. The counterweight equals the weight of a half-loaded car. A lightly loaded car will be lighter than the counterweight, and a full car will be heavier than the counterweight. This difference in weight helps the lift to use gravity to travel up with a light load or descend with a heavy load. Making use of a regenerative drive reduces that energy consumption by up to 75%.

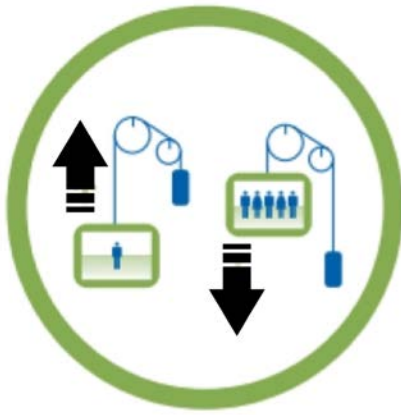


Figure 5: Energy created during specific loads

With the help of gravity, electricity is generated, that in traditional lifts would be wasted. The regenerative drive feeds the energy created back into the lift system. A lovely aspect of the placement of the High Zone lifts is that they face the street, providing a view of perpetual up and down motion to passers-by. The use of the waste heat loads reduces the HVAC energy needs for additional cooling. The whole system is centrally controlled with a compass system, and a critique is that when one lift is out of order, the other lift programs are not synchronised.

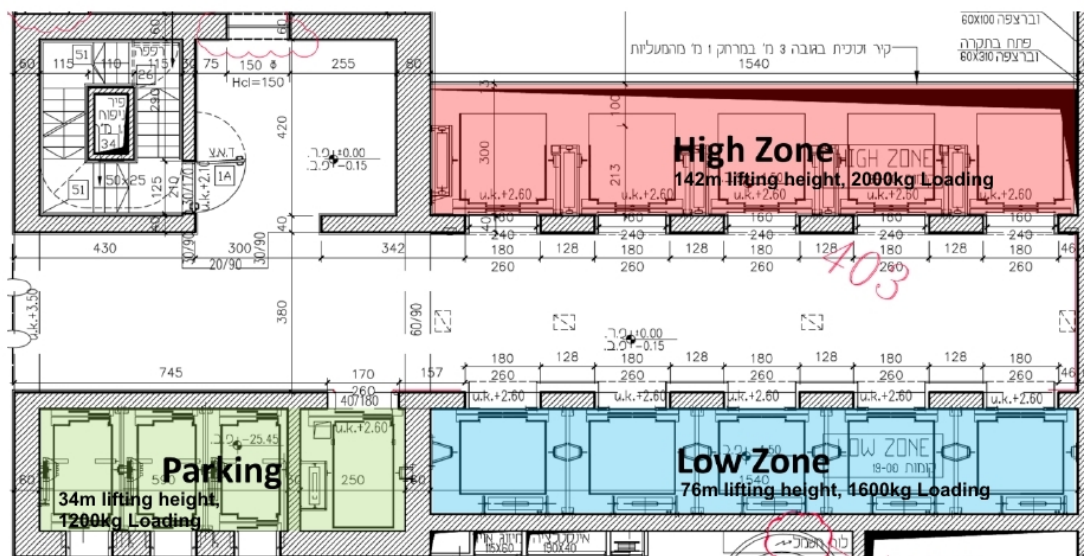


Figure 6: Lift zones

Other sustainable features of the lifts are the use of LED (Light Emitting Diode) lighting (that lasts up to 10 times longer than fluorescent lamps) that are on automatic switch-off mode when there is no passenger demand. The rollers are low friction, and the pulse belt monitoring system provides continuous and accurate monitoring and reporting of the system. A large number of high rise buildings in Israel have a Sabbath lift - a lift that permanently works and stops on every floor for the duration of the weekly Sabbath. To conserve energy, the Amot Atrium does not have a Sabbath lift.

HVAC condensation recycling

Due to the high relative humidity in Tel Aviv, a lot of moisture is generated with the cooling of buildings. The condensed water from the HVAC (heating, ventilation and

air conditioning) system is collected for use of toilet and urinal flushing of the first 10 floors of the building.

The condensed water is collected in a primary balancing tank on the bottom basement floor where it is passed through a sand filter into another tank for basic chemical dosing before going into the flush fixtures

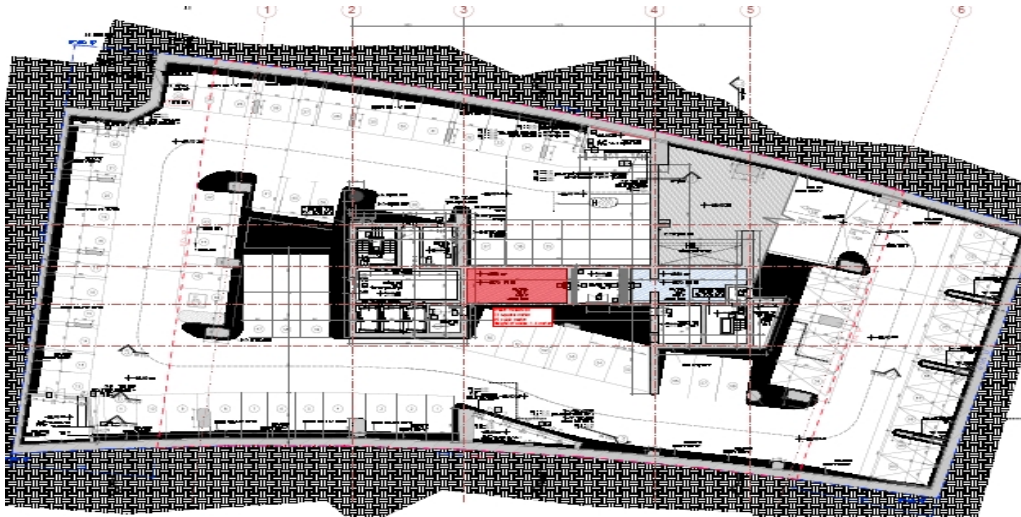


Figure 7: Basement level -8 showing water reservoir position

The system is backed up with municipal water when necessary, however the calculations show that condensation water collected on site equals $3235.125\text{m}^3/\text{year}$. The water demand for the flush fixtures of the first 10 floors is $1044.7\text{m}^3/\text{year}$, and the landscaping irrigation needs for the project equals 169m^3 per year, the combination of which is well below the amount of water generated.

Photovoltaic energy

The roof is covered with highly reflective materials and a Photovoltaic (PV) System. $120 \times 100\text{Watt}$ panels are fitted flat on the rooftop delivering enough power to light the public area of one of the floors of the building. Every series has 15 modules that are fed to 15kW inverters. Efficiencies are lost in the system by lack of optimum orientation of the PV panels. The total surface area of the PV array is 192m^2

The PV system provides 1.58% of the building's annual energy consumption of $1,200,000\text{ kWh}$ which may not seem a lot, but it still reduces the building's ecological footprint.

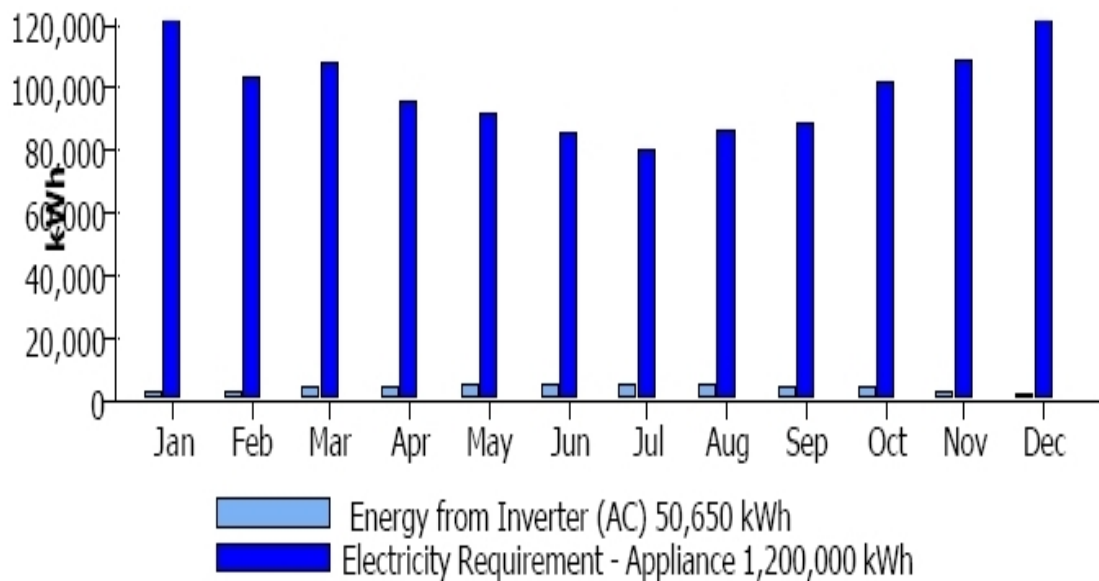


Figure 8: Solar Energy Consumption as Percentage of Total Consumption

CONCLUSIONS

The Amot Atrium provides a benchmark for other high rise buildings in Israel, using technologies that are non-standard practice in Israel.

The building is well placed in an urban environment close to the required amount of amenities. Innovative glazing solutions assist in providing thermal comfort in the extreme heat of Tel Aviv. Using advanced technologies such as regenerative drives for lifts, and photovoltaic systems, the building's energy demand is reduced. Not all intended features of the building could be realized.

From studying the building, there is enough evidence to continue investigating improvements of the sustainability of a building's structure, function and services.

The LEED system of evaluating green buildings, is a valuable tool to promote the "greening" of architecture. The way forward is to continue on the path for further development of Sustainable Architecture and increased public awareness.

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AN IDENTIFICATION OF COST MANAGEMENT CHALLENGES IN THE PUBLIC-SECTOR PROJECTS

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The prevalence of cost overrun in public sector projects is a call to all stakeholders to address cost management issues in the construction industry. This study seeks to make sense of these extant cost management practices. Such sense-making will enable an evaluation of the status quo and identify challenges hindering effective cost management during project delivery. Adopting a qualitative case study research design, this study relies on data obtained from a purposively selected list of interviewees from a coterie of cases, i.e., recently completed public sector construction projects in the Free State. These interviews will be juxtaposed with evidence from project-related documents. Based on the data, the study will provide a vignette of extant cost management frameworks applied to these projects. Encompassing various stages of the project delivery lifecycle, this vignette will enable an identification of the challenges afflicting cost management on these projects. It is expected that findings from this study will provide a succinct picture of the failings of current cost management frameworks.

Keywords: Construction, Cost Management, Projects, Public Sector, South Africa

INTRODUCTION

The construction industry in South Africa has remained the essential role player in the country's gross domestic product. The contribution made by the industry amounted to 4.9% in 2014 according to (Nimbona and Agumba 2014). The importance of the industry in contributing to job creation is highlighted by Mbatha and Mokhema (2014), whereby the industry became the highest hiring industry in the third quarter of 2014 with 99 000 jobs. The importance of performance improvement in the construction industry is underscored by the role it is playing in the economy. However, the industry is notorious for various forms of overruns recorded on projects (Ramabodu and Verster 2010; Baloyi and Bekker 2011; Ramabodu and Verster 2013; Monyane and Okumbe 2012; Mokuka, Aigbavboa and Thwala 2014). The management of construction projects is evaluated through the lens of project management parameters. Cost management is a parameter with multiple pathways of monitoring and control. The consistent report of cost overrun on projects is a reason to assess whether current cost management practices are successfully dealing with the challenges of the modern construction.

As mentioned earlier, cost performance of projects in the industry is a cause for concern. Regarding this paper, cost management challenges manifest through 'dissatisfactions' that are linked to either non-expenditure of budgets or over-expenditure of the budget. Challenges such as project poor estimating practices worsen the delivery of construction projects (Nimbona and Agumba 2014). In a recent

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study to address global cost management issues, Smith (2014) mentioned several blowouts of cost budgets on major projects around the world, which amounts to hundreds of millions and billions of dollars. Also, the problem is exacerbated by the 2008 global financial crisis that continues to have a significant impact on project financing around the world as financiers tighten controls on lending and avoid lending to projects lacking sufficient risk control (Smith 2014). Similarly, Ali and Kamaruzzan (2010) stress the importance of controlling cost to improve project performance. Construction projects are unique, and they tend to assume a higher dimension of complexity as they increase in size. In developing countries, cost management approaches have proven to be the less efficient when compared to time management (Ramli 2003).

A construction project is an inter-organisational process, which requires all stakeholders' contribution to achieve the goal of successfully completing the project within agreed constraints. According to Namadi, Pasquire, and Manu (2017), the current project delivery system still treats design and cost as a separate and independent function carried out discretely. Similarly, the United Kingdom (UK) and South Africa traditionally assign cost management duties to the chief Quantity Surveyor (Qs). Namadi et al. (2017) further reiterate that this practice of assigning cost management mainly to the chief QS accounts for much of the cost overruns that is prevalent in the construction industry due to its lack of collaborative approach to costing.

In the South African context, numerous studies have established cost overrun as a common problem that it requires appropriate interventions (Ramabodu and Verster 2010; Baloyi and Bekker 2011; Ramabodu and Verster 2013; Monyane and Okumbe 2012; Mokuka, Aigbavboa and Thwala 2014). In response to the call for interventions, this study was commissioned. The research that is reported in this paper forms an integral part of the broader lean-led study. The failings of current practice could provide opportunities for the introduction of lean-based solutions. The article thus presents a vignette of extant cost management practice in public sector driven projects. Incorporating various stages of the project delivery lifecycle, this vignette enables the comprehension of the cost management challenges on the identified projects.

LITERATURE REVIEW

Challenges of current cost management practices

Some studies have highlighted the problems of cost management performance of the industry. For instance, Ndihebukwayo and Haupt (2009) identified waste arising out of variation order on projects in South Africa construction industry. The study also found out that, excessive variations result in unnecessary costs to the project. The study concludes that clients link variation orders are connected to additional scope approvals. The changes in scope indicative of haste in project planning.

Similarly, Ramabodu and Verster (2010) established cost overruns is a problem in the Free State province of South Africa. They identified critical factors contributing to cost overruns by ranking them in order of importance. Furthermore, the latter study concluded an essential consideration for minimisation of the cost overruns to be overcome by removing the human element. □

The normal practice of delivering public sector projects the traditional way is to assign all professionals to handle the predesign tasks in a fragmented manner. The research

conducted by Mukuka, Aigbavboa, and Thwala (2014) revealed that the traditional way of improving cost performance is not providing value in the construction industry. Akinyede, Fapohunda, and Ayodeji (2014) also affirmed that the cost increases that happened daily on site are due to valuable construction resources demanded for production.

Outcomes of Traditional Cost management approaches

Hanid, Siriwardena, and Koskela (2011) identified seven key issues in cost management. They described the problems as shortcomings of cost management practice. The issues were first identified through literature and then validated with explorative interviews. The seven critical issues and /or shortcomings were:

- Failure to forecast;
- Failure to support improvement opportunities;
- Costs are considered as resulting from action;
- Relative neglect of value consideration;
- Poor support for inter-organizational cost management;
- Negative influence on behavior, and
- Constraint created by budgeting.

The severity of ineffective and poor cost management on public sector projects in South Africa is illustrated in Figure 1. Figure 1 indicates cost performance to be amounting to only 60% instead of the desired 95% (Samuel 2008).

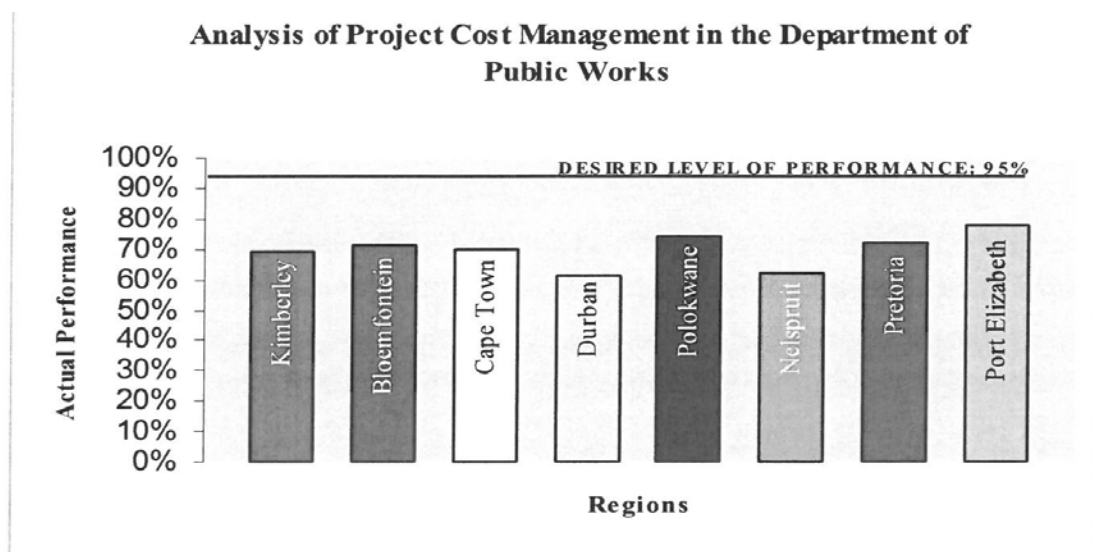


Figure 1: Analysis of project cost management on the Department of Public Works (Adpted from Lesele 2006 cited in Samuel 2008)

Figure 1 is a sign that public sector projects were still performing poorly concerning cost management. 32 years after, it appears that this paradigmatic shift is yet to occur as underwhelming project cost performance figures are on the increase, particularly in SA hence this study. This notion was long reported by Bowen and Edwards (1985) in which they espoused that a paradigm shift is imminent, whereby we must move from a deterministic stance, where cost models and price forecasts are based upon a 'single figure' to a more representation of reality in which price variability is explicitly considered.

Effective Cost Management and the Quantity Surveyor

Poor cost performance emanating from construction projects delivery is not just a local dilemma but a global phenomenon affecting owner's budgets, affordability of end-users and competency levels of project teams (Obi, Arif and Awuzie 2015; Memon, Rahman, Abdullah and Azis 2014; Smith, 2014; Mbachu & Nkado 2004). The Quantity Surveying (QS) fraternity traditionally conduct cost management functions in South Africa (many other Commonwealth countries). The QS profession evolved from the 17th century. The Royal Institute of Chartered Surveyors (RICS) established it as a practice in 1864 (Seeley and Winfield 1999 cited by Ashworth, Hogg and Higgins 2014). The contribution of QSs has traditionally being to offer cost advice, assist with alternative designs solutions, providing cost estimates of preliminary designs and procurement using elemental cost planning and checking (Kirkham 2007 cited by Namadi et al. 2017). Also, Ashworth et al. (2014) further list duties of the QSs to encompass post contract cost management tasks such as interim valuations, change control and to assess variations in final account.

Quantity surveyors employ traditional cost planning. A study by Zimina, Ballard, and Pasquire (2012) views traditional cost planning as ineffective and inadequate for effective cost management that produces value for money. The authors express their view as a challenge since the initial decision-making is solely dependent on the Architect rather than a collaborative decision making from all project participants. Thus, it is presumed that the reduced cost performances observed from public sector projects could be because of the lack of adequate techniques employed.

RESEARCH METHOD □

The study has adopted a qualitative research design. Case study research is commonly used when researchers want to comprehend a contemporary phenomenon within contextual conditions and when they have little control over events. The choice of descriptive case studies was based on the notion that it could produce context-specific insights (Yin 2014). Also, case studies' reputation is legendary for prompting an in-depth investigation of a phenomenon within its natural context. Also, the use of multiple cases encourages and sustains enhanced replication across cases. With the usage of numerous sources of evidence, it advocates construct validity (Yin 2014). The use of multiple cases to test a range of cross-case propositions boosts the external validity and enhances replicability, with both literal and theoretical replications alike. The study purposefully selected four cases from the department of public works. The projects were constructed in the last ten years. Means of document analysis analyzed the textual data. The document analysis data were supplemented with semi-structured interview data collected from project actors in the selected cases.

Organisational consent was sought from the Department of Public Works head office in Pretoria, through a letter to the Director-General. The interviewee sample comprised of a select group of experts who were part of the case study projects sampled for evaluation. In all, 15 interviewees were recruited, six interviewees were each drawn from the construction project management, architecture, civil engineering, electrical engineering, mechanical engineering, and quantity surveying cohorts respectively. Sampling was guided by project cases which rule out bias from the authors. Sessions for the interviews lasted for an average of 25 minutes each. Semi-structured questions were asked in the interview format. The semi-structured interviews were chosen because of the use of similar questions instead of identical questions as would be the case if structured interviews were espoused (Denscombe

2010). Interviewees were requested to discuss their roles in various stages of the life cycle of construction projects. The interview sessions were recorded and transcribed with permission of the interviews. To make sense of the data, the transcripts originating from the transcription exercises were read more than once by the researchers independent of each other. Pre-determined themes which were aligned to the research objective and questions. Pre-set themes evolved from the coded data.

FINDINGS AND DISCUSSIONS

Table 1 illustrates two case projects in the extreme positions regarding poor cost performance as earlier advocated by Samuel (2008). However, Table 2 demonstrates a different picture of two other project cases highlighting a better cost performance from the public-sector client. Reasons behind the two differences were because of the client demanding value engineering exercises to improve the outcome. Secondly, projects performance is measured after completion without really looking at the cause and effect of different reasons for the result. Table 1 for the two projects that have indicate poor cost performance. Table 2 is two projects that show to have had a good cost performance as a comparison to Table 1.

Table 1: Project 1 and Project 2

PROJECT INFORMATION		PROJECT INFORMATION	
Department	Department of Health	Department	Department of Education
Project Name	Extension to Boitumelong Hospital	Project Name	New Primary School□
Town	Kroonstad	Town	Bothaville
Date of site handover	28 July 2011	Date of site handover	02 October 2013
Actual start date	21 November 2011	Actual start date	02 October 2013
Completion date	November 2014	Completion date	29 May 2015
Actual completion date	April 2015	Actual completion date	29 May 2015
Contract amount	R138 263 009.29	Contract amount	R28 152 536.86
Final Amount	R170 339 718.37	Final Amount	R32 758 734.81
Overrun amount	R32 076 709.05	Overrun amount	R4 606 197.95

Table 2: Project 3 and Project 4

PROJECT INFORMATION		PROJECT INFORMATION	
Department	Department of Health	Department	Department of Education
Project Name	New Mantsopa Hospital	Project Name	New Special School
Town	Ladybrand	Town	Kroonstad
Date of site handover	12 August 2010	Date of site handover	02 March 2016
Actual start date	12 August 2010	Actual start date	02 October 2017
Completion date	12 January 2013	Completion date	02 October 2017
Actual completion date	12 January 2013	Actual completion date	02 October 2017
Contract Amount□	R264 662 777.29	Contract Amount□	R39 400 000.00
Final Amount	R264 662 777.29	Final Amount	R38 977 652.13
Overrun amount	R0.00	Overrun amount	- R422 347.87

Observed cost management practice from project participants

Figure 2 is the vignette for the current mode of project delivery and cost management processes carried out on public sector projects. The vignette is derived from semi-structured interviews conducted in the case studies. It is notable that the method of delivering public sector project can be classified as a traditional design by employer according to the Integrated Development Management System toolkit used by the National Treasury. It must be noted that schools project utilized design-build model of project delivery because designs are standard and there is no need for new drawings. However, despite the difference in project delivery method, recorded cost performance experienced by the design-build projects both performed poorly and another one performed exceptionally well. Figure 2 is a vignette for stages 1 to 6 of the professional consultant service agreement (PROCSA) signed between client and each professional team. The stages detail what service is expected of every professional appointed and the anticipated outcomes in each stage to enable an opportunity for fee claim after each stage is completed. Consultants carry out tasks related to the project at each stage and after such a phase is completed a fee claim can be submitted for payment to the professional. These are the stages critical in identifying cost management approaches employed by professionals and various tasks carried out to highlight opportunities for lean thinking strategies to improve the status quo of how professionals deliver projects to the client to the intended outcome of project parameters. Each stage represents the activities carried out related to each project executed by these professionals.□

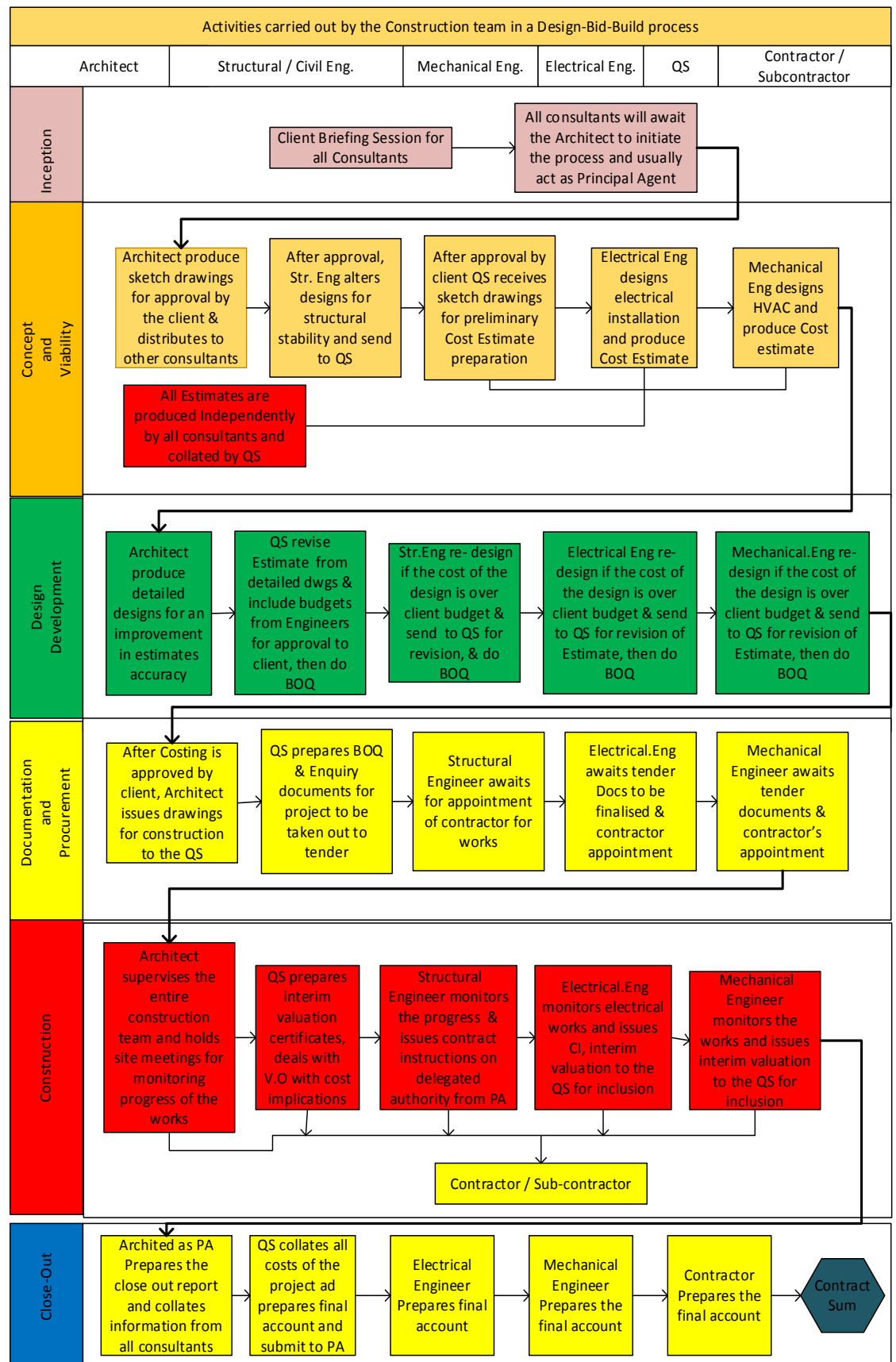


Figure 2: Observed activities from project participants

PROJECT 1		Cost management process on Design-Bid-Build projects		PROJECT 3
Cost element		Responsibility.	Cost element	Responsibility.
Inception	Number of meetings held -2	Client	Number of meetings held - 3	Client
Concept and Viability	Period for sketches – 3 weeks, Period for QS estimate -2 weeks Period for Electrical designs -2 weeks, Period for Mechanical designs 2 weeks. Number of meetings – 2 for approval	Architect as Principal Agent (PA)	Period for sketches – 5 weeks, Period for QS estimate - 4 weeks Period for Electrical designs - 2 weeks, Period for Mechanical designs- 2 weeks Number of meetings for approval - 5	PA
Design Development	Detailed drawings and specifications – 2 weeks, BOQ production – 3 weeks Electrical costing – 2 weeks Electrical BOQ – 1 week Mechanical costing – 2 weeks Mechanical BOQ – 1 week Number of Meetings – 2 for approval	PA	Detailed drawings and specifications – 6 weeks, BOQ production – 4 weeks Electrical costing – 4 weeks Electrical BOQ - 2 weeks Mechanical costing – 4 weeks Mechanical BOQ – 2 weeks Number of Meetings – 5 for approval	PA
Documentation & Procurement	Collating all BOQs – 2 weeks Tender document – 2 weeks Compiling and printing and binding tender – 1 week Meetings for approval – 1 week Advertising of tender - 8 weeks Adjudication of tender 8 weeks Appointment of contractor – 2 weeks	QS & PA.	Collating all BOQs – 2 weeks Tender document – 2 weeks Compiling and printing and binding one tender doc – 1 week Meetings for approval – 3 week Advertising of tender - 8 weeks Adjudication of tender – 6 weeks Appointment of contractor – 2 weeks	QS & PA & Client departments
Construction	Site hand over – 3 weeks Start date – contractually Revision of drawings – 5 revs Nr of RFI from contractor – 12 Project delay – 5 months Delays with Contractor payment – Yes, 3 months Scope creep – Yes with cost Time overruns - Yes Cost overruns - Yes Number of site meetings - 54	Client & PA.	Site hand over – 1 week Start date – contractually Revision of drawings – No revs Nr of RFI from contractor – None Project delay – None Delays with contractor payment – Yes, 1 month Scope creep – None Time Overruns - No Cost Overruns - No Number of site meetings - 19	QS & PA & Client departments
Close-Out	Agreement of final account – 4 months, Close out report – 2 weeks	QS, Mechanical, Electrical Engineers. & PA.	Agreement of final account – 4 months, Close out report – 2 weeks	QS, Mechanical, Electrical Engineers. & PA.

Figure 3: Cost management process from project participants

DISCUSSION

Figure 3 above is what the respondents have revealed to what has transpired from project 1 and 3 only. The study analyses only project 1 and project 3 from the four project cases due this being results of preliminary findings of an ongoing study. The study exposed the inefficiencies of the existing cost management processes in selected cases in figure 2 and figure 3. From the foregoing, costing is still carried out independently by the design team early on the project. The current practice encourages the so called "silo mentality" this indicates failure to support improvement opportunities, inability to forecast of which is like findings of (Hanid et al 2011). Figure 3 show that project one pre-contract planning was done quicker than project three, of which then led to huge amount of variations during construction hence the poor cost and time performance. This is confirmed as relative neglect of value consideration from the findings of (Hanid et al 2011). Project 3 from figure 3 indicates a successful cost performance due to better planning and high number of approval meetings observed from client for designs and costing unlike project one. Respondents also revealed that project one had less commitment from the client side hence major

changes came later. Hanid et al. (2011), demonstrates in their findings negative influence on behavior. □

However, project three recorded a better project performance concerning time and cost. Project 1 illustrates that a quicker pre-contract planning It is notable that in the case studies, the QS is still the custodian of the costing process. Again, findings of Hanid et al. (2011) illustrated this failure to support inter-organisational cost management, inability to sustain improvement opportunities and constraints created by budgeting. The only exception is the mechanical and electrical subsections of a project which are handled by their respective engineers for costing. Again, that creates a silo mentality of which collaboration for cost management is still fragmented. The PROCSA stages of construction are mostly followed in lieu of rationale for professionals to claim for fees and hence the following those stages of the latter. The relationship of different organizations and individuals involved in projects impact on the delivery of construction projects for the public sector.

CONCLUSIONS

The study firstly showed a vignette of the activities carried out by the professional team and interaction with the client during planning and execution of public projects using the PROCSA document which is a service level agreement in the South African Construction Industry. Subsequently, study demonstrated how respondents went about the process of cost management of the two project cases from the selected four. Figure 3 further demonstrated the inefficiencies of the existing cost management processes by comparing two of the projects extracted from both Table 1 and Table 2. □

From evidence of the case studies, it can be concluded that spending less time or enough time on planning for the project does not necessarily equates a favorable outcome expected concerning project parameters. However, the cases also reveal that there is an opportunity to spend just the right amount of time but using it efficiently and collaboratively to achieve the intended outcome for the client.

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IDENTIFICATION OF THE UNCERTAIN EVENTS IMPACTING ON CONSTRUCTION TIME OF SOUTH AFRICAN HIGHWAY PROJECTS

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This paper examines the uncertain events encountered in the construction process of highway projects towards evaluating their impact on construction time of highway projects in South Africa. The rationale for this examination stems from the view held by scholars that highways are complex projects initiated in dynamic environments which are often beset by different uncertainties and the lack of appropriate evaluation of the uncertain events that occur during the construction process. The research made use of a review of extant literature in the area of uncertainty management and modelling in infrastructure projects to guide the direction of the study, brainstorming and interviews of highway experts in identifying the factors of uncertainty that impact construction time on infrastructure projects. A simple uncertainty matrix for South African highway projects was developed using a quantitative model and descriptive statistics. It emerged from the study that the uncertain events that affect the construction time of highway projects are distributed by Economic, Environmental, Financial, Legal, Political, Social and Technical factors. Also, it was found that each factor contains several uncertain events which impact on construction time differently, through a combination of the uncertain events of the individual construction activities. Based on the findings, it can be concluded that construction time on South African highway projects is significantly related to the social and technical factors of uncertainties. The matrix developed will be useful in modelling uncertainty of the cost and time of individual construction activities in highway projects.

Keywords: Construction Time; Highway Project; South Africa; Uncertainty

INTRODUCTION

Highway construction projects are subject to risks and uncertainties (Moret & Einstein, 2016). There are various risks and uncertainties existing in highway construction projects that affect construction performance differently. Risks have different probability of occurrence that impact project performance (Walker et al., 2003) causing schedule delay or cost overrun (Chapman, 2006; Wang & Chou, 2003; T. M. Zayed & Halpin, 2004). The number and importance of such events depend on the size and complexity of the construction project (Zavadskas, Turskis, & Tamošaitiene, 2010). Highway projects is one of the most dynamic, challenging and complex construction projects because it is exposed to different risks (Mills, 2001). According to Flyvbjerg (2007) the uncertainty in highway projects are more than other construction projects, because of its unique features which include complexity between major construction activities, long duration of construction, dynamic process, repetitive linear project and mobile construction sites. Uncertainty affecting the construction projects has long been recognised by researchers as a major obstacle to

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achieving the projects objectives and low levels of productivity (Antunes & Gonzalez, 2015; Bloom, 2014; Childerhouse & Towill, 2004; Moret & Einstein, 2016).

Uncertainty means an unknown phenomenon (Walker et al., 2003) that is associated to the location and is project specific and has no root causes that can be generalized (Ramanathan, Narayanan, & Idrus, 2012). Therefore, there is an obvious need to effectively anticipate, identify and classify the uncertain events on different locations and projects to assess their influence on the objectives of construction projects. Uncertainty assessment involves identifying, evaluating and modelling various uncertainty events in the construction process of highway projects and developing a model for quantifying the impact of different events on projects objectives.

The magnitude influence of uncertainty can be assessed by two parameters, probability of occurrence and severity (Gadd, Keeley, & Balmforth, 2003; Institute, 2013; ISO, 2009). Quantification of these factors with classical methods such as probability analysis and influence diagram are very difficult (Zeng, An, & Chan, 2005). Efficient applications, quantification techniques are difficult and complex, and furthermore, exact data are required (Winch, 2010). Unfortunately, such data either do not exist at all or are hard to obtain. Furthermore, most of the classical mathematical assessment methods such as differential equations are not able to examine the relationship between input variables and an output variable and they are not well suited for uncertain problems (Youssef, 2004). Stepwise Regression Analysis (SRA) on the other hand is used in modelling to examine the strength and direction of relationship between each dependent variable and an independent variable and the results indicate this relationship is statistically valid. Also, SRA is able to estimate the dependent variable when the independent variable is known.

Therefore, this current research examines the uncertainty events in the construction of highway projects in South Africa and whether there are key events which have a significant impact on their completion time, towards developing SRA models to assess the impact of uncertainty on the completion time of highway construction projects

LITERATURE REVIEW

The effect of uncertain events on infrastructure projects objectives have been identified in several works of literature (Anderson, Molenaar, & Schexnayder, 2007; Antunes & Gonzalez, 2015); Barker and Haines (2009); (Moret & Einstein, 2016; Renuka, Umarani, & Kamal, 2014). The occurrence of uncertain events in highway construction projects are more than other construction projects, due to the unique features of highway projects which include complexity, long duration of construction, dynamic process, repetitive linear project and mobile construction sites (Flyvbjerg, 2007). Due to the peculiar nature of uncertainty, there is the need to identify and classify the uncertain events and their factors using the breakdown structure and the risk and uncertainty management process to assess their impact.

One of the most comprehensive research in the field of uncertainty factors identifications was done by Aziz and Abdel-Hakam (2016). They explored 293 disruptive events as delay causes of road construction projects in Egypt under 15 major groups. Another notable research was done by Odediran and Windapo (2017). They identified 81 risks in African construction markets under five major factors namely Political, Social, Economic/financial, Procurement, Design and Construction. Similarly, Assaf and Al-Hejji (2006) evaluated 73 uncertain events that cause delay in

different types of large construction projects in Saudi Arabia under following factors: Project, Owner, Contractor, Design, Materials, Equipment, Labors and External.

After a review of extensive literature in the field of risk and uncertainty in construction projects, the seven most uncertainty related factors common to researchers in the field were identified and presented in Table 1.

Table 1. Proposed Uncertainty Factors

Factor	Description	Sources
Economical	issues or concerns associated with the macroeconomic impact of the community and region in which the construction project which is to be located	Banaitiene & Banaitis, 2012; Dey, 2001; Iyer & Jha, 2005; Kuo & Lu, 2013; Saqib, Farooqui, & Lodi, 2008; Tah & Carr, 2000; J. Wang & Yuan, 2011; Zavadskas et al., 2010
Environmental	issues associated with the environmental problems, concerns, and activities confronting the project	Banaitiene & Banaitis, 2012; Ehsan, Mirza, Alam, & Ishaque, 2010; Iyer & Jha, 2005; Saqib et al., 2008; Tah & Carr, 2000; J. Wang & Yuan, 2011
Financial	issues or concerns associated with the financing of the project. Several researchers emphasise financial uncertainties as one of the important factors affecting infrastructure projects outcomes	(Banaitiene & Banaitis, 2012; Bunni, 2003; Dey, 2001; Ehsan, Mirza, Alam, & Ishaque, 2010; Fang, Marle, Zio, & Bocquet, 2012; Saqib, Farooqui, & Lodi, 2008; Shen, Wu, & Ng, 2001; Taghipour, Seraj, Hassani, & Kheirabadi, 2015; Tah & Carr, 2000; T. Zayed, Amer, & Pan, 2008)
Legal	issues or concerns associated with the significant legal consequences that flow from legal actions attributable to the project	Bunni, 2003; Shen et al., 2001; Zou, Zhang, & Wang, 2007
Political	issues or concerns associated with the local, regional, and national political and regulatory situation confronting the project. Various researchers identify political uncertainty as a major factor affecting the performance of infrastructure projects	Baloi & Price, 2003; Banaitiene & Banaitis, 2012; Dey, 2001; Ehsan et al., 2010; Iyer & Jha, 2005; Saqib et al., 2008; Taghipour et al., 2015; Tah & Carr, 2000; Zavadskas et al., 2010; T. Zayed et al., 2008
Social	issues or concerns associated with the social and cultural impacts of the community and region in which the construction project is to be located	Kuo & Lu, 2013; Saqib et al., 2008; J. Wang & Yuan, 2011; Zavadskas et al., 2010

Design, Drawings, specifications and samples	Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
Incompetent contractor/subcontract or	Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
Low productivity level work	Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
Payments delay	Financial	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
Planning and scheduling of project by contractor	Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
Difficulty of schedule	Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Lack of Capital by owner	Financial	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Change order (Change in the scope of the project)	Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Legal/industrial disputes between various parties in the construction project	Legal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8
Communication/ coordination between construction parties	Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8
Fluctuation of prices of materials and/or equipment	Economical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8

It can be seen from Table 2 that the most cited uncertain events are Technically related. To verify the existence of these uncertain events in highway construction projects in South Africa, the research conducted further investigations. The methods used are presented in the following section

Tel Aviv is a Mediterranean city with high temperatures and an average annual relative humidity of 71% (ASHRAE Inc, 2005). As found by Olgyay (1963), the Thermal Neutral Zone for humans is between 25 and 30 degrees C with a relative humidity of between 30 and 65% as shown in the bioclimatic chart. The hot period in Tel Aviv can last up to 8 months (From March to October).

RESEARCH METHODOLOGY

The study made use of a sequential mixed-method research approach in identifying the uncertainty events and their main factors and assessing the impact of uncertainties on the completion time of highway construction projects in South Africa.

Brainstorming sessions with six highway experts who have more than 25 years' of experience in South African highway construction projects were held. The highway expert panel reviewed and modified the uncertain events identified in literature to appropriately reflect the events occurring on South African highway construction projects. The expert panel also grouped these events in 7 uncertainty factors as seen in Table 1.

A survey questionnaire was designed on a five-point linguistic Likert scale form to assess the impact size of confirmed uncertainty events in highway construction projects in South Africa. The questionnaire was administered to 32 highway project managers with a minimum 20 years of experience in the South African construction industry to rate the probability of occurrence and severity of each uncertainty on the completion time of the highway project.

DATA ANALYSIS

To evaluate the effect of uncertainties on construction time of highway projects using collected data on the probability of occurrence and severity of uncertainties from the six highway experts the ISO 31000 (International Standard Organization) impact matrix was utilised (ISO, 2009). ISO (2009) defined the impact size of an event as a function of the probability of occurrence and the severity of that event should it occur.

Figure 1 shows the probability of occurrence and severity as two input variables and relevant impact size as output

		Severity				
		Insignificant (1)	Minor (3)	Moderate (5)	Major (7)	Catastrophic (9)
Probability of Occurrence	Rare (.1)	Minimal	Minimal	Low	Low	Moderate
	Unlikely (.3)	Minimal	Low	Moderate	Moderate	High
	Possible (.5)	Low	Moderate	Moderate	High	High
	Likely (.7)	Low	Moderate	High	High	Extreme
	Almost Certain (.9)	Moderate	High	High	Extreme	Extreme

Figure 1: Impact Size Matrix

Developing Stepwise Regression Model

The main objective of this study is to quantitatively analyse and assess the impact of uncertainties on completion time of highway construction projects through the numerical analysis of the uncertainty variables. Stepwise Regression Analysis (SRA) is an extension of Multiple Regression Analysis. The SRA model is a mathematical model used in estimating the relationship between a dependent variable and independent variables with a strong mathematical background. SRA models has been used extensively in different areas of construction management particularly assessing risk and uncertainty, assessing the critical factors affecting cost performance of Ethiopian public construction projects (Sinesilassie, Tabish, and Jha (2017); modelling the construction risk ratings and estimating contingencies in highway

projects (Diab, Varma, and Panthi (2017); identifying the success factors for public, private partnership projects in Korea (Yun, Jung, Han, and Park (2015); evaluating project risks in Iran (Ebrat and Ghodsi (2014); evaluating the risk factors leading to cost overrun in highway construction projects in Australia (Creedy, Skitmore, and Wong (2010); analysing the risk perception of build–operate–transfer road project participants in India (Thomas, Kalidindi, and Ananthanarayanan (2003); developing models to forecast the actual construction cost and time (Skitmore and Ng (2003); and designing a multivariate analysis to build project success factors in Hong Kong (Chan, Ho, and Tam (2001).

The impact size of uncertainty event as the dependent variable is a function of two independent variables (probability of occurrence and severity) of relative uncertainty (ISO, 2009) as shown in Equation 1.

$$\text{Uncertainty Impact}_i = a_i p + b_i s + r_i \quad (\text{Equation 1})$$

Where, r_i is a constant value. a_i and b_i represent regression coefficients of independent variables

Because each of inputs can have low correlation with output variable, the SRA model was used in this study. Table 4 presents the values of the correlation coefficients.

Table 4. Correlation Coefficient among Input and Output Variables

	Probability	Severity	Impact
Probability	1		
Severity	0	1	
Impact	0.685061	0.685061	1

Table 4 shows the low correlation between independents variables and dependent variable.

The general SRA model for impact size based on the matrix impact in Figure 2 has been developed to predict the impact size of each uncertainty on cost and time of highway construction projects. The SRA model test details are shown in Table 5

Table 5. Regression Test Details

Regression Statistics				
Multiple R	0.968822			
R Squared	0.93861607			
Adjusted R Squared	0.93303571			
Standard Error	0.31622777			

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.18	0.170294	1.056996	0.301982
Probability	2.9	0.223607	12.96919	8.82E-12
Severity	0.29	0.022361	12.96919	8.82E-12

Table 5 reveals the correlation value (R Square) of the model is close to 1 and the very low P-value (<0.05). The very low value of P-value indicates the statistically significant relation of each independent variables to the dependent variable of the model and the closeness of the R-value to 1 verifies the close fitness of the estimated output model with real data. The developed Stepwise Regression Analysis model for general uncertainty impact size is outlined in Equation 2.

$$\text{Uncertainty Impact} = 2.9 \times p + 0.29 \times s + 0.18 \quad (\text{Equation 2})$$

Similar steps were repeated to develop the SRA models for each uncertainty impact on construction time of highway projects. To assess the optimum impact size of each uncertainty the optimum values of two independent variables (probability of occurrence and severity of event) are identified using sensitivity analysis and inserted to develop SRA models. For instance, the maximum probability of occurrence (0.6625) and severity (5) value of event Weather was inserted to develop the SRA model ($Y = 0.2915 + 2.9728p + 0.27905s$), and the estimated impact size of this uncertainty (3.66) on the completion time of highway construction projects. The impact size of all identified uncertainties on the completion time of highway construction projects were estimated and ranked. Table 6 presents the top 20 events with significant impact size on construction time of highway projects from a ranking perspective

Table 6. Top 20 Estimated Impact Size Uncertain Events on Highway Projects

Code	Event	Probability of Occurrence	Severity of event	Impact Size	Rank
TG11	Latent ground conditions	0.84375	8.3125	4.94	1
TCS6	Time and cost estimation	0.79375	8.3125	4.78	2
TG5	Planning and scheduling of project by contractor	0.8125	7.6875	4.72	3
SO4	Rehabilitation of affected people	0.78125	7.8125	4.66	4
PL3	Human-made disaster (war, protest, Strike, etc.)	0.8125	7.4375	4.66	5
SO5	Disease (HIV, Ebola, etc.)	0.70625	6.8125	4.19	6
TG9	Change order by owner (scopes and specifications)	0.73125	6.4375	4.16	7
TG4	Difficulty of schedule	0.55625	7.75	4.00	8
TCR5	Rework due to contractor errors	0.64375	5.5625	3.84	9
EN2	Natural disasters (earthquake, floods, hurricane, etc.)	0.4125	7.9375	3.81	10
SO3	Social and cultural impacts	0.76875	4.375	3.81	11
TT1	Obsolete technology	0.58125	6.1875	3.78	12
LE9	Problem in dispute settlement due to law	0.625	5.6875	3.78	13
TCR4	Management or supervision of Project by	0.66875	5.5	3.78	14

contractor					
TL1	Low productivity level work	0.725	4.625	3.75	15
TM2	Materials delivery	0.56875	6.1875	3.75	16
TCS4	Design, drawings, specifications and samples	0.675	5.1875	3.75	17
PL1	Political situation	0.64375	5.6875	3.72	18
TCS3	Frequent design changes	0.60625	5.8125	3.72	19
TM3	Bad quality of materials	0.61875	5.5	3.72	20

It can be seen from Table 6 that the top three uncertain events based on estimated impact on completion time of highway construction projects from a ranking perspective are Latent ground conditions (4.94), Inaccurate time and cost estimation (4.78) and Inadequate planning and scheduling(4.72). Likewise, Latent ground conditions and inaccurate time and cost estimation are two uncertain events with catastrophic consequences.

To evaluate the SRA models' performance the Root-Mean-Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) and the R squared of 76 developed assessment models were calculated and the results for top 20 events in South Africa presented in Table 5.

Table 5. SRA Models Performance Evaluation for top 20 Events

Code	Model	P Value	R Squared	RMSE	MAPE
TG11	$Y = 2.9897 + 1.604p + 0.071255s$	$2.21e-10$	0.784	0.244	0.0638
TCS6	$Y = 1.3931 + 1.9967p + 0.21694s$	$1.01e-07$	0.671	0.249	0.0481
TG5	$Y = 0.89851 + 2.3235p + 0.25137s$	$3.56e-08$	0.694	0.261	0.0533
SO4	$Y = 0.5412 + 2.6448p + 0.26225s$	$7.5e-09$	0.725	0.262	0.0537
PL3	$Y = 0.80427 + 2.7748p + 0.21478s$	$3.7e-09$	0.738	0.255	0.0518
SO5	$Y = 0.064987 + 2.9907p + 0.29509s$	$2.85e-12$	0.84	0.245	0.0521
TG9	$Y = 0.88561 + 2.6217p + 0.21025s$	$2.1e-08$	0.705	0.252	0.0556
TG4	$Y = 0.88358 + 2.4275p + 0.22789s$	$2.21e-08$	0.703	0.248	0.0557
TCR5	$Y = 0.97812 + 2.1685p + 0.26421s$	$1.05e-06$	0.613	0.237	0.0553
EN2	$Y = 1.2336 + 2.0528p + 0.21823s$	$6.52e-07$	0.626	0.251	0.0621
SO3	$Y = 1.4539 + 1.8779p + 0.20912s$	$1.74e-07$	0.658	0.24	0.0571
TT1	$Y = 0.68305 + 2.7031p +$	$3.56e-09$	0.739	0.259	0.0664

	0.24679s					
LE9	Y= 0.52521+ 2.481p+ 0.29985s	1.55e-07	0.661	0.253	0.0628	
TCR4	Y= 1.2381+ 2.0753p+ 0.21005s	1.52e-07	0.661	0.253	0.0632	
TL1	Y= 0.75+ 2.3438p+ 0.28125s	2.25e-08	0.703	0.286	0.0729	
TM2	Y= 0.98332+ 2.0923p+ 0.25482s	6.62e-08	0.68	0.257	0.0660	
TCS4	Y= 0.92489+ 2.6345p+ 0.20179s	3.96e-08	0.691	0.253	0.0635	
PL1	Y= 0.80167+ 2.2434p+ 0.25897s	1.08e-08	0.718	0.251	0.0618	
TCS3	Y= 0.92834+ 2.1309p+ 0.25781s	2.62e-08	0.7	0.259	0.0669	
TM3	Y= 0.24167+ 3.1541p+ 0.27735s	1.54e-10	0.789	0.248	0.0620	

The small value of errors (RMSE and MAPE) and P-Values ($p < .01$) proved the reliability and statistical significance of all developed models. However, the fitness of the estimated values to real data varies from 0.442 to 0.954. Which 52 estimated values from developed models have strong fitness ($r > 0.7$), 22 models have moderate fitness ($.7 < r < .5$) and two models have a low fitness to the real data (Moore and Kirkland 2007).

Furthermore, the estimated impact size of uncertainty events was classified into five groups of Extreme, High, Moderate, Low and Minimal (See Table7).

Table 7. Impact Size Groups

Group	Impact Size	Events
Extreme	$I \geq 4$	Latent ground conditions, Time and cost estimation, Planning and scheduling of project by contractor, Rehabilitation of affected people, Human-made disaster, Disease, Change order by owner, Difficulty of schedule
High	$3 \leq I < 4$	Rework due to contractor errors, Natural disasters, Social and cultural impacts, Obsolete technology, Problem in dispute settlement due to law, Management or supervision of Project by contractor, Low productivity level work, Materials delivery, Design, drawings, specifications and samples, Political situation, Frequent design changes, Bad quality of materials, Security, New technology adoption, Corruption, Remote location cost, Availability of skill workers, Availability of materials, Change order, Delay in decisions making, Weather, Right of way acquisition, Payments delay, Fluctuation of prices of materials and/or equipment, Health & Safety, Financing by contractor, Cultural heritage issue, Inaccurate investigation of construction site, Monopoly of material and/or equipment

		suppliers, Low efficiency of equipment, Unreliable supplier of material, Lack of technical staff, Mistakes in design and/or specifications, Encroachment problems, Lack of capital by owner, Poor quality of workmanship, Planning and scheduling of project by contractor, Frequent change of subcontractors, Contract failure - new contract establishment cost, Terrain or Topographical, Construction methods, Lack of technical staff, Ineffective delay penalties, Poor communication/coordination between construction parties
Moderate	$2 \leq I < 3$	Absenteeism of labour, Contractor/subcontractor, Legal/industrial disputes between various parties in the construction project, Changes in government regulations and laws, Inadequate monitoring and supervision, Poor financial control, Type of Contract, Availability of equipment, Deficient documentation, Contractual claim, Late delivery of equipment, Personal conflicts among labour, Lack of experience in the line of work, Lack of experience in design and supervision, Fluctuation in foreign exchange rate, High cost of materials and/or equipment, High Tender Price, Changing of bankers' policy for loans High cost of labour, Saturated market, Difficulties in importing equipment and materials
Low	$1 \leq I < 2$	Slow mobilization of equipment, Tax and/or legal fees, Size of contract
Minimal	$1 < I$	NONE

Key: I = Impact Size

Table 7 groups the uncertainty events identified in South African highway projects based on their estimated impact on the completion time of projects

DISCUSSION OF FINDINGS

The current study modelled the existing uncertain events in South Africa highway construction projects using Stepwise Regression Analysis (SRA) to assess their impact on the completion time of highway construction projects. The impact assessment of the uncertain events is essential to prevent delay on the project before the signs of delay begin to appear.

Comparison of top 20 uncertainty events from literature review (Table 2) with top 20 events with highest estimated impact in South Africa (Table 3) revealed that only 7 events of this list are common with the top 20 cited events (Planning and scheduling of projects by contractor 3rd, Change order by owner 7th, Difficulty of schedule 8th, Management or supervision of Project by contractor 14th, Low productivity level work 15th, Materials delivery 16th, Design, drawings, specifications and samples 17th). On the other hand, the other 13 most cited events are found to impact the construction time of highway projects differently (Availability of skilled workers 25th, Availability of materials 26th, Weather 29th, Payments delay 31st, Fluctuation of prices of materials and/or equipment 32nd, Health & Safety 33rd, Financing by contractor 34th, Lack of capital by owner 43rd, Construction methods 49th, Poor communication/coordination between construction parties 52nd, Incompetent

contractor/subcontractor 54th, Legal/industrial disputes between various parties in the construction project 55th, Availability of equipment 60th).

The study found that more than 70% of identified events impact on the completion time of highway construction projects. The presented results in Table 7 revealed that eight uncertain events (10.5%) have an extreme impact on completion time, 44 events (57.9%) have a high impact, 21 events (27.6%) have a moderate impact and three events (4%) have a low Impact on construction time of highway projects. This is evidence of the fact that the completion time of highway construction projects in South Africa is very sensitive to uncertainty events. These results are aligned with previous studies. For instance, Aziz and Abdel-Hakam (2016), Adam et al. (2017), Taghipour et al. (2015), Fang et al. (2012), T. Zayed et al. (2008), Zou et al. (2007), Assaf and Al-Hejji (2006) and Baloi and Price (2003) also found the latent ground conditions as a key uncertain event impacting the construction time of projects.

Also, the SRA model results indicates that inaccurate time and cost estimation, inadequate planning and scheduling, specification change and difficulty of schedule are the other four technical uncertain events that extremely affect completion time of construction projects. These technical events were also identified in previous researches (Assaf & Al-Hejji, 2006; Aziz & Abdel-Hakam, 2016; Bunni, 2003; Ehsan et al., 2010; Gosling, Naim, & Towill, 2012; Huang, Negnevitsky, & Nguyen, 2002; Mahendra et al., 2013; Marzouk & El-Rasas, 2014; Saqib et al., 2008; Zou et al., 2007). Human-made disaster and disease emerged from the study as two political and social uncertainties events with extreme impact on construction projects in South Africa which is consistent with the findings of Odediran and Windapo (2017); Aziz and Abdel-Hakam (2016) and Marzouk and El-Rasas (2014) studies done in South Africa and Egypt

CONCLUSIONS

The current study adds to existing knowledge of construction management by extensive literature review in the field of uncertainty in construction projects, it established the uncertainty events and uncertain factors through brainstorming by highway experts panel and verified the probability of occurrence and severity of 20 events through gathering data from highway construction experts. A significant number of the uncertainties were related to social and political factors. Therefore, it is recommended that the companies pursuing highway construction in African countries should seriously consider the social and political risks along with the technical events when involved in this market. The study also developed Stepwise Regression Analysis models to assess the impact of each event on the completion time of highway construction projects and classified these events into five groups based on the estimated their impact.

This study is relevant to both practitioners and researchers. It provides practitioners with a simple and straightforward tool to assess and prioritise the impact of uncertainty events on highway construction projects and researchers with a qualitative and quantitative methodology and a mathematical model for use in evaluating the effect of uncertain events on highway construction projects in South Africa. The SRA was used in assessing the impact of uncertainty events on highway construction completion time due to the fact that the model has a strong mathematical background and has been employed in assessing risk and uncertainty in the field of construction management. The study found the SRA model to be a reliable and statistically significant method for assessing uncertainty on construction projects. However, the

accuracy of the estimated impact of some of the models is low. Therefore, to accurately estimate the impact of these events the study recommends using the systematical Fuzzy Inference System such as the Adaptive Neuro-Fuzzy Inference System (ANFIS).

The detailed analysis and estimated outputs from this research should be used as a platform and benchmark for future studies in highway construction in South Africa. This platform should be utilised for estimating the duration of highway construction projects accurately, by assessing the uncertain events that impact on the completion time of each construction activity.

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AN EVALUATION OF FACILITIES MANAGEMENT (FM) INFORMATION TECHNOLOGY (IT) DERIVED APPLICATIONS IN NIGERIA

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The aim of this paper was to assess the current state of adoption of facilities management (FM) information technology (IT) systems in Nigeria with a view towards generating a proper understanding of the current state of use and its effectiveness in FM service performance. Anchored on quantitative exploratory approach, this paper initially established the concepts of FM and IT systems in FM through a literature review. Data from 68 facilities managers spread across three strategic cities of Lagos, Port Harcourt, and Abuja on the use of FM IT derived systems were then analysed using descriptive statistics while the correlation between use of FM IT applications and FM service performance was analysed with the help of spearman rank correlation. Findings on the assessment of IT adoption in FM revealed that, computer-aided facilities management (CAFM) is the most frequently used FM application in the Nigerian FM industry. Besides, CAFM and computerised maintenance management system (CMMS) are the most effective tools for asset management, energy and safety management, and inventory management. Additionally, it was discovered that the use of FM applications had significant correlation with lifecycle cost reduction and timely delivery of services. The paper advances the body of knowledge on facilities management by providing further insight into the relationship between use of FM IT applications and FM services performance. This paper provides key information for facilities managers on the effectiveness of major FM IT applications and areas of significant and not so significant impacts of these technologies on FM service delivery.

Keywords: FM applications, level of use, level of effectiveness, service performance, Nigeria

INTRODUCTION

The construction industry is one of the most active sectors propelling the Nigerian economy. It is so vital to the nation's economic development which is why it produces nearly 70% of the country's fixed capital formation and accounts for 1.4% of the nation's gross domestic product (GDP) (World Bank, 2013). Over the past two decades, there has been growing concern that the global construction industry is fraught with complexities, uncertainties, and ambiguous traditional practices that has impeded knowledge sharing resulting in duplication of processes (Khosrowshahi and Arayici, 2012) while fragmentation and calcified processes have inhibited needed widespread change in the industry (Aranda-Mena et al., 2009). In response, governments around the world have devised regulatory strategies to bring about the needed efficiency and flexibility by mandating the use of platforms that addresses declining productivity in the industry (Kaseem et al., 2015). In the UK for instance, a key priority is the mandatory use of data and management information to determine expected cost, drive out waste, improve efficiency and allow the government to

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function as an intelligent client (Williams, 2013). In effect, the country mandated the adoption of building information modelling (BIM) technologies for all centrally procured projects from 2016, including the handover from the design and construction stage to operation and asset management stage (soft landings) (Kaseem, et al., 2015).

FM has continued to live by its definition of creating the right enabling environment that supports the core functions of organisations. According to Business Services Association (2014), it has developed into a major and thriving business player enabling organisations to function at their most efficient and effective level, achieving collaboration and offering real added value to the organisation's core business. This growing trend of FM is corroborated by a recent survey credited to Services Futures (2017) in which the FM global market is expected to grow from \$952.2 billion in 2012 to \$1.314 trillion in 2018. Although many are of the view that information technology (IT) has brought revolution into the construction industry, one argues that building data captured during the project lifecycle can improve the effectiveness and efficiency of how facilities and buildings-in-use are managed at the operational stage. This is because the largest prize for information management lies in the operational phase of the project lifecycle (Kaseem, 2015) while estimates show that the lifecycle cost is five to seven times the initial investment costs and three times the construction costs (BIM Task Group, 2013). Plausibly, efficient and effective use of information systems in FM and its synergy with design and construction is not only necessary but pre-requisite for sustainable project delivery.

While recent studies such as Bcerik-Geber et al., 2012; Parsanezhad and Dimyadi, 2014; and Kaseem et al., 2015 identify the general FM technologies such as Computer-based FM (CAFM), computerised maintenance management systems (CMMS), and Industry Foundation Classes (IFC), one contends that facilities managers are only beginning to explore facilities management (FM) tools and applications, while most of the standards and software are in early stages of development. The application of information technologies at the operational (FM) stage has been much less explored (Kaseem et al., 2015) when compared to its use and applications at design and construction stages in the Nigerian construction industry (Kuroshi and Okoli, 2010; Alufohai, 2012; Abubakar et al., 2014). This study contributes to that gap by (1) examining the level of use of FM IT applications; (2) assessing their effectiveness for FM roles and thereafter (3) exploring impact of these applications on FM service delivery in Nigeria.

LITERATURE REVIEW

Building information is the life wire for any successful FM as it requires a vast amount of information and data to operate facilities effectively and efficiently. The hitherto traditional methods of storing building information are now being vigorously replaced by digital FM software and related IT systems. For instance, Computer-Aided Facility Management (CAFM) enables facility managers to increase the utilisation of space and facilities, reduce office/building moves and reallocations, plan preventative maintenance, efficiently execute reactive maintenance, standardise services, and streamline processes (Parsanezhad and Dimyadi, 2014). Although, the software can work in isolation, it could also be integrated into other FM packages such as intelligent building management systems (IBMS) for managing massive event reporting by creating database which contain statistical information about a facility such as gross floor area and office space for individual occupants. Although CAFM has been the most preferred among researchers and practising facilities managers due

to improved processing and efficiency, data quality and cost savings (Abel and Lennerts, 2005), it is worth noting that entering, verifying and validating hard data into it is time consuming and costly. Computerised maintenance management systems (CMMS) on the other hand provides support for the whole maintenance process in a building-in-use while supporting maintenance personnel in developing work orders, registering on-going tasks, getting instructions for maintenance tasks, registering completed tasks, and reporting deviations/problems (Kullolli, 2008; Tretten and Karim, 2014). It is important to quickly point out that inaccurate or poor data may influence its output negatively which is why maintenance tools and systems must be designed to detect poor quality data. Building Automation systems (BAS) is a computer based system that monitors, coordinates, organises, and optimizes building subsystems such as Heating, Ventilation and Air Conditioning (HVAC), lighting, security, fire/life safety, elevators, and others (Jiang, et al., 2009). Researchers argue that a centralised BAS provides opportunity for a more robust and intelligent approach for FM, safety, and energy in buildings (Kumara et al., 2016) although lack of confidence in end result, lack of end-user involvement in the specification and incapability of subsystem integration could mar its success as an FM tool. Document Management Systems (DMS) uses computer system to store, manage and track electronic documents and electronic images of paper based information captured through the use of a document scanner (Tarng and Liu, 1994). However, DMS is a human social system laden with human induced errors. Facilities managers must recognise and be aware that information technology is part of organisational culture and must be accepted and accommodated by its users. Otherwise, users' dissatisfaction, suppliers' complaints, conflicting opinions and waste of scarce resources will continue to plague its success. The Integrated Workplace Management System (IWMS) is a strategic enterprise-wide solution for planning, operating, analysing and optimising any organisation's real estate portfolio of buildings, workspaces and assets. According to Manhattan IWMS (2017), the IWMS integrates financial matters, lease management, project, space management, and maintenance into a single synchronized platform. It has several benefits among which are that it reduces total cost of occupancy (TCO), improves resource utilisation and above all improves FM services performance. It is argued that although these applications are gaining popularity among FM practitioners in Nigeria, information about their diffusion, usability and extent of effectiveness is largely unclear as there is no documentary evidence to buttress such. This study intends to fill that gap.

FM IT derived systems have been useful for space and asset management where object oriented data bases are linked to CAD space-plan drawings for detailed information on space utilisation needs (Becerik-Gerber, 2012). Other areas in which FM applications have impacted FM roles include health & safety (H&S) and environmental management; maintenance, repairs and contract management; security management; and financial, budget and inventory management (Booty, 2006; Becerik-Gerber et al. 2012; Teicholz, 2013). H&S and environmental management that deals with energy management, emissions, fire, emergency, environmental impact assessment (EIA), integrating building control systems and meters across sites; while maintenance, repairs and contract management involves operation and maintenance (O&M) history of all plants and equipment, lifecycle maintenance, planned preventive maintenance (PPM), malfunctioning alert on plants and equipment; security management deal with fault reporting and resolution service, CCTV monitoring,

motion detectors, alarms etc. while financial, budget and inventory management involves management of cost associated with capital and current assets including lifecycle costing, consumables, stock tracking, measurement and forecasting at strategic levels.

FM service delivery in the context of this study is the group of measurable attributes of FM services which an organisation can use to track performance. Traditionally, researchers have focused on three major criteria of cost, time and quality as benchmark for assessing performance of projects. There is plausible evidence to show that despite the inhibiting factors associated with FM technologies, there are several ways in which it adds value to FM in terms of time, cost and quality performance. For instance, data regarding space, systems, finishes, H&S and emergency management can be captured in digital format within building information cycle and do not necessarily need to be recreated in downstream FM system (Eastman et al. 2011) thereby reducing time and cost required to collect and build FM systems during the building lifecycle (Teicholz, 2013). Researchers such as Huber (2011) and Volk et al. (2014) also argue that the use of laser scanning technology associated with FM derived technologies reduces cost of producing as-built building information. Additionally, adoption of FM IT systems for FM roles implies that facilities managers are integrated into the building lifecycle at a much earlier stage usually the design stage to convey their input and expertise on issues of buildability and maintainability. The outcome is improved quality of output (buildable designs and maintainable facilities) and satisfaction of stakeholders including the clients.

RESEARCH METHODOLOGY

In line with quantitative survey approach adopted for this study, a self-completion questionnaire was personally administered to 150 target respondents (facilities managers, maintenance managers and property managers) who are registered members of International Facilities Management Association (IFMA), Nigeria's chapter in three strategic cities of Lagos, Port Harcourt (PH) and Abuja. The 150 respondents comprising Lagos (70), PH (50) and Abuja (30) were drawn from the register of IFMA, Nigeria's chapter using purposive sampling technique. The technique was adopted to enable the researcher draw out target respondents with specific knowledge about FM applications such as CAFM and CMMS. Lagos was chosen because it is the centre of business and commerce in Nigeria while PH was adopted because it is the home of major oil multinationals and major stakeholder in the Nigeria FM industry. Abuja remains the capital of Nigeria and one of the fastest developing cities in the world in terms of infrastructure.

The measured attributes identified from literature (Booty, 2006; Kullolli, 2008; Becerik-Gerber et al. 2012; Teicholz, 2013; Parsanezhad and Dimyadi, 2014; Tretten and Karim, 2014; Kumara et al., 2016) were used to prepare the content of the questionnaire. Copies of the first draft were then sent to five academic experts while personal interview section was organised with a focus group of four facilities managers from the IFMA, Nigeria's chapter with a view towards scrutinising contents of the questionnaire. The final list of variables was chosen based on outcome of the pilot to reflect theme of the research problem.

Respondents were asked closed ended questions relating to (1) their backgrounds and that of their organisations, and (2) FM applications and their impact on FM service

delivery. A five-point Likert scale (of 1=very low, 2= low, 3=moderate, 4=high, 5=very high) was used to measure attributes of the study variables. Descriptive and inferential statistics were used to analyse demographics of respondents, level of use and effectiveness of FM applications. The correlation between FM IT applications use and FM service delivery was analysed with the help of spearman rank correlation.

RESULTS AND FINDINGS

Profile of survey respondents and their organisations

The result of analysis indicates that, of the 150 respondents, 68 comprising Lagos (32), PH (23) and Abuja (13) returned valid copies of completed questionnaire giving a cumulative response rate of 45%. Besides, in terms of job description, 38 were facilities managers, 21 were maintenance managers while 9 were property managers. In terms of years of experience in FM, 11 had experience of between 0 and 10 years, 39 had experience of between 10 and 20 years, 16 had experience of between 20 and 30 years while only 2 had over 30 years of experience. It is worth noting that over 80% of respondents who returned valid questionnaires had experience of between 10 and 20 years. This is an indication that the respondents had the requisite experience and knowledge about.

Use of FM IT derived applications

To explore the extent of use of FM applications, respondents were asked to rate the frequency of use of the applications.

Table 1: Results of analysis on frequency of use of FM applications

S/n	FM Application	MS	Standard Deviation	Rank
1	CAFM	4.32	0.84	1
2	CMMS	4.18	0.77	2
3	BMS	3.16	1.15	4
4	DMS	3.22	1.03	3
5	IWMS	2.89	1.22	5

The results on the frequency of use of 5 FM applications presented in Table 1 indicate that Computer-Aided Facilities Management (CAFM) received the highest mean score (MS) of 4.32 with standard deviation (SD) of 0.84, followed by Computerised Maintenance Management Systems (CMMS) with a MS of 4.18 and SD of 0.77. Document Management Systems (DMS) was rated third with a MS of 3.22 and SD of 1.03. Integrated Workplace Management Systems (IWMS) was the least rated with a MS of 2.89 and SD of 1.22.

Effectiveness of FM IT derived applications

To examine the effectiveness of FM applications for FM roles, respondents were asked to rate the level of effectiveness of the 5 applications for 10 FM roles derived from literature. The result of analysis is presented in table 2.

Table 2: Results of analysis on level of effectiveness of FM applications for FM Roles

S/n	FM Roles	MS	Standard Deviation	Rank

1	Asset management	4.49	0.32	1
2	Space management	4.24	0.58	7
3	Health and Safety (H&S	4.10	0.67	9
4	Operation and maintenance (O&M)	4.25	0.66	6
5	Security & IT management	4.28	0.57	4
6	Financial management	3.39	0.52	10
7	Project management	4.26	0.51	5
8	Energy & Safety management	4.44	0.58	2
9	Cleaning	4.22	0.57	8
10	Inventory management	4.29	0.64	3

The result indicates that FM IT derived applications are most effective in asset management (MS=4.49, SD=0.32), energy and safety management (MS=4.44, SD=0.58), and inventory management (MS=4.29, SD=0.64) as the three most rated while the three least rated are cleaning (MS=4.22, SD=0.57), H&S (4.10, SD=0.67), and financial management (3.39, SD=0.52). However, a cross tabulation carried out to examine the nature of relationship between extent of use of FM applications and their effectiveness for the given FM roles indicates that 64 of the 68 respondents agree that CAFM is the most effective for asset management, 63 of them agree that it is the most effective for energy and safety management, while 63 of the 68 respondents agree that it is the most effective for inventory management. Meanwhile 9 out of the 10 FM roles used for the study received high scores of over 4 points which is an indication that FM applications have been very effective in the FM industry.

Impact of use of FM applications on FM service delivery

To explore how the use of FM IT derived applications has impacted on FM service delivery, a hypothesis is postulated as follows:

"H0: There is no significant correlation between the level of use of FM applications and FM service delivery"

Respondents were asked to indicate the level to which the use of FM applications has impacted FM service delivery in their organisations. For the purpose of the evaluation, the 5 FM applications were correlated with the 4 constructs of FM service delivery using spearman's rank correlation. The four constructs operationalized as four-dimensional constructs of life cycle cost reduction, timely delivery of services, quality of output, and stakeholders' satisfaction were derived from the literature. The decision rule is that the hypothesis is accepted for all values of $p > 0.05$ while it is rejected for all values of $p < 0.05$. The result of analysis is shown in table 3.

Table 3: Correlation matrix for use of FM applications on FM service delivery

Correlated Item	MS	SD	R-value	P-value	Decision
CAFM	4.32	0.84			

Cost reduction	4.28	0.59	0.252	0.038	Reject
Timely delivery	4.25	0.56	0.098	0.427	Accept
Quality output	4.21	0.74	0.304	0.021	Reject
Stakeholder satisfaction	4.41	0.65	-0.064	0.607	Accept
CMMS	4.18	0.77			
Cost reduction	4.28	0.59	0.233	0.032	Reject
Timely delivery	4.25	0.56	0.188	0.004	Reject
Quality output	4.21	0.74	-0.081	0.514	Accept
Stakeholder satisfaction	4.41	0.65	0.047	0.705	Accept
BMS	3.16	1.15			
Cost reduction	4.28	0.59	0.358	0.003	Reject
Timely delivery	4.25	0.56	0.099	0.421	Accept
Quality output	4.21	0.74	0.051	0.678	Accept
Stakeholder satisfaction	4.41	0.65	0.118	0.336	Accept
DMS	3.22	1.03			
Cost reduction	4.28	0.59	0.159	0.195	Accept
Timely delivery	4.25	0.56	0.105	0.393	Accept
Quality output	4.21	0.74	0.114	0.355	Accept
Stakeholder satisfaction	4.41	0.65	0.114	0.355	Accept
IWMS	2.87	1.22			
Cost reduction	4.28	0.59	0.132	0.282	Accept
Timely delivery	4.25	0.56	0.016	0.895	Accept
Quality output	4.21	0.74	0.105	0.394	Accept
Stakeholder satisfaction	4.41	0.65	0.113	0.360	Accept
R=Spearman's rank correlation coefficient; SD=Standard deviation; P=degree of significance					

The result from table 3 shows that DMS and IWMS have no significant correlation with any of the FM service delivery variables with p-values ranging from 0.195 to 0.895. On the contrary, the tests of correlation between CAFM and cost reduction as well as quality output; CMMS and cost reduction as well as timely delivery of FM services; and BMS and cost reduction have p-values lower than the significant level. Therefore, the rejection of the hypothesis is an indication that (1) the use of CAFM has significant influence on lifecycle cost reduction and timely delivery of FM services but not on quality of output and stakeholder satisfaction (2) the use of CMMS has significant influence on cost reduction and timely delivery of services but no influence on quality of output and stakeholder satisfaction, (3) BMS has significant influence on lifecycle cost reduction.

DISCUSSION AND IMPLICATIONS

The result on the general level of use of FM technologies in the Nigerian FM industry indicates that CAFM is the most frequently used FM application. The findings which is fairly consistent with previous studies (Williams, 2013; Becerik-Gerber et al. 2012; Patacas et al., 2015) confirms the acclaimed use of the application for achieving transparency in information flow, easy access to data, while also ensuring reduction in operational cost at both short and long term. Findings also indicate that FM applications are most effective in asset management, energy and safety management, and inventory management as the three most rated. It is a plausible indication that FM IT derived technologies support both operational and strategic FM within the Nigeria's FM industry.

The significant influence of CAFM and CMMS on both cost reduction and timely delivery of FM services is linked to the widely held view among researchers (Teicholz, 2013; Huber, 2011; Volk et al., 2014) and practitioners that they are the most preferred due to their improved processing efficiency, data quality and cost savings. The acceptance of the null hypothesis for DMS and BMS on FM service delivery may be due to the fact that they are not as popular as the other three FM IT applications among the respondent organisations in the Nigerian economy.

This study complements the body of knowledge on FM and IT. It has provided the first ever insight into the relationship between use of FM IT applications and FM services delivery. For instance, consistent with previous studies, it has established key positive relationships between use of CAFM & CMMS, and life cycle cost reduction as well as timely delivery of services. With regards to practice, findings from this research has provided facilities managers and stakeholders alike with key information on the component of FM delivery where the use of FM technologies has impacted positively. However, it is fair to argue that all the IT derived applications for FM including CAFM and CMMS are viable tools for FM services delivery in the FM industry. However, the plausible reason for this outcome might not be unconnected with the several challenges militating against improved adoption of IT in the evolving FM industry in Nigeria. The challenges may include the difficulty in compatibility and early stages in the development of some of these FM software. Consequently most facilities managers and stakeholders alike who were respondents in this study may not have been well convinced about the benefits of IT derived application in FM.

CONCLUSIONS

Based on a questionnaire survey of 68 respondents, this research explored the level of use of FM technologies in the Nigerian FM industry and analysed their impact on FM service delivery. Data collected were analysed using descriptive and inferential statistics. Spearman's correlation procedure was used to analyse the influence of use of FM IT applications on FM service delivery.

The paper concludes that CAFM is the most frequently used BIM for FM application in the Nigerian FM industry, followed by CMMS and DMS in that order. BAS is however the least rated. The paper also concludes that BIM for FM IT applications especially CAFM and CMMS are most effective in asset management, energy and safety management, and inventory management. Besides the paper concludes that (1) the use of CAFM has significant influence on lifecycle cost reduction and timely delivery of FM services but not on quality of output and stakeholder satisfaction (2) the use of CMMS has significant influence on cost reduction and timely delivery of

services but no influence on quality of output and stakeholder satisfaction, (3) BMS has significant influence on lifecycle cost reduction.

However, this study has an obvious limitation. The data generated for this research was primarily based on quantitative questionnaire survey in which respondents were asked closed ended questions. However, a more detailed single case study research on use of IT systems by facilities managers in Nigeria's vibrant oil and gas industry is currently being explored to triangulate outcome of this study.

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SUCCESS FACTORS FOR THE EFFECTIVE IMPLEMENTATION OF TOTAL QUALITY MANAGEMENT (TQM) IN THE MAINTENANCE OF UNIVERSITY BUILDING

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The paper examined success factors enhancing the effective implementation of TQM in the maintenance of university buildings in South Africa. The study further investigated the existence of a statistical difference in workers' affiliated campuses, workers' positions and their perception of the factors that ensure successful implementation of TQM in the maintenance of university building facilities. The study adopted a case study approach and purposive sampling method was used to select 71 participants and respondents for the study. Questionnaires with closed-ended questions were distributed to workers in the maintenance department in a university across five campuses. Descriptive and inferential statistics were used to analyse the data. It was revealed that TQM success factors were extensively practiced with respect to training and education of maintenance workers, use of statistical methods, and commitment to satisfaction to school stakeholders, as well as commitment from top management. A statistically significant difference existed in the perception of workers' affiliated campuses on the level of practice of TQM success factors. The study provides immediate interventions which include prioritisation of success factors and long-run interventions which include benchmarking through development of best practices and standards to be followed in all campuses in situations where significant differences were discovered. Data for the study was built upon an available sample of maintenance workers in only one university. This therefore may limit the representation of other school categories in the country in the study. The study recommends an effective communication network such as memo and newsletters to disseminate information within the maintenance department to keep employees informed and get them involved.

Keywords: Maintenance, Success factors, Total Quality Management, University buildings

INTRODUCTION

While quality has become a universal concern, tertiary institutions are challenged with maintaining existing physical facilities within acceptable quality standards (Buys & Nkado, 2006). Arguably, maintaining buildings within acceptable quality standards is one of the most important aspects of administration.

University building maintenance is an integral component of the institutions' educational programmes. School administrations have experienced a lot of setbacks in the maintenance of buildings, due to several bottlenecks. Several studies indicate that

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most schools' administrative functions, including maintenance, are complex in nature and require special skills to execute (Chaka, 2008).

The achievement of acceptable levels of quality in maintenance has long been a problem. Abu-Hassan, Khalid and Eziaku (2011) indicate that TQM has demonstrated that it's a useful tool which ensures the attainment of set standards and successful productivity improvements in the maintenance process. Although TQM has been a productive instrument for the improvement of quality in the maintenance of university building facilities, many universities are still struggling to implement TQM in the maintenance of their buildings (Yang, 2003). Owolabi et al. (2014) have identified some challenges in the implementation of TQM during building maintenance, such as; lack of proper planning and lack of an appropriate administrative culture supportive of TQM. Other barriers were further identified as: lack of customer focus, poor management commitment and involvement, lack of employee empowerment and training, drive for short-term financial outcomes, politics and turf issues, as well as availability of resources. Considerable investments in time, money and resources, both human and material, are wasted each year because of sloppy or inadequate quality management procedures during the maintenance process (Obaid, 2005).

SUCCESS FACTORS FOR THE EFFECTIVE IMPLEMENTATION OF TQM

With regard to the critical success factors for the effective implementation of TQM, no universal factors are in existence. Critical success factors have a huge impact on customer satisfaction and they vary among organisations. The effectiveness of these factors has a long-term effect on the sustainability of TQM (Idris & Zairi, 2006). Critical success factors should be linked with the goals of the organisation, since most organisations fail to practice them, despite being aware of the importance (Yusof & Aspinwall, 2000).

Fotopoulos and Psomas (2009) present the following seven critical success factors for the implementation of TQM: leadership, process management, service design, human resource management, customer focus, education and training, and supplier quality management.

Black and Porter (1996) identify ten critical TQM success factors based on the Baldrige Award criteria, and these factors are: people and customer management, supplier partnership, customer satisfaction orientation, communication of improvement information, strategic quality management, external interface management, team structure of improvement, corporate quality culture, operational quality planning and quality improvement measurement systems.

Ahire, Golhar and Waller (1996) identify twelve factors that are important for the implementation of TQM, and these factors are: top management commitment, customer focus, supplier quality management, design quality management, benchmarking, use of statistical process control, internal quality information, employee empowerment, employee involvement, employee training, product quality, and supplier performance.

Antony, Leung, Knowles and Gosh (2002) suggest the following factors should be considered when implementing or developing an efficient TQM plan: (1) Training and education of employees, (2) Employee Involvement and commitment, (3) Communication, (4) Continuous Improvement, (5) Management Commitment and

Leadership, (6) Commitment to Customer Satisfaction (7) Reduced cost of poor quality, (8) Improved competitive advantage (9) Service design.

Training and Education of Employees

Employee training and education is an important factor that assists in the achievement of quality and quality improvement during building maintenance. Mete (2004) argues that training and education of team members is a crucial factor that helps in developing quality improvement. TQM is a concept which shifts an organisation's working approach. In order to adapt to the new techniques involved, comprehensive and extensive training and education is required (Mukherjee, 2006).

Employee Involvement and Commitment

Leaders are responsible for ensuring all employees are involved and their ideas and experiences are exchanged amongst the team. Chapman (2001) emphasises that the involvement of employees can speed up understanding of organisational processes, enhance the level of decision-making and also promote knowledge and ideas among employees for the advancement of the organisation.

Communication

Kasongo and Moono (2010) indicate that the success of an organisation depends on its ability to put into place a proper communication network that facilitates proper exchange of information. There should be an effective and transparent communication network present between all levels of management. Schmint and Finnigan (1993) perceive communication during the TQM process as the factor that helps to instil confidence in others, as well as encourage team members to share risks.

Continuous Improvement

Continuous improvement requires the full support of all parties, because it promotes progress in the relationship between the customer and employee, as well as fostering innovation and organisational development (Pineda, 2013). According to Adinolfi (2003), continuous improvement of all activities in an organisation is at the heart of TQM.

Top Management Commitment and Leadership

The involvement of employees alone is not sufficient for TQM to be successful. The involvement of top management facilitates the TQM journey by ensuring that all decisions are made adequately and timeously. According to Muraid and Rajesh (2010) management should be committed to being aware of the demand for change, should renew important elements, make structural changes in the organisation, resolve conflicts, promote the participation of members and design an effective plan to improve the management process.

Commitment to Customer Satisfaction

According to Rahaman (2014) customers should be continually satisfied by conforming to their requirements in terms of product design, quality, services and prices. Hasson and Klefsjo (2003) suggest that customer satisfaction is the most important requirement for the sustainability of any organisation and that sustainable organisations understand and agree that customers will get the satisfaction they want if they receive whatever product and service they are to receive, at the appropriate time and manner that satisfies their needs. Thus, the key rationale behind TQM is valuing

the customer by paying attention to the basic customer needs and maximising customer satisfaction.

Teamwork

According to Oakland (2005) teamwork requires the exchanging of ideas and information, making decisions, solving problems and building trust amongst employees. This promotes an independent attitude towards achieving a common goal within the organisation. Rahaman (2014) explains that teamwork promotes efficiency in solving complex problems through sharing the knowledge and experiences of employees and accentuating recommendations over individual suggestions.

METHODOLOGY

A quantitative research design was adopted for the study. A total of 71 questionnaires with close-ended questions were distributed to purposively-sampled maintenance workers across 5 campuses in a tertiary institution. The maintenance team consisted of top management, supervisors, foremen, clerks of works, technicians, labourers and administrators. The questionnaire aimed to examine success factors perceived to enhance the effective implementation of TQM implementation in the maintenance university buildings. The Five-point Likert scale method was used in the questionnaire. Participants were required to score their choices from 1-5 with very low to very high for the given statements.

For the purpose of this study, reliability of scaled questions was tested with the use of Cronbach's alpha coefficient. The Cronbach's co-efficient for the scale questions was 0.94, which satisfies the reliability test requirements.

Out of 71 questionnaires administered to employees of the maintenance department, 54 questionnaires, representing a response rate of 76% were duly completed and returned. Descriptive and inferential statistics were used to analyse the data collected. For the descriptive statistics the frequency distribution and measurement of central tendency (mean and standard deviation) were used. A normality test was conducted to be able to determine the type of inferential statistics to adopt for the study. Kolmogorov-Smirnov and Shapiro-Wilk tests were adopted to test for a normal distribution or a non-normal one. The Shapiro-Wilk test and Kolmogorov-Smirnov test makes comparisons between the scores obtained from a sample to normally distributed score sets with the same mean and standard deviation. In a situation where the test is non-significant i.e. the test significance is greater than .05, it means that the difference is not significantly different from a normal distribution and it is normal. However, if the test significance is less than .05, it means the test is significantly different from a normal distribution and it is not normal (Field, 2013). The Kolmogorov-Smirnov and Shapiro-Wilk tests are commonly affected by large samples in which small variations produce notable outcomes (Pallant, 2006). For this study, the Shapiro-Wilk test was used because of the study's small sample size. Table 1 shows that the result of the normality test conducted was of level of practice of TQM success factors was 0.00, indicating a non-normal distribution. Therefore, the Kruskal-Wallis test was applied.

Table 1: Test for normality

Practice of TQM	Statistic	df	Sig.	Statistic	df	Sig.
success factors						

						Kruskal-Wallis
0.20	54	0.00	0.89	54	0.00	

FINDINGS

Research participation

Table 2: Profile of participants

Profile of participants	Bellville		Cape town		Mowbray		Wellington		Granger bay		Total	
Position	N	%	N	%	N	%	N	%	N	%	N	%
Top Management	2	3.7	0	0	0	0	1	1.9	3	5.6	6	11.2
Supervisor	3	5.6	3	5.6	1	1.9	1	1.9	1	1.9	9	16.9
Foreman	1	1.9	5	9.3	0	0	1	1.9	2	3.7	9	16.8
Clerk of Works	1	1.9	3	5.6	0	0	0	0	1	1.9	5	9.4
Technician	5	9.3	5	9.3	1	1.9	1	1.9	1	1.9	13	24.3
Labourer	3	5.6	0	0	4	7.4	1	1.9	0	0	8	14.9
Administrator	2	3.7	1	1.9	1	1.9	0	0	0	0	4	7.5
Work Experience												
0-10	4	7.5	2	3.8	0	0	2	3.8	1	1.9	9	16.2
11-20	9	16.8	12	22.0	6	11.2	3	5.7	5	9.4	35	65.1
21-30	3	5.7	3	5.7	1	1.9	0	0	2	3.7	9	17.0
31-40	1	1.9	0	0	0	0	0	0	0	0	1	1.9

Questionnaires were administered to workers across five campuses of the university; Bellville, Cape Town, Mowbray, Wellington, Mowbray and Grangerbay. Table 2 shows that 11.2% (6) of the respondents occupy the top management position, 16.9% (9) of the respondents occupy the position of supervisor, 16.9% (9) of the respondents occupy the position of foreman, 9.4% (5) of the respondents work in the position of clerk of works, 24.3% (13) of the respondents occupy the position of technician, 14.9% (8) respondents occupy the position of labourer and 7.5% (4) respondents occupy the position of administrator. 16.2% (9) respondents have less than 10 years' experience, 65.1% (35) have between 11 and 20 years' experience, 17.0% (9) have between 21 and 30 years' experience, 1.9 % (1) has between 31 and 40 years' experience.

Level of practice of TQM success factors

This section sought to investigate the level of practice of TQM success factors within the maintenance department. Respondents were required to rate their level of practice using a five-point Likert scale where; 1 = very low, 2 = low, 3 = moderate, 4 = high and 5 = very high. Responses from each campus are presented separately.

Table 3: Level of practice of TQM success factors

TQM success factors	1	2	3	4	5	Total	M	SD	Rank
	%	%	%	%	%				
Training and education of maintenance workers	0	22.2	13.0	14.8	50.0	54	3.92	1.24	1
The use of statistical methods	1.9	11.1	20.4	29.6	37.0	54	3.88	1.09	2
Commitment to the satisfaction of the school stakeholders	5.6	7.4	25.9	24.1	37.0	54	3.79	1.18	3
Commitment from top maintenance management	7.4	11.1	24.1	14.8	42.6	54	3.74	1.32	4
Benchmarking of maintenance processes	3.7	11.1	24.1	33.3	27.8	54	3.70	1.10	5
Top management involvement	3.7	5.6	35.2	31.5	24.1	54	3.66	1.02	6
Empowerment of maintenance workers	3.7	5.6	33.3	38.9	18.5	54	3.62	0.97	7
Continuous improvement of maintenance processes	3.7	7.4	37.0	37.0	14.8	54	3.51	0.96	8
Commitment and involvement of workers	11.1	7.4	14.8	61.1	5.6	54	3.42	1.09	9
Adequate communication network	9.3	3.7	31.5	53.7	1.9	54	3.35	0.95	10
OVERALL						54	3.66	1.09	

From Table 3, it is shown that the mean scores obtained were in the range between 3.92 and 3.35. The table shows that TQM success factors were diligently practiced

with respect to training and education of maintenance workers, use of statistical methods, and commitment to satisfaction of school stakeholders and commitment from top management. The remaining success factors ranged from 3.70 to 3.35, indicating that respondents expressed a moderate level of practice for the remaining success factors. The least practiced success factors were commitment and involvement of workers and adequate communication network. These findings are confirmed by Badri and Davis (1995), Owlia and Aspinwall (1997), Tang and Zairi (1998), Kanji and Malek (1999), and Bayraktar, Tatoglu and Zaim (2008).

Level of practice of TQM success factors in workers' affiliated campuses subjected to the Kruskal-Wallis test

Table 4: Test of statistics related to TQM success factors in workers' affiliated campuses

Total(N)	54
Test statistic	12.23
Degree of freedom	4
Asymp. Sig	0.01

Table 5: Post-hoc test

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig	Adj. Sig.
Mowbray vs Bellville	4.40	7.03	0.62	0.53	1.00
Mowbray vs Cape Town	5.02	7.03	0.71	0.47	1.00
Mowbray vs Wellington	-7.28	9.16	0.79	0.42	1.00
Mowbray vs Granger Bay	-25.59	8.10	3.03	0.00	0.02
Bellville vs Cape Town	-0.61	5.37	0.11	0.90	1.00
Bellville vs Wellington	-2.88	7.96	0.36	0.71	1.00
Bellville vs Granger Bay	-20.19	6.71	3.00	0.00	0.02
Cape Town vs Wellington	-2.26	7.96	2.84	0.77	1.00
Cape Town vs Granger Bay	-19.57	6.71	2.91	0.00	0.03

Wellington vs Granger Bay	-17.31	8.92	1.94	0.05	0.52

The results from the test of statistics for the perception of workers' affiliated campuses on the level of practice of TQM success factors are presented in Table 4. The results are shown as $H(4) = 12.23$; $p = 0.01$. A significance level of 0.01 was obtained. This indicates a significant difference in the perception of workers' affiliated campuses of TQM success factors. These findings are supported by Sudhakar and Geentaji (2016). Student's perceptions regarding the practice of TQM success factors were tested within and between groups of institutions with the one-way analysis of variance. The study revealed that all the critical factors play a crucial role in the implementing of TQM with respect to different colleges. The study found that in one of the institutions, there was a significant difference regarding the perception of the practice of customer satisfaction from other institutions.

The Dunn-Bonferroni post-hoc method was used to compare the combination of different groups following a significant Kruskal-Wallis test. A pairwise comparison was conducted amongst and between the groups to determine where the significant difference lay. Results obtained from the post-hoc test are presented in Table 5. Findings reveal that a significant difference exists between respondents in Mowbray and Granger Bay ($p = 0.02$), Bellville and Granger Bay ($p = 0.02$), and between Cape Town and Granger Bay ($p = 0.03$) regarding their perception on TQM success factors. This implies that there was a variation in how TQM success factors are implemented across the different campuses and how these success factors are perceived.

Level of practice of TQM success factors in workers' positions subjected to Kruskal-Wallis test

The test of statistics for the level of practice of TQM success factors in workers' perceptions is presented in Table 6. The result indicates $H(8) = 7.88$; $p = 0.44$. Findings reveal that there is no statistical difference in the perception of TQM success factors as regards workers' positions as a result of the Asymp.sig (p-value) of 0.44 obtained. The findings from the current study are contradicted by Atieno et al. (2014). A correlation analysis was conducted for the responses of students, lecturers, administrators and top management on level of implementation of TQM success factors. The results from the study indicated that top management and administrators agreed with each other on the level at which TQM success factors were implemented, while there was a disparity in the responses of the lecturers and students.

Table 6: Test of statistics related to the level of TQM success factors in workers' positions

Total(N)	54
Test statistic	7.88
Degree of freedom	8
Asymp. Sig	0.44

CONCLUSION

It is apparent that the most significantly practiced TQM success factors were training and education of maintenance workers' use of statistical methods for monitoring and controlling of the maintenance process, and commitment to satisfaction of school stakeholders and commitment from top management. The least practiced success factors were commitment and involvement of workers and adequate communication networks. Therefore, it can be concluded that the application of success factors enhances the effective implementation of TQM in the maintenance activities of university buildings. The test carried out revealed that there was a significant difference in the perception of workers' affiliated campus on the level of practice of TQM success factors. It can therefore be concluded that there are discrepancies in the standard and processes involved in the practice of the TQM success factors across the various campuses.

The scope of the research was limited to a tertiary institution in the Western Cape province of South Africa. Challenges were encountered in getting respondents to participate in the study. Some respondents declined to complete the questionnaires administered.

RECOMMENDATIONS

A statistical difference was discovered in the perception of workers' affiliated campuses regarding TQM success factors. Given that statistically significant differences between groups were tested, it is suggested that immediate and long term interventions should be taken to address the differences in situations where variances were discovered.

In terms of immediate interventions, it is suggested that the TQM success factors should be applied rigorously during the implementation of TQM, most especially by balancing training and application of all TQM parameters across all campuses.

For long run interventions related to the campuses, benchmarking through development of best practices and standards to be followed in all campuses is suggested. Best practices for the maintenance processes should be identified. Thorough analysis of the processes leading to these best practices should be conducted and standards and improved processes should be developed. Comparisons between similar maintenance activities and performances should be conducted to improve performances, with the aim of achieving the best.

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BARRIERS DELAYING SUSTAINABLE TRANSFORMATION IN THE CONSTRUCTION INDUSTRY OF SOUTH AFRICA

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The industry norm of construction being viewed as a project stage is becoming more and more catastrophic by day. As a result, the whole world is experiencing the aftermath of unsustainable construction practices which resulted in rapid climate changes, limited arable land and various types of pollutions just to mention a few. The purpose of the study is to assess the barriers delaying sustainable transformation in the construction industry with specific focus on the Gauteng province being the economic powerhouse of South Africa. The study was designed from both primary and credible secondary based (literatures) data. The primary data for the study was collected through a structured questionnaire survey distributed to 200 randomly selected construction professionals which only 136 out of 200 surveys were retrieved thus yielding a 68 per cent response rate. The primary data was analysed using descriptive statistics procedure. The findings indicate that the lack of capacity for sustainable empowerment, building regulations and standards, and public- sector governance ranked high as barriers delaying sustainable transformation. Moreover, this study contributes to the body of knowledge on the factors affecting radical sustainable transformation in the construction Industry of South Africa.

Keywords: Construction Industry, Ecology, Green, Sustainability, Transformation.

INTRODUCTION

The construction industry is a critical player in the economy of South Africa. Regardless of the various challenges facing the industry in developing countries, it contributes a remarkable percentage towards the South African economic development (Construction Industry Development Board [CIDB] 2012). The construction industry is responsible for the development of houses, buildings, roads and bridges, among others. Similarly, all renovations and repairs to existing infrastructure are conducted by the construction industry.

According to PricewaterhouseCoopers, PWC (2013), the South African construction industry was depressed prior to 2010, with a decidedly negative sentiment in the market. In a change of events, the market was seen holding its own among the world's top performing sector and the revenue finally rose during the 2010 FIFA World Cup. Nonetheless, a gradual decrease in investments was still experienced in South Africa during 2014 despite an increase in economic growth of 10 per cent between 2012 and 2013. In spite of these positive and negative economic outlook, the significance of the outcomes of this study will aid the construction industry with potential factors that could delay the sustainability of the industry which is needed in order to promote economic growth and development in South Africa.

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SUSTAINABILITY - BARRIERS DELAYING THE TRANSFORMATION

Sustainability in the built environment has turned into a universal phenomenon in the building construction industry. Sustainability is a concept created to be the solution towards the slowly deteriorating environment and ecosystem at large.

According to study by Bangdome and Kootin (2013), sustainability is a developing economic phenomenon in light of the information that aims to address the association of economic development, ecological systems and the unfavourable effects that economic activities can have on the environment. A survey of past theoretical literature uncovered the accompanying barriers which were found to impact the transformation, production, economic development and sustainability of the South African construction industry. These barriers include the following:

Procurement practices

The Construction Industry Development Board, CIDB (2004) assessment report revealed that the current positive procurement system is a problem because of its failure towards professionals in encouraging them to set up their own organisations as opposed to cooperating on entrenched developed organizations. The assessment indicated a decrease in the high level of skill that can be incorporated in medium and larger organizations who have existing feasible systems and green/sustainable divisions. Also, the CIDB (2012) and Scott (2012) revealed that a positive strategy for green procurement had only taken form in South Africa during that year. Similarly Bowen, Akintoye, Pearl, & Edwards (2007) highlighted that the failure of procurement executions potentially brought about levels of unhealthy rivalry that affected the development of smaller organisations who were capable of driving a sustainable movement.

Modern technology and innovation

Observations by Ofori (1990) revealed that the inability of individual contractors to undertake some projects is due to relatively new technology. Similarly, Windapo and Cattell (2013) mentioned that South Africa has satisfactory access to modern technological innovation when compared to other developing countries in Africa.

However, the limitations of the projects that can be attempted are influenced by the use of local and international technology and innovation. In addition, Windapo and Cattell (2013) observed that end-users' observations about other practical options to develop building systems, particularly in the market of low-cost housing were limited to conventional methods. Moreover, failing to attain more innovative systems and labour resources are essentially a concern in South Africa.

The CIDB (2007) assessed that government intends on implementing modern strategic objectives aimed at socio-economic infrastructure delivery and higher economic growth turnover that will promote more sustainable transformation within the industry and South African economy as a whole.

Availability of suitable land for construction

Ofori (1990) noted that the availability of arable land is to a great extent in short supply because of the physical demand of infrastructure development in developing countries. Similarly, Boshoff (2010) mentioned that private land ownership is not readily attainable in South Africa compared with the vast accessibility of public areas. In addition to this, Windapo and Cattell (2013) observed that there are numerous legal

battles relating to land claims, zoning issues and heritage sites which influences the price around inhabitable land. The price instability causes a delay in infrastructure development and the implementation of sustainable procurement relating to arable land.

A Public Sector governance

According to Mbande (2010), the skills sector of South Africa together with state-owned organizations lack expert knowledge on public sector governance. Polidano (2000) defined public sector governance as the capacity of the government's administrative systems to adopt sustainable policies that would assist in service delivery through advising decision-makers on which policy is suited for a particular project. This could be achieved through the use of numerical data or indices which analysis in a comparative manner the performance of various sectors within an economy. A three stage process involving: implementation together with capacity policy and operational efficiency is required in order to fully interact the public sector (Polidano 2000).

The CIDB (2004) noted that infrastructure and sustainable development in the construction industry were somehow influenced by the governance within the public sector. Milford (2010), observed that the absence of the public sector governance affected the adverse procedure of financing construction ventures by the government which at a later stage fail to meet the demand of project financing. As a result, this failure could create a backlog of over six months in interim payments to contractual workers and organizations.

Moreover, Windapo and Cattell (2013) observed that the failure of the South African government to promote radical sustainable transformation within the construction industry; its failure to assess public-private partnership schemes tendering for infrastructure development hampered on the overall development of the country. Similarly, the CIDB (2012) concluded that the factors mentioned above are a reflection of the procurement capability of clients and their agents, thus influencing the current implemented sustainable model which also had its short comings in promoting the needed sustainability the industry.

Building regulations and standards

Building regulations and standards included health and safety, height limits and standards, amongst other factors, in the building construction industry at an arbitrary time period (Ofori 1990). As indicated by the CIDB (2004), the South African government has certified over a thousand legislations since 1994, which have produced different standards aimed at infrastructure development, which ignored the ecology and environmental attributes of sustainability. These regulations and standards, if not amended will affect the sustainability of the construction industry in the long run.

Windapo and Cattell (2013) noted that the recent environmental degradation threaten the growth and development of the construction industry of South Africa. According to the United Nations Industrial Development Organisation, UNIDO (2009), who mentioned that determining worldwide issues, for example, sustainable development and global warming was challenging due to building construction activities that contributed to environmental pollution. This pollution in turn created more cost for developers due to the need of waste management. Likewise, different issues incorporated the utilization of water, energy and other common assets which are

challenging for participants within the construction industry to comply with the involved requirements.

Sustainable empowerment - “Green” infrastructure

According to Windapo and Cattell (2013) who stated that human settlements required infrastructure development to be achieved, which means more hectares of land being required. The demand for infrastructure would lead to a rapid development of land that will disturb the ecosystem and affect the environment due to mass production of unsustainable infrastructure. Sustainable empowerment through grants offers or subsidies from the government is needed to drive the green movement of infrastructure development. Similarly, a region cannot be productive without infrastructure development, for example, electricity, channel-borne water and roads, amongst others (Ofori 1990). The CIDB (2007) mentioned that the South Africa stakeholders use vast monetary resources on improving exhausted and deteriorated urban and provincial infrastructure. Furthermore, reports of water scarcity becoming an increasing problem are alarming as witnessed recently with the Cape Town droughts. Failure in providing grants and subsidies to emerging participant in the construction industry will delay the needed green infrastructure which demand less from natural resources being threatened by day. In addition, the achievement of the 2030 Agenda for Sustainability adopted by world leaders at the United Nations in 2015 is critical in implementing radical sustainable measures by the construction industry (Hajer et al., 2015).

Inflation

Ameh and Itodo (2013) noted that construction materials accounts for more than 50 per cent of the aggregate costs of a particular project. Windapo and Cattell (2013) remarked that the South African construction sector manufactures its own materials and depends on imported machinery due to a lack of skills. Therefore, concerns arise when costs within the industry escalate. The CIDB (2007) stated that the construction industry in South Africa recognized that the costs of essential building materials, for example, steel, concrete, sand and bricks, amongst others, increased by 100 per cent since the year 2000. Identically, Ameh and Itodo (2013) evaluated that there has been a direct increment at an average rate of more than 50 per cent since there early 2000s for building material. Moreover, most building material costs increased up to the year 2008, amid the peak of material costs.

Windapo and Cattell (2013) further explained that development in the construction sector declined gradually after 2012 because of higher construction costs, which have spiked at rates higher than the inflation rate. The CIDB (2007) concluded that the impacts of building material costs had on the construction industry had influenced the failure of construction companies to build reasonably priced housing projects, high tender valuations and poor execution in the industry.

Globalization

The impact of globalisation on the development of the construction industry in developing nations affected global trade sector which contributed tremendously to a country's gross domestic product (Lewis 2007). The previous worldwide economic recession and its effect on the world economy indicated that the challenges caused by the failure to implement sustainable measures directly influenced our efforts to mitigate the critical global issues the industry faces today. Moreover, The Organization for Economic Co-operation and Development, OECD (2008) stated that

there is a dire need to create counsels for the monitoring of cost-effective sustained restorational technologies in order to achieve sustainable performances globally.

Harris and Roach (2013) mentioned that private stakeholders fail to acknowledge the entire value of sustaining natural capital, as those with short-term perspectives are unable to consider long-term effects, such as cumulative soil erosion, that can be mitigated through sustainable transformation. Similarly, property rights are poorly explained in natural settings causing bias legalities and permit holders to despoil a natural capital base at a rapid rate.

Ecological specifications

The traditional approach of the construction industry was centred on the utilisation of strategies/techniques for mitigating emissions to suit the administrative requirements of a building or project in order to decrease expenses. Mora (2007) realised that sustainability in the construction industry can assist with the effects of infrastructure development and construction processes. Moreover, green/ecological specifications are aimed at promoting “greener” material requirements during construction and post occupancy satisfaction. Ecological specification can be said to be prescribed requirements needed to promote more environmentally friendly construction techniques.

Similarly, Green Building (2007) advocated that the life cycle assessment of buildings including that of their environmental impacts, patterns of energy and materials needed to be aligned with modern principles and techniques which are more sustainable. Lam, Chan, Poon, Chau, and Chun (2010) explained that the foundation for an ecological specification is through consideration and knowledge about the environment. Citherlet and Defaux (2007) added that the consideration of energy usage of a construction project on the net emission during construction as well as material manufacture, transportation, and demolition was important during the evaluation period of the building’s life cycle. In addition, the studies revealed that material recycling in construction is as crucial as the energy conservation. Thus, the comprehension of the role of energy, material prescription, environmental collisions and sustainable practices in the construction industry need to be adopted in order for the transformation in the construction industry to be achieved.

In addition Lam et al. (2010) indicated that green building performance assessment and ecological specifications have different characteristics of promoting sustainability within the construction industry. The ecological specification has an immutable connection to green construction assessment like the Leadership in Energy and Environmental Design (LEED) Building Council, for example. The evaluation of ecological specifications was significant during the design stage for a new construction project. Moreover, Lam et al. (2010) pointed out that though the induction of multiple green building assessments in various countries focused on local elements, numerous institutions dealing with specifications services have already issued or are arranging to begin with specification services for the green building assessments. Above all, the formation of ecological specifications and the green building assessment together with available model clauses should be utilized as a crucial resource in the South African construction industry.

Stakeholder management

A structured way to dealing with sustainability in construction development was recommended after the introduction of management systems related to quality within

the construction industry amid the late 90s (Deakin, Curwell, Lombardi and MacDonald, 2005). Similarly, Fenn, Lowe and Speck (1997) highlighted that the reduced interest amongst stakeholders resulted in conflict and disputes in the construction industry. However, Berke (2002) emphasized that the incorporation of different interests from stakeholders and the support of the general population in solving the sustainability crisis can yield a change towards a better environment.

Lam, Chan Poon, Chau and Chun (2010) mentioned that clients, design consultants, contractors and subcontractors, the manufacturer of products, building officials together with building occupants were the stakeholders of any construction projects. Lam et al. (2010) advocated that management needs to address stakeholders' interests to contribute towards sustainable development. For example, the examination of recycled aggregates should be conducted by a certified laboratory to guarantee both the clients and design team relating to the suitability of the project, over and above the mandatory requirements.

Similarly, involving the different interests of stakeholders should be of paramount importance. Lam et al. (2010) maintained that in enabling stakeholder participation, the development of ecological specifications must be conducted together with executive management and other stakeholders. Publication of green product directories and web-based distribution of commentaries are amongst other examples to enable stakeholder involvement.

Leadership and responsibility

Lam et al. (2010) indicated that leadership and the responsibility of stakeholders in the construction industry needs to contribute to the achievement of sustainable transformation by reducing the excess use of energy and environmental effects due to the construction activities. This could be achievable through business leaders who execute a functional decision-making system. Similarly, political will of the ruling party together with policies promoting sustainability influenced the transformation of the industry and South Africa in general. Swift (1999) opined that professionalism should be exercised with caution when handling the interest of the public and averting a conflict of interest, as professionalism is imperative when aiming to gain public participation and trust during the preparation of ecological specification specifications. Lam et al. (2010) argued that the two most common barriers for environmental initiatives in ecological specification were liability and uncertainty. Rubin (1994) further revealed that pollution is amongst the most detrimental contributor towards environmental decay which is a popular subject that is associated with scholars on green programmes.

According to Pearce and Vanegas (2002), uncertainty and liabilities associated with innovative green technology prevented various construction professionals from recommending sustainable building material during the feasibility phase of a project. Similarly, about 4 per cent of all client respondents from a Barbour Index (2004) commonly prescribed innovative products that had low interests to ecological specification as a result of clients being misinformed. Therefore Lam et al. (2010) noticed that a reduction in uncertainty regarding the liability linked to ecological specifications through an equal distribution of responsibilities could yield an increase in their utilization.

RESEARCH METHODOLOGY

The research study was conducted from both theoretical literature and field work through a survey design. The population including built environment professionals from both the private and public sector. The professionals were mainly: Quantity Surveyors, Construction Managers, Civil Engineers, Project Managers and Construction Project Managers and Architects as they were the major actors in the industry. The survey was designed to explore existing knowledge of the research area of sustainability, economics transformation and the ecology. Through the use of stratified sampling, the study reflected the current barriers affecting the sustainable transformation within the South African construction industry.

Only 136 out of 200 questionnaire surveys distributed through electronic mail and hand delivery were received back which yielded a 68 per cent response rate. This was considered sufficient for analysis according to Baruch and Holtom (2008) who studied that the bases of the results of a survey could be considered even though the return rate was as low as 50 per cent. The collected survey data was analysed using descriptive statistics procedures. A five point Likert scale was used to determine the barriers delaying sustainable transformation in the construction industry with regards to the identified barriers from the reviewed literature. The adopted scales were as follows: 1 = Strongly disagreed; 2 = Disagreed; 3 = Neutral; 4 = Agreed; 5 = Strongly agreed.

The limited research duration resulted in the study being limited to only the Gauteng province as it is the countries' economic powerhouse thus making the generalization of findings more meaningful due to housing professionals from various provinces with South Africa. In addition, a mathematical computation of each variable was done through the use of mean item scoring and standard deviation respectively. From the computation, the study was able to rank each barrier according to their importance

FINDINGS AND DISCUSSIONS

Biographic data of the respondents

Findings revealed that 58.3 per cent of the sampled respondents were employed in contracting firms, 25.8 per cent are engaged in the public sector, 31.1 per cent of the respondents' companies worked in the private sector while 15.9 per cent worked in the public sector. Similarly, 53 per cent of the companies operated in both the private and public sector. Further results showed that 6.8 per cent worked for project management firms, 4.5 per cent worked for engineering consulting firms and 4.5 per cent worked for quantity surveying firms. Findings reflecting occupant's current job position in their respective companies revealed that 44.7 per cent were Quantity Surveyors followed by Civil engineers at 17.4 per cent. In addition, 9.1 per cent Project Managers, 8.3 per cent were Construction Project Managers at and lastly Architects were at 5.3 per cent.

Barriers delaying sustainable transformation

Table 1 shows the respondents' ranking of the major barriers delaying sustainable transformation obtained through previous and current literatures. It shows that lack of capacity for sustainable empowerment is the major barrier with a mean item score (MIS) of 3.90, a standard deviation (SD) of 0.881 and ranked (R) of 1. The second major delay was building regulations and standards followed by lack of land for construction activities and public sector capacity. In addition, the table further shows

that restricted work responsibility, inflation, critical global economic issues and construction techniques as other major barriers. Furthermore, the table also reveals that lacks of political was the least barrier that could potentially delaying sustainable transformation.

Table 1: Barriers delaying sustainable transformation in the construction industry

Potential Barriers	SD	MIS	R
Lack of capacity for sustainable empowerment	0.88	3.90	1
Building regulations and standards	0.96	3.89	2
Lack of land for construction activities	0.92	3.88	3
Public-sector governance	0.88	3.88	4
Procurement practices	0.89	3.79	5
Stakeholder management	0.98	3.78	6
Usage of new innovation and technology	0.68	3.77	7
Traditional construction techniques and standards	0.85	3.77	8
Restricted work responsibility	0.74	3.77	9
Inflation	0.76	3.62	10
Critical global economic issues	0.75	3.61	11
Ecological specifications	0.76	3.61	12
Lack of political will	0.74	3.53	13

DISCUSSION OF FINDINGS

The findings of this study were not in agreement with the finding by Ofori (1990) and Windapo and Cattell (2013) which revealed that inflation of construction materials and availability of ‘Green’ construction land are the top ranking factors while the utilization of new innovation and technology was ranked last. Although both studies were carried out in South Africa, the findings of both studied were heterogeneous as they were conducted in different provinces.

The current study findings also were not in agreement with a studies conducted by Fenn et al. (1997), Berke (2002) and Lam et al. (2010) in developed countries which revealed that stakeholder management and restricted work responsibilities were the major barriers while the usage of new innovation and technology was the least barrier. There are few or no studies that have been conducted on construction techniques and the principle of traditional construction. Thus, the current study contributed to the body of knowledge on sustainable transformation.

In addition, Mbande (2010) mentioned that the South African skills sector and state-owned companies had a shortage of professional skills which was proven to be true from the current study as 31.1 per cent of professionals were employed in the private

while only a mere 15.9 per cent were employed in the public sector. Similarly, Muhwezi, Chamuriho and Lema (2012) concluded that not many construction companies, both public and private, dedicate time and resources in considering sustainable transformation through promoting the idea of reusing/recycling building materials.

RECOMMENDATIONS AND CONCLUSIONS

The achievement of radical sustainable construction for the conservation of the ecological, environment and economic well-being of South Africa was the main purpose of this study. Thus, the study assessed the barriers delaying sustainable transformation within the construction industry as it is one of the key players in the South African economy. From the study, it is revealed that sustainable transformation is perceived both as a result-driven initiative and as a milestone to long-term well-being status.

Nonetheless, from the research findings it is evident that the failure of public-sector governance to implement more sustainable policies could potentially delay the needed sustainability within the construction industry. Furthermore, the government's failure to assess public-private partnership schemes tendering for infrastructure and sustainable development could potentially delay the overall achievement of the 2030 Agenda for Sustainability adopted by world leaders at the United Nations in 2015.

It is therefore recommended that introducing sustainability 'green' workshops in the construction industry can promote sustainable thinking and ecological values amongst existing and aspiring construction professionals. Moreover, construction companies should operate in both the public and the private sector to evenly distribute sustainable transformation in the industry. As an extension of this study, further research can be conducted into the benefits of a sustainable construction industry post radical transformation.

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AN ASSESSMENT OF THE ROLE OF POWER INFRASTRUCTURE DEVELOPMENT IN THE ECONOMIC GROWTH OF NIGERIA

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Developed nations have been able to attain great heights in both human and economic resources growth through the guaranteed access to electricity. Any nation that strives to improve its economic relevance in the world must first develop its power infrastructure sector, most especially the provision of secured electricity. The purpose of this paper is to identify the role of power infrastructure development in the Nigeria society. Data was collected from primary and secondary source for the purpose of this research. The primary data was collected through a structured questionnaire aimed at the professionals involved in the development of power infrastructure in Nigeria. The effects of power infrastructure development that have benefitted the economic development of Nigeria were found to be; improved health care system, improved educational system, and also improved income of the citizens, creation of wealth were seen as some of the roles power infrastructure development could potentially play in the economic growth of Nigeria. To appropriately ensure the improvement of the economic growth in Nigeria, power infrastructure development must be prioritized and given adequate backing by the government regarding long-term policies and also, participations of private investors to ensure the roles of power infrastructure development in the economic development in Nigeria are sustained. This study contributes to the economic development of Nigeria, which will likewise improve the standard of living of the citizens, boost innovations and also promotes economic development in the entire continent.

Keywords: Economic growth, infrastructure growth, policy effects, Power development

INTRODUCTION

Infrastructure development can be referred to as the model for every nation's economic growth (Kumari and Sharma 2017). Power infrastructure in the same vein plays an imperative role in nation's economic development. Sustainable power infrastructure development is needed in developing countries as a tool to improve the economic and welfare development (Parker & Kirkpatrick 2004). Foster & Briceno-Garmendia, (2010) stated that the cause of underdevelopment in African countries could be traced to lack of power infrastructure development. China's economic growth is a perfect example of the influence power infrastructure development has on the economic development in a society. These can be traced to decades of power infrastructure development investment in the country (Zhang et al 2013).

Power infrastructure development has determined the rate of economic growth in countries (Kirkpatrick et al 2006). The access to secured power supply has improved lives in the society, countries all over the world have been able to reduce poverty among the citizens due to efficient development in their power infrastructural sector

(World Bank 2003). Before the mid-1980s the development and financing of public infrastructure e.g. power infrastructure was done independently by the government. However, the lack of ways to improve the development of infrastructure constrained and limited the economic development and growth in nations across the world (World Bank 1995).

International establishments such as the World Bank has been collaborating with several nations in the world in boosting power infrastructure development as a way of increasing the economic profile of the country (Banerjee et al 2008). The investment in power infrastructure development will lead nations to unprecedented economic growth: e.g., wealth creation, increase in production, poverty alleviation (Eberhard et al 2011). However, with the efforts of harnessing the benefits that come with the investment in the power infrastructure development, nations has pursued privatization as a tool of financing and service delivery of power infrastructure (Kaseke & Hosking 2013). Due to the motive of reducing the burden placed on government in the development of power infrastructure, there are calls for improvement on the level of domestic and international investors as a way of actualizing economic growth (Zhang et al 2013).

Also, to encourage foreign and domestic investors in collaborating with the public sector in bringing forth power infrastructure to reality, there must be favorable policies to enhance the investments of this magnitude (Organization for Economic Co-operation and Development 2009). It is of great importance for the government to make available policies that encourage private investments, with the presence of favorable policies backing their investments, there will be great investment in the sector and directly boosting economic growth in the region (Eberhard & Foster 2008).

In Nigeria, the poor state of power infrastructure development in the society has resulted in little or no improvement in the country's economic development (Ijaiya et al 2011). The living standards for countries in the world can be traced to their per capita electricity consumption, because per capita energy consumption of a nation is directly proportional to its economic growth (Oyedepo 2012). Therefore, to enhance economic growth in Nigeria, there must be a workable and efficient model that will improve development of power infrastructure (Ethlers 2014). It is based on this knowing that this study assessed the perceived economic benefits power infrastructure development brings to the economic growth of Nigeria, with a view to proffering possible recommendations towards improving economic growth in the country through power infrastructure development.

LITERATURE REVIEW

Power Infrastructure Development

Power infrastructure development is the landmark of every nation's economic development. Power infrastructure investment has the capacity of increasing industrial productivity (Africa Development Bank 2013b). Report from AFDB, (2013a) stated that countries in the region, making efforts to ensure a positive power development in the region must first stabilize its macroeconomic and political structure. This includes the provision of favorable conditions necessary to encourage private capital investment in the region. Access to secured electricity promotes production, improves the standard of living in the society due to sustained economic development derived as a result of sustainable development in the power infrastructure sector (Kodongo &

Ojah 2016). Provision of power infrastructure can alleviate poverty from the society and boost trade and commerce (Mbaku 2013).

Infrastructure development enhances every country's Gross Domestic Product (GDP). By the end of the 2000 to 2010, it was estimated that Africa countries needed an annual expenditure of about USD 93 billion, this will result in about 15% increase in GDP of the region (Foster & Briceno-Garmendia 2010). Sachs et al., (2004) goes on to say that moving forward the annual investment of infrastructure in the region will result in about 9% to 13% improvement in the GDP. Comparing Africa countries to the rest of the developing countries it is evident that Africa countries are behind regarding investment in power infrastructure development and economic growth (Eberhard et al 2011). For instance, power infrastructure sector in Africa is worst affected. In the period from 2008 to 2012 the consumption rate of energy in the region has only improved by 0.9% from 10.23 QBtu to 10.32 QBtu. Also, it has a share of 1.9% of the world energy consumption (Eberhard et al 2011).

Despite the diverse benefits that come with the development of power infrastructure, countries in Africa e. g Nigeria's investment in the power infrastructure development has been below par. Calderon & Servén, (2010) stated that rate of low investment of power infrastructure in the region has jeopardized the internal competitions, limited economic growth, and constrained trade in the region (Fedderke et al 2006). Therefore it cannot bring to reality the benefits associated with the investment of power infrastructure, which is: creation wealth, reduced cost of production, enhances the functioning of the nations economy, production improvements, and the improvement of the standard of living of the people in the society (Ndulu 2006).

RESEARCH METHODOLOGY

The method used in this study was quantitative research approach with the motive of achieving the aim of the study, which is the role of power infrastructure development in the economic growth of Nigeria. Quantitative methods relate to positivism and factual data. The questionnaire was developed from a wide review of the literature and is not part of any existing survey instrument. Practicing power infrastructure professionals in the power sector of Nigeria were engaged in the collection of the primary data on the role of power infrastructure development in the economic growth of Nigeria.

One hundred and fifty (150) questionnaires were randomly distributed, and one hundred and thirty-two (132) were received, this represents an 88% response rate and used for the analysis of the research findings. In collecting data for the questionnaire, it was ensured that the professional were currently working in the required field. Also, the professionals would have worked or currently working on projects of power infrastructure development and works in the power industry in Nigeria. The collected questionnaires were analyzed through descriptive statistics to meet the research objective for the study. The analyzed data were presented through the frequency distributions table using the mean item score of the measured variables

A five-point Likert scale was used to determine the role of power infrastructure development in the economic development in Nigeria concerning the identified variables from the explored literature. The scales adopted for the study are the following: 1 = strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree and 5 = strongly agreed. The five-point Likert scale was presented as mean item score (MIS) for every variable as evaluated by the respondents. The index was then used to know the rank of

every item. The ranking of the variables made it feasible to cross compare the relationship between variables as seen by the respondents. This method was used to evaluate the data gotten from the structured questionnaires for the study.

After the mathematical calculations, the derived variables were ranked according to the descending order of their mean item score (from the peak to the lowest).

RESULTS AND FINDINGS

Findings related to the respondents as shown in the table 1 below reveals that Architect represents 9.1%, builders represents 7.6, engineers represents 15.2%, Quantity Surveyors represents 12.1%, projects managers represent 9.1%, consultants represent 7.6%, financial institution professionals represents 22.7% while the state-owned electricity professionals represent 16.7%.

Table 1. Professional Qualification

Professionals	Percentage
Architects	9.1%
Builders	7.6%
Quantity Surveyors	12.1%
Engineers	15.2%
Project Manager	9.1%
Consultant	7.6%
Financial Institution Professionals	22.7%
States-owned electricity distribution professionals	16.7%

In the same order, the survey on the professionals years of experience as shown in Table 2 below revealed that 0.8% of respondents has less than a year working experience, 5.3% of respondents represented 1-2 years working experience, 16.7% respondents represented 3-5 years working experience, 34.8% respondent represented 6-10 years working experience, 30.3% respondents represented 11-15 years working experience, 9.1% respondents represented 16-20 years working experience, 2.3% respondents represented 21-25 years working experience and finally, 0.8% respondents represented above 25 years working experience.

Table 2: Respondents Experience

Years	Percentage
Less than a year	0.8%
1-2 years	5.3%
3-5 years	16.7%
6-10 years	34.8%
11-15 years	30.3%
16-20 years	9.1%
21-25 years	2.3%

Above 25 years

0.8%

The Role of Power Infrastructure Financing on the Economic Growth of Nigeria

The following are the rankings of the variables from the highest to lowest, according to the respondent's perceived view on the role of power infrastructure development in the economic growth in Nigeria. This is ranked according to the calculated mean score and standard deviation. The study shows that Creation of wealth (SD=0.333, MIS=4.89, R=1), creation of jobs (SD=0.412, MIS= 4.86, R=2), reduces cost of productions (SD=0.472, MIS=4.77, R=3), ensures a functioning economy (SD=0.421, MIS=4.77, R=4), ensures a viable economic growth in the country (SD= 0.430, MIS=4.76, R=5), income increment (SD= 0.452, MIS=4.75, R=6), improves the standard of living of the people (SD= 0.435, MIS=4.75, R=7), ensures socio-economic improvements (SD= 0.460, MIS=4.73, R=8), increases productions (SD= 0.443, MIS=4.73, R=9), increases the profitability of organizations (SD= 0.484, MIS=4.68, R=10), increased competitions to boost economic growth (SD= 0.536, MIS=4.66, R=11), improves investors' confidence on the economy (SD= 0.509, MIS=4.65, R=12), it makes life easy (SD= 0.500, MIS=4.63, R=13), health care and education improvement (SD= 0.584, MIS=4.45, R=14), it enhances innovation in the society (SD= 0.542, MIS=4.44, R=15), and finally it creates connections between domestic and international investors (SD= 0.543, MIS=4.22, R=16).

Table 4. Roles of power infrastructure development on the economic growth in Nigeria

Roles	SD	MIS	Rank
Creation of wealth	0.333	4.89	1
Creation of jobs	0.412	4.86	2
Reduces cost of productions	0.472	4.77	3
Ensures a functioning economy	0.421	4.77	4
Ensures a functioning economic growth	0.430	4.76	5
Income increment	0.452	4.75	6
Improves the standard of living of the people	0.435	4.75	7
Ensures socio-economic improvement	0.460	4.73	8
increases productions	0.443	4.73	9
increases the profitability of organizations	0.484	4.68	10
increased competitions to boost economic growth	0.536	4.66	11
improves investors' confidence on the economy	0.509	4.65	12
it makes life easy	0.500	4.63	13
healthcare and education improvement	0.584	4.45	14
it enhances innovation in the society	0.542	4.44	15
creates connections between domestic and international investors	0.543	4.22	16

Note: SD=Standard Deviation, MIS = Mean Item Score

The roles of power infrastructure development observed from the study are not only peculiar to the Nigerian society only, but agree with the report of AFDB, (2013) which shows that access to electricity enhances improvement in the living standard of the society. These were also in agreement with the study of Kodongo & Ojah, (2016) which stated that investment in power infrastructural sector brings about economic development and wealth creation in the society. This agrees with the study of Mbaku, (2013) which stated that the provision of power infrastructure facilities in a country have the capability of alleviating poverty from the society. Also, the study of Foster & Briceno-Garmendia, (2014) interpreted the development of power infrastructure as a catalyst in boosting the GDP of a country and welfare development. The benefits associated with the development of power infrastructure in the society cannot be brought to reality without certain factors. Therefore it is necessary for nations to put in place sustainable financing model, favorable legislative policies which can eradicate challenges facing investments in the sector and favor private investment capital to develop power infrastructure to sustainable height

CONCLUSIONS AND RECOMMENDATION

This paper assesses the role of power infrastructure development in the economic growth of Nigeria. The data used for this research study is from the primary and secondary sources. The secondary data showed that power infrastructure development enhances economic development in the society. However, to achieve the benefits that development of power infrastructure brings to the society it is important to mitigate the challenges that limit the investment in the sector. Literature revealed power infrastructure development as a vital aspect of achieving Sustainable Development Goals (SDGs). Findings from the empirical survey revealed several roles of power infrastructure development on economic growth in Nigeria such as the creation of wealth was ranked the highest as the role power infrastructure has on the economic growth in Nigeria. Likewise, the creation of jobs was ranked next as the benefits power infrastructure development has in the economic growth in Nigeria. Reduced production cost was ranked third, ensures a functioning economy was ranked fourth, ensures a functioning economic growth in the country was ranked fifth, income increment was ranked sixth, improvement in the standard of living of the people was ranked seventh, creates connections between domestic and international investor was ranked sixteenth respectively by the respondents as the roles power infrastructure development has in the economic growth in Nigeria. From the literature review and result of the study, it was derived that factor must be in place to ensure development in the power infrastructure sector. Firstly, there must be established favorable legislative policies that can positively influence the involvement of private capital in the sector. Secondly, the government must eliminate several challenges like the cost of doing business, lack of loans for investment in the country as means of attracting foreign investment in the sector, since it has been established that power infrastructure cannot be solely financed by the government. This study has been able to contribute to the body of knowledge as it has revealed several benefits power infrastructure development brings to the society. However, it is recommended that this research should be done on wider scale of respondents and area of research, as this will broaden the knowledge on the roles power infrastructure development plays in the economic growth in the society.

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A CONCEPTUAL FRAMEWORK OF KNOWLEDGE TRANSFER FROM THE CONSTRUCTION COMPANY TO THE HOST COMMUNITY

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Knowledge transfer and management in organizations throughout the world is a competitive advantage. It is what the organization knows, how it uses what it knows and how fast it can discover something new, be it in acquisition of technology for innovation, or business activities development, studies have been undertaken in this area to examine knowledge transfer and management process in the organisation. But little is known about the effectiveness of knowledge transfer by construction companies to the project host communities. Therefore, this paper builds on existing concepts of knowledge transfer and diffusion of new ideas and offers a conceptual framework of knowledge transfer and its diffusion from the construction industry to the project host community. The conceptual framework identifies stages of Knowledge conversion and diffusion and factors that are expected to enable the transfer process at different stages. The framework also shows the inter-relation between Knowledge transfer and diffusion by combining the theory of Nonaka & Takeuchi on knowledge creation and shearing with Everett Rogers's innovation decision theory. This has been achieved by first, reviewing and discussing theories relating to diffusion of new idea (NI) and knowledge transfer (KT). Secondly, the paper evaluates the interrelation between knowledge transfer and diffusion of new ideas. Thirdly, it establishes a connection between knowledge transfer and diffusion of new ideas. Finally, it brings the latter in the context of construction industry. This paper has demonstrated that a construction firm that is able to create and improve its Knowledge base and transfer such new Knowledge to the community in which it finds itself, would have much collaboration and a peaceful atmosphere to carry out its corporate goals or complete its project within schedule.

Keywords: Knowledge transfer, Diffusion of new idea, construction health and safety, Conceptual framework

INTRODUCTION

The concept of organizational knowledge as a foundation for global competitiveness is of significant theoretical importance (Liyanage et al 2009). Unstructured transfers of Knowledge routinely take place within and across organizational boundaries, whether the process is actively managed or not (Davenport and Prusak 1998). Some researchers argue that after an appropriate Knowledge has been selected, transfer of such Knowledge is an unsure process, Gilbert and Cordey-Hayes (1996); Nonaka and Nitsuguchi (2001); Liyanage et al (2009). They further suggest that, for knowledge to be transferred successfully, a context of understanding should comprise mechanisms for both knowledge sharing and adoption. This paper is based on an ongoing research project that can help construction companies transfer knowledge from the construction companies to their host communities. The two main processes in this context are knowledge transfer and diffusion. This paper attempts to bring these two together in

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transferring the knowledge of health and safety from the construction companies to their project host community.

There are many conceptual frameworks on knowledge transfer and management in the organization, but the literature which this research has so far reviewed or read has not dealt with transferring and managing knowledge from the construction industry to the project host communities of the construction activities. Some of the theories and frameworks on organizational Knowledge transfer found in literature are Remenyi et al. (2002); Alavi and Leidner, (2001); Szulanski, (2000); Argote & Ingram, (2000); Epple et al. (1996) and Attewell, (1992). These authors looked at the ability to transfer and manage knowledge from one unit to another in an organization alone, which they all concluded to have contributed to the organizational growth and performance. Other authors such as Nonaka et al. (2000); Argote and Ingram, (2000); as well as Liyanage et al. (2009) tend to look at how organizational knowledge is transferred through the various units and managed within the organization in the area of business management. Some also looked at innovation diffusion in the construction industry e.g. Shibeika, (2014); Fellows & Liu, (2012); Esmaeili et al. (2012); Kale & Arditey, (2010); Taylor, (2007), Dubois and Gadde, (2002) as well as Arditi and Tangkar (1997). These and many other researchers have done extensive work in the area of knowledge management and transfer in the construction industry, organizational behaviour, human management, diffusion studies and technological innovation management.

But all their works have been centred within the organization or inter intra firm alone, not linking this organizational knowledge to the communities neighbouring these organizations. Hence the need for a framework that is construction specific and capable of transferring knowledge from the industry to the community since construction companies operate within these communities. Szulanski (1999), argues that the mere possession of potentially valuable knowledge assets somewhere within an organization does not necessarily mean that other parts of the organization benefit from that knowledge. The construction industry is noted for its fragmented nature coupled with various project stakeholders from inception, finance, design, procurement, construction and post construction stage. The construction industry is viewed as one of the difficult social systems when it comes to knowledge transfer by many authors such as, Widen et al., (2009); Manley, (2008); Ende, (2006); Larsen, (2005); due to its various stakeholder involvement. Although the fragmented, temporal and various stakeholders are seen as major barriers to knowledge transfer in the construction industry. This paper argues that these weaknesses are as well major strengths in the diffusion paradigm. When it comes to knowledge transfer beyond the organisational settings and reaching out to different professionals and non-professionals throughout different projects settings the construction industry stands tall in diffusion new ideas.

This paper is developed based on a review of empirical and theoretical studies already published. Past researches on knowledge transfer and diffusion in and outside the organization were obtained primarily from research databases including Google scholar, Taylor and Francis, Emerald Insight, Research Gate, IGLC Science Direct and other internet sources. The initial descriptors used for the search were Knowledge transfer variables, innovation Diffusion variables, organizational Knowledge transfer and, Knowledge transfer in the construction industry. The initial descriptors were used to search the databases. A total of 50 articles were reviewed for the research in order to establish a connection between knowledge transfer and diffusion. To identify the

variables to a successful knowledge transfer, and identify variables to a successful diffusion process. And to understand the theories behind organizational knowledge management and transfer in the construction industry.

LITERATURE REVIEW

KNOWLEDGE

Nonaka & Takeuchi (1996) theorized that Knowledge is created and improved when it flows between different levels of organization between individuals and groups. This theory states that for a knowledge transfer to be successful, it must go through socialization, externalization, internalization and a confirmation process.

Socialization: from tacit to tacit is a process of sharing experiences and thereby creating tacit knowledge such as shared mental model and technical skills. An individual can acquire tacit knowledge directly from others without using language but through observation, imitation and practice (Nonaka & Takeuchi 1996).

Externalization: from tacit to explicit is a process of articulating tacit knowledge into explicit knowledge concepts. It is a typical knowledge creation process in that tacit knowledge becomes explicit, taking the shapes of metaphors, analogies, concepts, or models (Nonaka & Takeuchi 1996).

Combination: from explicit to explicit is a process of systemizing concepts into a knowledge system. This mode of knowledge conversion involves combining different bodies of explicit knowledge. Individuals exchange and combined knowledge through such media as documents, meetings, telephone conversation, or computerized communication networks (Nonaka & Takeuchi 1996).

Internalization: from explicit to tacit is a process of embodying explicit knowledge into tacit knowledge. It is closely related to learning by doing, when experience throughout socialization, externalization, and combination are internalized into individuals, tacit Knowledge (Nonaka & Takeuchi 1996).

What is Knowledge?

According to Nonaka and Takeuchi (1995), knowledge in contrast to information, is about actions, beliefs and commitment as it is dependent on the perspective or intention of individuals. What knowledge and information have in common is about meaning. They further opined that knowledge and information need to be seen in a specific context and relations as they depend on particular situations and evolve dynamically through social interactions of individuals. Knowledge is a fluid mix of framed experiences, value, contextual information, and expert's insight that provides a framework for evaluating and incorporating new experiences and information (Davenport and Prusak 2000). Duguid (2002) stated that knowledge means a knower who is able to offer it to its direct environment e.g. teams, networks and other surroundings. Davenport and Prusak (2000) argued that knowledge is rooted in information and information is in turn originated from data.

Knowledge Transfer in context

Knowledge transfer (KT) is an area of knowledge management concerning the movement of knowledge across the boundaries created by specialized knowledge domains (Carlile & Rebentisch, 2003). The concept of knowledge transfer is derived from the field of innovation. Knowledge transfer is the movement of knowledge from one place, person ownership to another (Liyanage et al. 2009). According to Liyanage

et al (2009), any transfer must involve more than one party. There must be a source, the original holder of the knowledge) and the destination (where the knowledge is transferred to).

A good knowledge transfer means that transfer results in the receiving unit accumulating or assimilating new knowledge (Nonaka & Takeuchi 1996; Nonaka 1994). Knowledge transfer involves either keenly collaborating with others and sharing what one knows, or actively referring others to learn what they know. When people in a social setting identify knowledge that is critical to them, they can use knowledge transfer systems to acquire that knowledge. They can then improve it through reinvention and make it available through diffusion for others who need it. Since knowledge transfer (KT) involves networking and encourages having close ties with people to share knowledge between and within a social system, it can be identified as an act of communication (Paulin & Suneson 2008).

Forms of knowledge

The distinction of knowledge dates to the philosopher Michael Polanyi. He opined that knowledge can be categorized into two arrangements: explicit knowledge and tacit knowledge. Some authors argued that, tacit and explicit knowledge are not totally separated but mutually complementary entities (Nonaka & Takeuchi, 1995; Lahti and Beyeclein, 2000; Nonaka and Nishiguchi 2001; Zack, 1999; Chini, 2005). They further stated that human knowledge is created and expanded through social interaction between tacit and explicit knowledge. This means that for there to be knowledge transfer in any way or form, these two knowledge conversions must be present.

Tacit knowledge according to Polanyi (1966) is a nonverbalized, intuitive and unarticulated knowledge. It's a knowledge that resides in human brain and cannot be easily captured or codified according to Nonaka and Takeuchi (1995). Tacit knowledge in nature is complex and many at times, impossible to capture and diffuse, but compared to explicit knowledge, it adds more value to the holder. Explicit knowledge on the other hand, is the knowledge that can be articulated in formal language and easily transmitted among individuals and social settings. It is knowledge that is codified and can easily be understood because it can be codified and carried out through formal and methodical language in books, databases and libraries (Zack, 1999).

Knowledge Conversion

According to Carlile and Reberich, (2003), knowledge transfer is the movement or transferring specialist knowledge across boundaries. Liyanage et al. (2009) also argued that successful knowledge transfer is when the transfer results in the receiving unit accumulating or assimilating the new knowledge. Ryu et al., (2003) stated that knowledge transfer and sharing is a person-to-person process. Truch et al., (2002) is also with the opinion that knowledge transfer is a two-way process. This involves both the source (supplier of the knowledge) and the adopting unit (the receiver of the new knowledge.)

Nonaka & Takeuchi (1995) came out with four modes of knowledge conversion and transfer as shown in figure 1 below

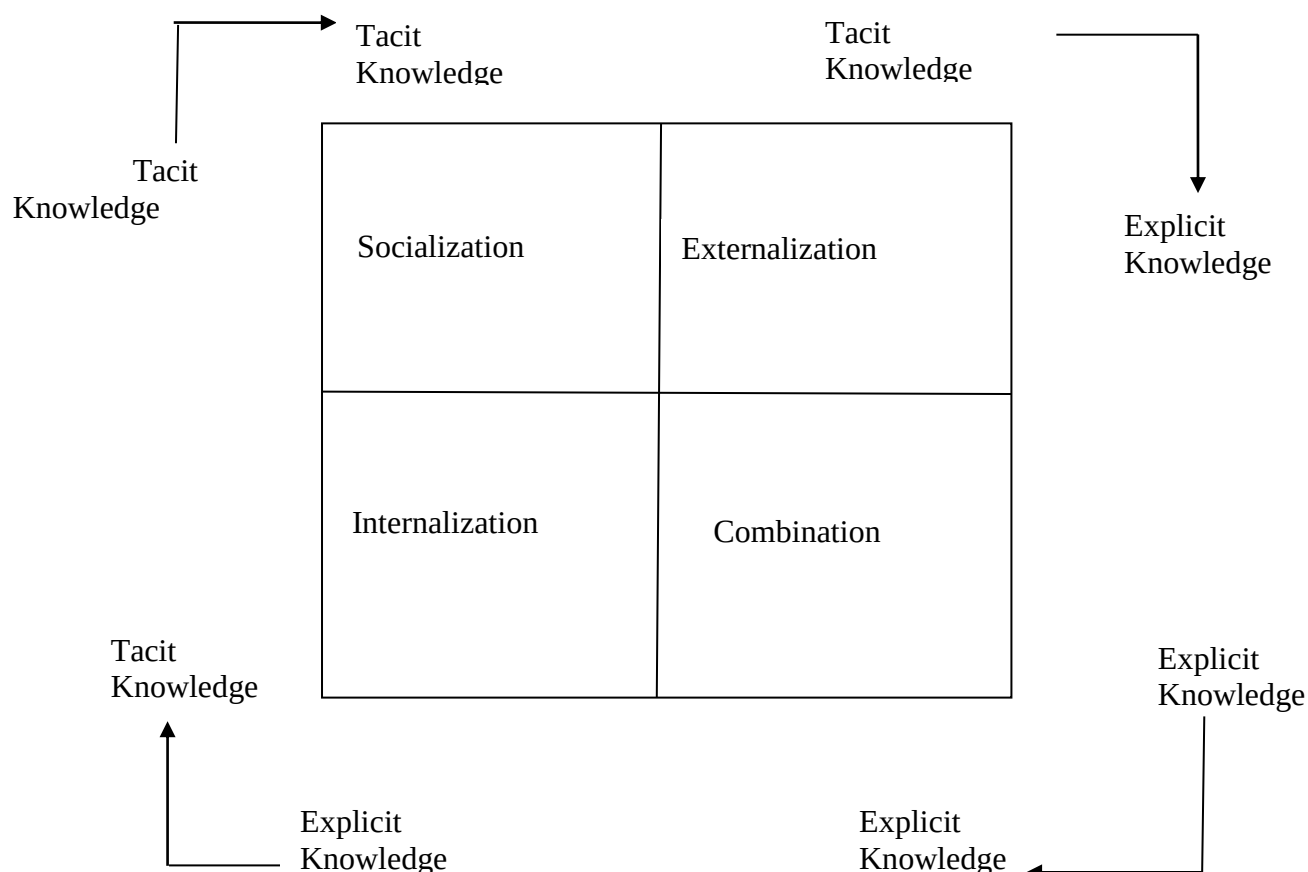


Figure 1: Knowledge conversion model (Adopted from Nonaka and Takeuchi)

DEFINITION OF DIFFUSION

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers 1995, 2003). Diffusion is also defined as the process in which technological innovation and managerial innovation have been introduced into work processes and adopted by a specific group or across the whole organization (Green and Hevner, 2000; Bresnen and Marshall, 2001). According to Koebel, (1999, 2008) diffusion involves communicating a new idea to the target adopters. According to Rogers (1995), it's a special type of communication, in that the messages are concerned with new ideas. Rogers (1995) defines communication as a process in which participants create and share information with one another in order to reach a mutual understanding. This means that two or more individuals exchange information with one another to move towards one another or part. (Rogers 1995; Toole, 1998; Sexton, 2004).

Innovation Decision

Innovation decision is the process through which an individual or other decision-making unit passes from first knowledge of innovation, to forming an attitude toward the innovation to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision (Rogers 1995). Rogers further argued that the innovation decision process consists of a series of actions and choices over time through which an individual or an organization evaluates a new idea and decides whether or not to incorporate the new idea into ongoing practice. Rogers (1995) in his seminal book on innovation diffusion opines that individual decision about an

innovation is not an act but a process that occurs over time and consists of a series of actions. What is the exact nature of the sequential stage in the process of innovation decision making? The model of knowledge transfer and innovation decision conceptualized in this paper consist of the five stages, Knowledge, Persuasion, Decision, Implementation and Confirmation.

Knowledge stage; this consist of the innovation-decision process as beginning with the knowledge stage which commences when the individual or other decision-making unit is exposed to the innovation or new knowledge existence and gains some understanding of how it functions (Rogers and Shoemaker 1971; Rogers 1995). Rogers further state that, an individual plays a passive role in being exposed to knowledge awareness because one becomes aware of an innovation quite by accident, as one cannot actively seek an innovation until one knows that it exists.

Persuasion stage; at the persuasion stage in the innovation decision process the individual forms a favourable or unfavourable attitude towards the innovation. Whereas the mental activity at the knowledge stage was mainly cognitive or knowing, the main type of thinking at the persuasion function is effective or feeling. Until the individual knows about a new idea, he or she cannot begin to form an attitude towards it (Rogers and Shoemaker, 1971; Rogers, 1995). Rogers further noted that at the persuasion stage is where an individual becomes more psychologically involved with the innovation; he or she seeks information about the new idea.

Decision stage; the decision stage in the innovation decision process occurs when an individual or other decision-making unit engages in activities that lead to a choice to adopt or reject the innovation. Adoption is a decision to make full use of an innovation or reject the innovation as the best course of action available (Rogers 1995). Rogers argues that most individuals will not adopt an innovation without trying it first on a probationary basis to determine its usefulness in their own situation. He further state that this small-scale trial is often part of the decision to adopt, in order to decrease the uncertainty of the innovation for the adopter.

Implementation stage; implementation occurs when an individual or other decision-making unit put an innovation into use. Until the implementation stage, the innovation-decision process has been a strictly mental exercise. But implementation involves overt behaviour change, as the new idea is put into practice (Rogers 1995). Rogers postulates that a certain degree of uncertainty about the expected consequences of the innovation still exists at the implementation stage, even though the decision to adopt has been made previously. Because an individual particularly wants to know the answers to such question as 'where do I obtain the new idea'? 'how do I use it'? And what operational problems am I likely to encounter, and how 'can I solve them'? As a result, active information seeking usually takes place at the implementation stage also.

Confirmation stage; at the confirmation stage the individual or other decision-unit seeks reinforcement for the innovation decision already made, but he or she may reverse this decision if exposed to conflicting messages about the innovation. The confirmation stage continues after the decision to adopt or reject for an indefinite period (Rogers 1995).

According to this theory, potential adopters of an innovation must learn about the innovation, be persuaded as to the merits of the innovation, decide to adopt, implement the innovation and confirm, reaffirm or reject the decision to adopt the innovation.

THE NEED FOR CONSTRUCTION SPECIFIC KNOWLEDGE TRANSFER

The need for construction specific knowledge transfer stems from its fragmented nature, it is also noted as a very complex industry when it comes to knowledge transfer. Construction projects are temporary and unique in nature different from other industries. Jian Sun and Xu Ren (2014) corroborate this assertion by arguing that, construction project teams are temporary and consist of multidisciplinary teams. They further argue that, after the completion of a project, parties involved move on to new and different projects. And so knowledge gained or transferred is lost and the lessons learned are dispersed at the end of that project (Jian Sun and Xu Ren, 2014).

The assertion of this author implies that after one project is completed the purpose of knowledge transfer and assimilation is defeated because teams involved in the knowledge transfer exercise are temporal unlike other industries. Furthermore knowledge transfer in other industries cannot be adopted wholly in the construction industry because they turn too focused on inter-intra firm knowledge transfer and management alone. Bosch and Postma (2010) noted that, the knowledge of collaborative network in the construction project is difficult to transfer, since it depends on the ease of communication and intimacy of the overall relationship between the source unit and the recipient unit. Lindner and Wald (2011) also added that, construction organizations often have a lack of natural mechanisms of learning which makes the transfer of knowledge difficult. Hence the need for construction specific knowledge transfer that builds on experiences of knowledge transfer in other industry.

Factors such as global competition, strategic unions, corporate strategies, and project delays as well as community involvement in today's construction projects have led firms to come out with innovative ways to enhancing their organizational image. According to Eliufoo, (2005) the use of joint investment and access to markets around the world reveal that Knowledge transfer is becoming increasingly significant in the industry. In the Knowledge base theory, Knowledge transfer and its application especially are considered the main factors of competitive advantage and organizational performance improvements (Alavi & Leidner, 2001).

MAKING A CONNECTION BETWEEN KNOWLEDGE TRANSFER AND DIFFUSION

There is the need for a connection between Knowledge transfer and diffusion of innovation because a process between the supplier (construction company in this case) and the adopter (the community) from the onset to the end of a diffusion process must be well correlated to avoid failure of adopting a new idea by a decision making unit or an adopter.

The framework below shows the inter-relation between Knowledge transfer and diffusion a combination of the theory of Nonaka & Takeuchi knowledge creation and shearing and Everett Rogers's innovation decision theory. It also introduces transformation in the middle which means that after a new knowledge have been transferred and diffused there must be a transformation in the adopting or receiving unit. As noted by Nonaka & Takeuchi (1995) and as shown in figure 2, there are several processes to a successful Knowledge transfer and diffusion which must be satisfied in order to achieve a successful Knowledge transfer and diffusion, these

variables are explained as depicted in the conceptual framework developed below in figure 2.

EXPLANATION OF THE VARIABLES IN THE FRAMEWORK

The framework proposed in this paper has seven main constructs that are supposed to be the main players in transferring knowledge from construction companies to their host communities. These are discussed in the ensuing subsections.

The change agents

The change agent in this framework is the construction company because most construction projects happen in communities. Construction activities are amongst one of the industries that has a negative impact on the environment in which it occurs therefore it's prudent for the industry to compensate for its adverse impact on the people living in and around the project sites hence the change makers.

Transformation

Transformation introduced in this framework is the successfulness and effectiveness of the knowledge codification, transfer and diffusion from the change agent (Construction Company) to the potential adopter (the host community). This means a good and successful knowledge transfer and diffusion must result in a change in attitude and knowledge on the part of the receiving unit. However, before this can be successful, there are some very vital drivers or actors that must be in place to enable its success.

Influential factors

The intrinsic influences for a successful knowledge transfer are persons specific because all persons have different rate of absorption. Some persons are able to codify and understand new knowledge faster than others. Also cultural norms in some communities facilitates the acceptance of new ideas while others does not. It also depend on opinion leaders like the chiefs and elders who are respected in most societies as people look up to them or consult them before making decisions. Other factors are peer networks community networking and interpersonal networking. These factors are also very vital in influencing others to changing their lifestyle.

Continuous collaboration and networking

Continuous collaboration and networking in any diffusion and knowledge transfer process is needed for reinforcement of the transferred knowledge. This is because, for one to accept to imitate what another person does, there must be a mutual trust and understanding between the holder of such new knowledge and the receiver. There should be continuous collaboration between the two sources throughout the transfer process from the onset to avoid discontinuation of the transferred knowledge because all persons are somehow risk averse.

Knowledge transfer variables

Knowledge transfer variables in this framework are Socialization, Externalization, Internalization and a combination of these variables are the systems in which knowledge is codified in the minds of persons. As the codification is going on formally or informally one must get close to another to be able to know what the other person is doing. Health and safety knowledge has been codified in the construction industry tacitly or explicitly between the workers. For example, most of the skilled and non-skilled labour is recruited at where the project is taking place. These groups

of persons are trained formally in HSE, they intend go home with this knowledge and consciously or unconsciously transfer the new knowledge to their families.

Socialization is the process of sharing tacit knowledge through observation, imitation, practice, and participation in formal and informal communities and this agrees with Professor Albert Bandura's socialization theory which says that an individual learns from another by means of observation. In other words, one observes what another does and then does something similar. Externalization usually begins with building a field or special interaction between the source and the receiver, in this case construction workers (change agents) and the community (adopters). The externalization according Nonaka and Takeuchi is seen in the process of concepts creation and is triggered by dialogue or collective reflection. Internalization is the process of embodying explicit knowledge into tacit knowledge. Nonaka and Takeuchi (1995) argue that knowledge is created and improved when it flows between different levels of a social system and between individuals and groups. Combination as indicated by Nonaka and Takeuchi (1995) is the process of integrating concepts into a knowledge system to integrate multiple bodies of explicit knowledge. They further opine that, it is important to consider that all the four phases of knowledge exchange must be satisfied to achieve a successful knowledge conversion within and across a social system.

Innovation decision variables.

The innovation decision in this framework is also made up of knowledge, Decision, Persuasion, Implementation and a Confirmation process. These variables are also very vital elements of the framework. In the first place, the host communities must first know of the existence of the HSE knowledge before taking decision to even ask of its merits and demerits or what it is. From this point onwards is when they may be persuaded to either try the new knowledge or not. At this point it is an individual decision process by the person to implement or try the said new knowledge to see whether it would suit him or her. Following this, he or she would either confirm to use the new knowledge or reject it entirely.

It can be helpful for a decision unit to identify and acquire externally generated knowledge that is crucial to them. The greater the effort, the more quickly the decision-making unit or an individual will build its knowledge-base. However, there are limits to a decision unit's or an individual's ability to achieve this speed. In the decision stage, during Knowledge diffusion, the adopter (receiving unit) needs to take the decision to adopt or reject the new idea. This process becomes crucial because it recognizes the potential benefits or disadvantages by associating with its needs and already existing Knowledge and if it turns to be more advantageous to the existing Knowledge, only then it becomes a knowledge that is usable for the receiver to adopt.

The implementation or knowledge application stage is the most significant stage during a knowledge transfer process. Literature has shown that no other process in the Knowledge transfer paradigm leads to improved performance. Improvement occurs only when Knowledge transferred from the source to the receiver is successfully applied or used at where it's required. Confirmation or a successful adaptation and reinforcement depend on successful communication of the Knowledge transferred and the adopters possessing adequate absorptive capacity to be able to receive and apply the new idea. Knowledge transfer has been regarded as a one-way process where the receiver usually takes the bulk or all the benefits. However, this study argues that the source, being the construction industry, also benefits from the Knowledge transferred

because they are giving back to the society and in return get back the peaceful and well collaborated environment to carry out their corporate goal.

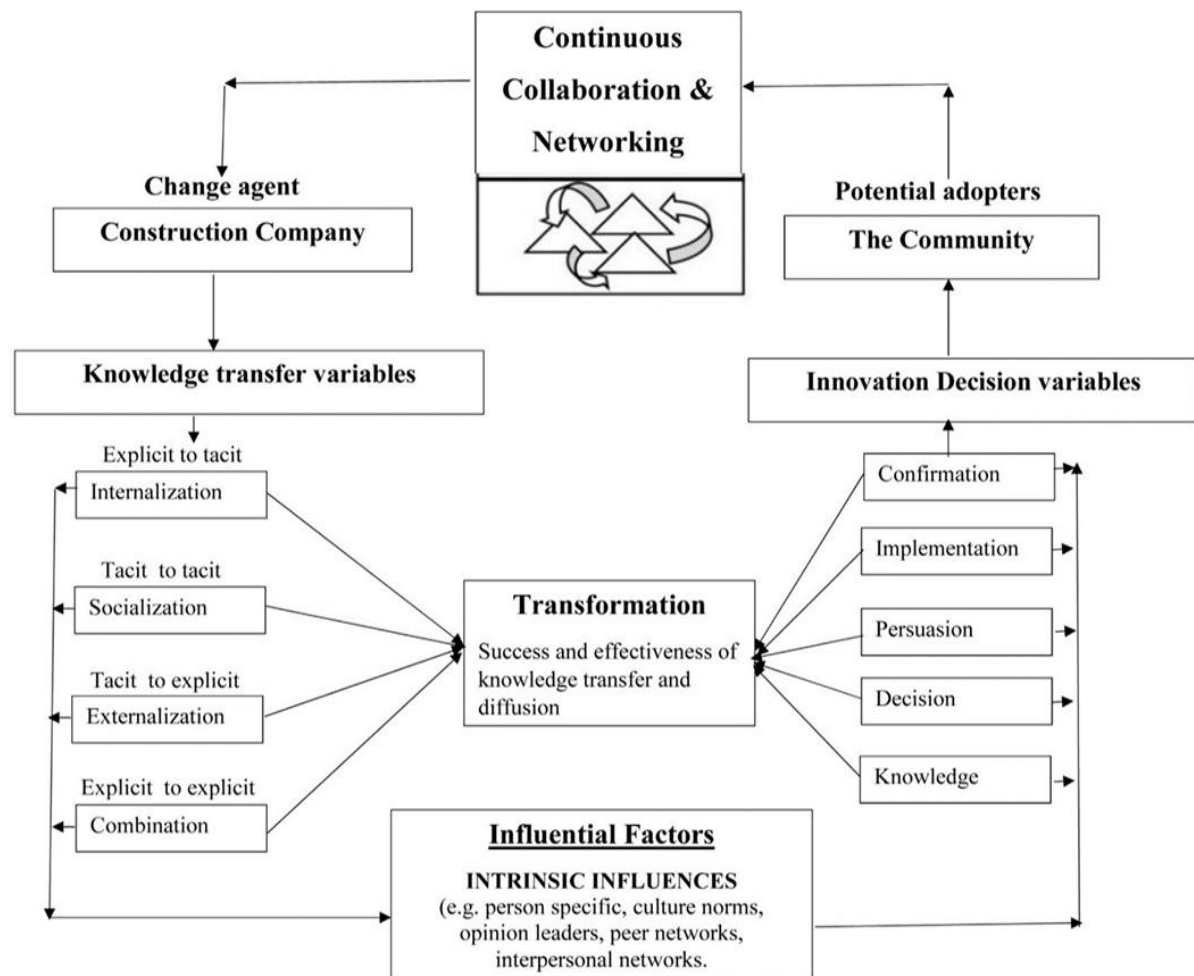


Figure 2: Knowledge Transfer and Diffusion – a Conceptual Framework

DISCUSSIONS

The introduction of health and safety among the project host communities involves the need to influence potential adopters, who are in this case the individual in the communities. Accordingly, an understanding of the diffusion behaviour of these individuals in the social system is relevant so as to manage the diffusion process adequately given the importance of diffusion of a new idea and innovation to organizational competitiveness and improvement as well as the importance of construction to national growth and development. This framework is not limited to health and safety alone but to other improved knowledge in the construction industry but health and safety is one of the most important subject matters which has a forward and backwards linkage with the national economy in the developing countries and for that matter Africa as well. The knowledge of health and safety in the host communities has the potential of improving to a large extent most of the prevailing issues confronting the host communities that militates against their welfare.

This research argues that for there to be a smooth transfer of health and safety from the construction industry to the community, it is important for the Knowledge to be transferred first and then diffused among the social system (the community in this

case). But for the process to be successful, there are several variables where sub-processes of knowledge transfer (KT) can be interrelated with the diffusion process (figure 2). First it is the knowledge awareness stage where the whole adoption process starts, because knowledge awareness will be helpful to identify whether and where a new idea exists. It presupposes a great level of participation from the source and the receiver and requires a strong inter personal relationship between the two parties. A Knowledge transfer process can be stifled if the adopters are unwilling to collaborate due to uncertainty of the outcome of the new idea since all persons are somehow risk averse.

The research further argues that, the practice of health and safety must provide the project host community with the perception that the adoption would better improve their wellbeing than they are currently without it this must not necessarily be so different than their way of leaving and should be built in their existing practices. The adoption and practice of health and safety practice must be presented to the project host community as consistent with their cultural believes and societal customs. This research is in agreement with the postulation of Rogers that an idea that is not compatible with the norms and values of the host community will not be adopted as rapidly as a new knowledge that is compatible. The health and safety introduction to the community needs to be easy for the receiving unit to understand and it should be done by people who are well vested in HSE practices. Some ideas are readily understood by most members of a social system, others are more complicated and will be adopted more slowly. In general, new ideas that are simpler to understand will be adopted more rapidly than knowledge that requires the adopter to develop new skills and understanding.

Letting the community have practical hands on safety drills prior to adoption of the new idea will allow for improve self-efficacy. Also, new idea that can be tried on the instalment plan will generally be adopted more quickly than knowledge that is not divisible. The idea of the need for health and safety improvement among the Ghanaian community must be presented in a way that the results are observable to others or late adopters. Rogers (1995) argue that the easier it is for individuals to see the results of a new knowledge, the more likely they are to adopt. Rogers (1995) concluded that a new knowledge that is perceived by receivers as having greater relative advantage, compatibility, trial-ability, and observer-ability and less complexity will be adopted more rapidly than other new ideas. He further argue that these are not the only qualities that affect adoption rates, but past research indicates that they are the most important characteristics of innovations in explaining rate of adoption.

CONCLUSIONS

In conclusion, this research aims at bringing the construction industry closer to the communities in which they operate, by transferring its health and safety Knowledge to that community. The research has shown the process of Knowledge transfer from the construction industry and its successful diffusion in the community. The view of Knowledge transfer and diffusion presented in this framework is consistent with theoretical evidence on Knowledge transfer and diffusion, which shows that transfer often occurs but it is incomplete unless it is diffused among the social system. The framework presented here provides a deeper and logical understanding of the conditions under which Knowledge transfer and diffusion occurs and the variables that can stifle, as well as enable the transfer and diffusion process. The framework advances theory about Knowledge transfer outside the construction industry and

provides logical insight for its diffusion among the community. The framework shows a dual role of continuous collaboration between the communities and the construction companies and intrinsic influences such as; cultural norms, opinion leaders, community networking and personal networking, as enablers and the same time as barriers to a successful Knowledge transfer and diffusion. Because these variables link the construction workers or the construction company's units to that of the community's units to new sources of Knowledge and aids the conversion of such new Knowledge.

This research has a number of implications for the industry. It has demonstrated that a construction firm that is able to create and improve its knowledge base and transfer such new knowledge to the community in which it finds itself, would have much collaboration from the community to perform its corporate goals. The framework has the potential of providing the industry with a peaceful atmosphere in carrying out project and completing them within schedule. The framework also has the potential of militating against community protest against project therefore given companies that do so a competitive advantage than companies which does keep their acquired knowledge internally. The frame work provides the industry with construction specific external knowledge transfer and diffusion that is needed to improve communities and the industry as a whole.

Further research should be conducted to identify the relative impact of the concepts introduced in this paper on Knowledge transfer outside the construction industry. Research should also be conducted to assess the extent to which the framework addresses Knowledge transfer and its rate of diffusion within a heterogeneous society. A more thorough understanding of how these variables interacts to drive Knowledge transfer and successful adoption would enable the industry to begin to predict the time needed to transfer Knowledge from the construction industry to the community and its rate of adoption. The construction firms should not be seen as a separate entity from the communities since they are interwoven. Once the framework proposed in this paper is expanded and validated, it would act to counter most community protest against construction projects causing delays and sometimes resulting in financial loses to the contractors and also facilitate the recruitment of people leaving in and around the project catchment area which would result in the improvement of their living standards.

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UNCERTAINTY IN PROPERTY VALUATION: A CONCEPTUAL FRAMEWORK

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Uncertainty is a common experience in life. Particularly in property valuation practice, uncertainty has been one of the phenomena generating debate in recent times. A number of questions however remain unanswered regarding both the theoretical and empirical understanding of uncertainty in property valuation. A key problem has been the lack of an appropriate or adequate theoretical underpinning to the conceptualization of the phenomenon. The purpose of this study is to examine the concept of uncertainty in property valuation with the aim of developing a conceptual framework towards a better understanding of the phenomenon using the theoretical underpinning of Transaction Costs Economies (TCE). The study utilized the literature review approach to examine the understanding of the concept of uncertainty in property valuation literature and the applicability of TCE. Specifically, empirical and conceptual articles that centred on property valuation, property market, valuation uncertainty, and TCE were reviewed, analysed and discussed. The study found that the conceptualization of valuation uncertainty in the literature has focused on valuation outcome rather than the uncertainty regarding valuation inputs. This study argues that uncertainty is more attributable to valuation input and would be better understood if conceptualized as such. Therefore, based on the theoretical lens of TCE, the study proposes a conceptual framework premised upon the three broad sources of valuation uncertainty for a better understanding of valuation uncertainty which are market, internal, and external uncertainties. The findings raise pertinent questions to provoke a better understanding of valuation uncertainty from the perspective of the associated costs. Furthermore, the proposed framework provides a theoretical perspective for the conceptualization of valuation uncertainty. Every property valuation assignment involves certain level of transaction costs, but these transaction costs are rarely measured or seen as an object of discourse in the literature. This study is the first to provide insights in this direction within the valuation literature. Hence, the research introduces a new dimension into the discussion of uncertainty in property valuation by taking a theoretical perspective to the understanding of the phenomenon.

Keywords: Uncertainty, Property Valuation, Property Market, Transaction Costs Economies, TCE

INTRODUCTION

There has been rising concerns and efforts towards improving the practice of property valuation among researchers and practitioners in recent times. This is evident in the various professional development programmes by professional bodies and institutions of higher learning, sponsorship of studies on practical issues, and periodic reviews of valuation standards and guidance notes, among others. More importantly, issues around valuation accuracy, valuation variance, and client influence have received considerable attention across this spectrum of stakeholders. Researchers have investigated this from varied dimensions, majority of which have established the existence and nature of these challenges (Diaz and Hanz, 2010; Babawale and Ajayi,

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2011; Wilkens, 2015), and others the causes and effects on practice (Bretten and Wyatt, 2002; Babawale and Omirin, 2012; Adegoke, 2016). In the same vein, the findings from previous studies have substantiated the problem of valuation both in developed and developing markets, and confirmed the significant negative effects it has on the reputation of the profession (Aluko and Amidu, 2007; Nwuba, et al., 2015), as well as the credibility of valuers' opinions (Amidu and Aluko, 2007), among others. However, despite the research effort and professional guides and rules, the debate around these issues remains a continuous phenomenon (Amidu, 2011).

Studies have reported that the uncertainty in valuation, reflecting most times in the form of valuation inaccuracy and variance, is caused principally by the lack of adequate market data, peculiarity of subject property, influences from clients, and human cognitive limitation within which valuers operate, among others (French and Gabrielli, 2005; Joslin, 2005). These are obviously input related factors. However, the conceptualization of the valuation uncertainty in the literature seems to focus more on valuation outputs thereby losing focus on how these uncertainties can be managed within the valuation process. RICS (2002) acknowledges that uncertainty is a normal market phenomenon which should be openly acknowledged and it varies from one property to another as well as between different markets. Therefore, it is to be managed as it cannot be removed. Nevertheless, the trend of the studies on valuation uncertainty shows that much attention has not been given to theoretical explanation of valuers behaviour around these uncertainties and how the uncertain conditions in property markets can be managed to reduce the effect on the reliability of valuation output (French and Gabrielli, 2004; French, 2011). This gap in the literature has limited both the available knowledge about the valuation uncertainty and the result of the efforts towards addressing its effects.

This paper therefore conceptualises valuation uncertainty from the perspective of valuation inputs, thereby representing a departure from the direction of previous studies. In this light, this study aims at contributing to the understanding of the concept of uncertainty in property valuation by pursuing two specific objectives which are: first, to establish the limitations of the existing conceptualization of valuation uncertainty in the real estate literature; and second, to propose a framework for a better understanding of the phenomenon based on the application of Transaction Cost Economics (TCE).

In order to achieve this aim of this study, subsequent sections of this paper are structured in themes. The next section describes the methodology approach the study utilized, while section 3 presents the link between property valuation and property market. Section 4 discusses the nexus between uncertainty and property valuation and this is followed by how valuation uncertainty has been conceptualized in the literature (section 5). Section 6 presents the effects of uncertainty in valuation and valuers' approach towards it, while in section 8 the deficiencies of the convectional valuation theory and human problem solving theory are highlighted. Following from the preceding sections, section 9 presents a conceptual framework based on Transaction Costs Economics (TCE) theory. The last section concludes the paper by articulating the potential contributions of the proposed framework to the on-going debate on valuation uncertainty and the research agenda it stimulates.

RESEARCH METHODOLOGY

This research utilises literature review approach to stimulate discussion and substantiate arguments towards achieving the aim of the study. Literature were

retrieved from online databases and search engines including Google Scholar, Taylor and Francis, Scopus, and Science Direct. Specifically, the review covers issues around property market and valuation, sources of valuation uncertainty, the conceptualization of valuation uncertainty, as well as the concepts and application of TCE. These influenced the choice of keywords used in the search. In essence, the review focusses on how uncertainty is conceptualized, its nature, causes and approaches towards addressing it in property valuation, as well as basic concepts of TCE and their applicability to property valuation studies. This study therefore situates the causes of valuation uncertainty and valuation process within the concepts and tenets of TCE. This subsequently led to the development of a conceptual framework

PROPERTY MARKET AS A BEDROCK FOR PROPERTY VALUATION

The property valuation is a branch of the real estate profession that thrives on information (Alastair, et al. 1998). A valuer requires information about the subject property and information about recent transactions in the market, as well as other relevant economic factors for effective execution of the valuation assignment. Essentially, this information emanates from the property market where interests in land and landed property are traded (Harvey and Ernie, 2004; Maier and Herath, 2009). Therefore, a well informed and stable property market provides the required support system for the practice of property valuation. However, property markets hardly provide such support as they are characterised by high cost of transaction, heterogeneity of products, secrecy of transactions, and the lack of adequate information which distinguish it from other sub-markets such as the stock market (Harvey and Ernie, 2004; Dugeri, 2011). In essence, the property market fails to satisfy virtually every quality of a perfect market.

The property valuation practice is premised upon the contemporary valuation theory which sees market value as a product of the expected 'perfect' forces of demand and supply in the property market (Mooya, 2009; 2016). This assumption is hardly the real experience as property markets are generally imperfect in nature. In addition, the behaviour of property markets differs from one environment to another. Property markets are localized and exist within the fabric of various economic factors. Hence, the peculiarity of each market is linked to the social, economic, political, institutional and cultural characteristics of its environment, which in turn frame the behaviour of the market (Keogh and D'Arcy, 1999; Dugeri, 2011).

Property markets in most Sub-Sahara African countries are generally immature while their counterparts in advanced economies are highly transparent and mature (JLL, 2016). For example, studies such as Dugeri (2011), and Akinbogun, et al., (2014) found that the Nigerian property market is immature. Studies have also reported the lack of market data-bank in Nigeria, and Ghana (Baffour-Awuah and Gyamfi-Yeboah, 2017). In the same vein, literature suggests relatively higher level of valuation accuracy in advanced countries (Parker, 1999; Hansz and Diaz, 2001) when compared to the developing nations (Ogunba and Ajayi, 1998; Babawale and Ajayi, 2011; Baffour-Awuah and Gyamfi-Yeboah, 2017). Hence, it is reasonable to say that the maturity level of the property market is an indicator of the degree of uncertainty in the market, whether in the developed or developing nation.

UNCERTAINTY AND PROPERTY VALUATION: THE NEXUS

Market participants (valuers' clients including buyers, sellers, banks, property investors, insurance companies, etc) require the knowledge of the appropriate value of their properties in order to make informed decisions. Hence, they are faced with the need to conduct market search, aggregate market data, verify data, and carry out some computation of figures. However, because of the imperfect nature of property market and unavailability of adequate market data, market participants are faced with uncertainty in deciding the true market value of properties. This necessitates the need for the skill and expertise of property valuers who is trained and skilled in interpreting the market circumstances and advising on the appropriate value of interests subsisting in properties (Levy and Schuck, 2005; Wyatt, 2007). In essence, the task is transferred from the market player to the valuer for a fee. Thus, valuers assume the roles of their clients in search of market value (Mooya, 2016) and are therefore faced with the same uncertainty. Based on this, French (1997) opines that a more acceptable valuation model is the one which assesses the market price based on 'the underlying thought process of the players in the market'. Therefore, the conventional valuation theory places the valuer in the position of a market participant in deciding the appropriate value of a property. Hence valuers are expected to adopt the methodology that mirrors the thought pattern of their clients. Therefore uncertainty forms an important input factor in valuation.

Uncertainty is a phenomenon that cuts across variety of disciplines and professions. Therefore, different views and definitions exist from different authors and domains of knowledge. From a more general definition, Dosi and Egidio (1991) defines uncertainty as a situation of unknown and/or inadequate information necessary to make decision, and this may arise from the lack of information and/or incapability of economic agents to achieve their objectives due to limitations. Berger and Calabrese (1975) define uncertainty from human communication perspective, as a circumstance with a number of possible outcomes or explanations. ISO (1995) also defines uncertainty as an attribute of an outcome of a measurement, which reflects lack of adequate knowledge of the value of the object being measured. The main theme common to these definitions is lack of precision. This also reflects in the definitions of uncertainty from valuation literature. French and Gabrielli (2004:485) define uncertainty as 'anything that is not known about the outcome of a venture at the time when the decisions is made'. Mallinson and French (2000) posit that uncertainty in valuation is what goes on in the valuer's mind as regards to how the market will behave due to the peculiarity of the subject property. International Valuation Standard Committee (IVSC) (2012:4) defines valuation uncertainty as 'the possibility that the estimated value may differ from the price that could be obtained in a transfer of the same asset or liability taking place at the same time under the same terms and within the same market environment'. It can be deduced from these definitions that uncertainty is more about the challenges with the input which cast doubt on the certainty of the output.

The nature of uncertainty in property valuation can be divided into two – normal and abnormal uncertainty (IVSC, 2013; RICS, 2014). Normal uncertainty is described as a valuer's perception of the certainty of market conditions such as market liquidity, market depth, market information, market fluctuations and, valuer's status, among others (RICS, 2014). Abnormal uncertainty can be divided into three, namely market disruption uncertainty, input availability uncertainty, and choice of method/model uncertainty (IVSC, 2013). Market disruption refers to the unforeseen macro-economic, financial, political or natural events (RICS, 2014). Input availability

uncertainty means the lack of required market data or when the available data is difficult to analyse, while choice of method/model uncertainty occurs when two or more methods/models are used and they produced outcomes that cannot be reconciled. RICS (2014) also describes some conditions that may have a material effect on the level of certainty in valuation. These include the status of the valuer, that is, the valuer's skill and experience; inherent uncertainty, that is, peculiar characteristics of the subject property; and restriction on information, that is, limited market data. Others include liquidity and market activity which means fewer transactions in the market; and market volatility, that is, unforeseen financial, macro-economics, legal, political or natural occurrence. These submissions show the obvious connection between the nature of the property market, human cognitive limitations, and valuation outcome.

The foregoing suggests that uncertainty reflects in property valuation in various forms which can be categorized into three. First, uncertainty is associated with the lack or inadequacy of market information. According to Morgan, et al. (1992), circumstances that may give rise to the uncertainty of this nature include incomplete information, disagreement between information sources (information asymmetry), linguistic imprecision (i.e vague information), variability among pieces of information, the quantity of information, and information structure. This can be likened to the abnormal uncertainty. In essence, this form of uncertainty is experienced in a situation of unknown and/or imperfect market information (French and Gabrielli, 2004; French, 2011). This can be referred to as market uncertainty. The second source of uncertainty is from human cognitive limitation. Human decision making studies have established that human beings are limited or bounded rationally by the cognitive limitations of resources, knowledge, and time, among others (Gigerenzer and Selten, 2001; Furubotn and Richter, 2005). Human beings are limited creature and as such do not possess perfect knowledge because the complex nature of the knowledge itself and because some tasks could be complex in nature to have one true answer (Handmer, 2008). Therefore, as human beings, valuers execute professional duties within the framework of these cognitive limitations (Amidu, 2011) and, as such, subject to the inherent uncertainty. Dosi and Egidi (1991) refers to this as procedural uncertainty where the expected outcome of a task is constrained by the computational and cognitive abilities of decision makers. This could be situated within the category of normal uncertainty as described by RICS (2014). Most often, this limitation relates to the decision maker's experience, education, training, and the working environment, among others.

The third category is the external uncertainty. the nature of valuation practice makes the valuer to be in contact with the client at different stages of valuation process which exposes the valuer to influence. Evidence of clients' influence in valuation has been reported in valuation literature from every part of the globe. In many instances, clients influence the value judgement towards the direction of their interest through varied means including reward treat, information treat, and business relationship threat, among others (Levy and Schuck, 1999; Amidu and Aluko, 2007; Chen and Yu, 2009; Nwuba, et al., 2015). For example, Handmer (2008) observes that uncertainty may not be negative as it may be used as a self-protecting tool. The author further explains that uncertainty may be deliberately created by hiding or distorting information so as to keep other party in the dark, probably to achieve some personal gains. However, while uncertainty may be positive to the party creating it, it is negative to the other party involved. Therefore, the valuer could be uncertain about the disposition of the client during the valuation process and this becomes a challenge when the client eventually

makes an attempt to influence valuation outcome. The prevalence of client influence on valuers may be associated with the nature of property market. For instance, Chen and Yu (2009) attributed the prevalence of client influence in Taiwan to the lack of transparent market information. In the same vein, valuers operate within the economic, legal, political and institutional environment which, most times, are highly fluctuating and difficult to predict. These represent obvious external uncertainties to the valuers.

The corollary of the foregoing is that, uncertainties faced by valuers are those that typical market participants are expected to face in the course of ascertaining property values in addition to those resulting from their (valuers) professional responsibilities of relating with clients and working within professional and legal frameworks. Therefore, apart from the market information uncertainty (market uncertainty), valuers, like every other human being, are subject to both human cognitive limitations (internal limitations), and institutional and influences of clients (external uncertainty).

UNCERTAINTY IN PROPERTY VALUATION: THE CONCEPTUALIZATION IN THE LITERATURE

Discussion around uncertainty in property valuation has been of interest to stakeholders in the property profession for over two decades. The obvious debate stated in 1994 as a result of the Mallinson Report (RICS, 1994) which recommended that the Royal Institution of Chartered Surveyors (RICS) should prescribe an ammonized means of measuring and expressing uncertainty in property valuation. This submission was reiterated in the Carsberg Report (RICS, 2002) who submitted in its Recommendation 15 that 'RICS should commission work to establish an acceptable method by which uncertainty could be expressed in a manner which will be helpful and will not confuse users of the valuation'. Subsequent studies on valuation uncertainty have taken varied dimensions but skewed mostly towards the direction of how best can valuers report the certainty of valuation of the end users (Mallinson and French, 2000; Joslin, 2005; French and Gabrielli, 2005; Adair and Hutchison, 2005; Adair, et al., 2005; Lorenz, et al., 2006; Kucharska-Stasiak, 2013; van Vuuren, 2017). It is, therefore, reasonable to state that submissions of Mallinson and Carsberg reports have patterned the direction the debate around valuation uncertainty.

Scholars have confirmed that uncertainty in property valuation is a subject of concern, though with differing dispositions towards addressing it. For example, while the study like Brown, et al., (1998) suggests that uncertainty is inherently part of valuation and there is hardly anything that can be done about it, others argue that improvement on valuation models like the use of Automated Valuation Models (AVMs) can mitigate the effects of uncertainty on valuation (Lorenz et al., 2006; French and Gabrielli, 2005; Hoesli, et al., 2006; Loizou and French, 2012). However, majority of these studies responded to the calls of Mallinson's and Carsberg's reports by prescribing different ways by which valuers can express and report the uncertainty of valuation to their clients (Mallinson and French, 2000; Joslin, 2005; French and Gabrielli, 2005; Adair and Hutchison, 2005; Adair, et al., 2005; Lorenz, et al., 2006; Kucharska-Stasiak, 2013; van Vuuren, 2017). This suggests that despite the reality of the phenomenon and challenges it poses to valuation profession, the major solution that seems to be elaborated in the literature is how it can be reported to clients. Even with this, the appropriate approach to reporting uncertainty has not been conclusively agreed upon in the literature as several methods of reporting uncertainty have been suggested including verbal, ranking, statistical (numerical), and the use of confidence

score (Mallinson and French, 2000; French and Gabrielli, 2004; RICS, 2014; Enever and Isaac, 2014; Van Vuuren, 2017). There is yet to be a generally acceptable approach to addressing the phenomenon, hence valuers are left to their subjective judgement (Joslin, 2005; Lorenz et al., 2006). This means that reporting uncertainty in valuation to clients alone is not bringing the desired result towards mitigating the effect the uncertainty. For instance, Brown, et al., (1998) suggests that research focus should rather be on valuation error caused by the use of poor market information or poor valuation practice. It is, therefore, argued that focusing only on how uncertainty can be reported amounts to conceptualizing uncertainty in valuation as a problem with valuation output, thereby taking attention away from the root cause of the problem which is the uncertainty in the inputs. Morgan, et al. (1992:1) opines that ‘when a problem is rooted in a faulty processing of uncertain information, it is always hard to detect’. This seems to be the situation in this circumstance and it calls for research agenda in this direction.

EFFECTS OF UNCERTAINTY ON PROPERTY VALUATION PRACTICE

The lack of adequate data or the inability to access it heightens uncertainty and subsequently increases the level of subjectivity of the valuer in a valuation process. This often leads to high level of valuation inaccuracy (Shapiro et al, 2012). Therefore, valuers’ understanding of and the ability to manage the uncertainty surrounding valuation inputs determine the credibility of the valuation output. The effect of failure in this regard cuts across the spectrum of stakeholders. For example, Lorenz et al (2006) raised a pertinent concern about the inability of valuers to account for the uncertainties in the market which led to a more than 80 percent reduction in valuation figure of a property on closed-end property fund within the period of two years. The authors also reported an instance of a property purchased for 500 million Euro and immediately valued for 290 million Euro (42% reduction) just after the transaction. The study attributed the challenge to how the valuers managed the uncertainties in the market and those surrounding the subject property rather than the problem of methodology. A similar case reported by Otegbulu and Babawale (2011) involves a 34 per cent inaccuracy in plant and machinery valuation as a result of the valuer not considering what the authors called ‘economic penalty’ in the valuation. This confirms the assertion of French and Gabrielli (2005:81) that “uncertainty is due to the lack of knowledge and poor or imperfect information about all inputs that must be used in the valuation”. The concern in these instances is not only of the investors who may lose a fortune for depending on valuers’ opinions, but also of the reputation of valuation profession which becomes questionable.

APPROACHES TO UNCERTAINTY IN PROPERTY VALUATION

It is well documented in the literature that when the required data are not available or accessible, valuers resort to heuristic behaviour which exposes valuers largely to bias and client influence (Gallimore, 1994, 1996; Amidu, 2011; Mooya, 2016). Generally, heuristic refers to the behavioural model, rule of thumb or short-cut that human beings apply in decision making under constraints (Gigenzer and Todd, 1999; Todd and Brighton, 2016). There are variants of heuristic tools and the common among them are anchoring heuristic (to select a starting point and adjust based on additional information), availability heuristic (to assess probability based on their familiarity), representativeness heuristic (to take sample as a representative of parent population), and positivity heuristics (to seek information that confirms existing beliefs) (Tversky

and Kahneman, 1975; Evans, 1989; Harding, 1999; Harvard, 2001). However, anchoring has been the principal heuristics reported in the valuation literature while others are conspicuously absent (Diaz and Hanz, 2001; Hansz, 2004; Adegoke and Aluko, 2007; Adegoke 2008; Bokhari and Geltner, 2011; Amidu, 2011; Scott and Lizieri, 2012) except in Iroham et al., (2014).

However, while the effort in this regard is commendable, the actual underlining reason for this behaviour is still lacking in the literature. For instance, Hardin (1999) opines that the heuristic bias found in research could either be as a result of the lack of specific expertise on the part of valuers or lack of its application during the research process. In essence, a clear theoretical explanation for this behaviour is conspicuously missing in valuation literature and this forms a reasonable gap in knowledge. For instance, Hardin (1999) concludes that it is not enough to for research to show that valuers exhibit heuristic behaviour, it is important to probe further into the reason for such behaviour.

Furthermore, Morgan et al., (1992) assert that human being resorts to cognitive heuristics and strategies in order to cope with uncertainty, however, these strategies introduce error and bias into human judgement. The nature of uncertainties in the market and valuers' approaches towards them could be summarized in the position of Diaz (2010:204) that :

"There is great inefficiency in the market; there is significant friction. Because of basic architectural limitations on human cognition, limitations that we all suffer, real estate valuation is a heuristic process shadowed by predictable bias and haunted by sentiment. We anchor to the past and to the opinions of others, we herd, we react emotionally, and we are overly averse to loss. We overweight convenient information and discard evidence that does not support our preconceptions. Our ultimate conclusions can be influenced by a frame of reference, and because we need to believe in patterns, we find them where they do not exist and extrapolate into the uncharted dark".

Diaz (2010)'s position is that the heuristic behaviour, which has so far been found to be valuers' approach to handling the frictions caused by the inefficiency in the property market and the apparent human cognitive limitations, exposes valuations to bias and influences. However, as it is believed in the world of statistics that increase in information reduces uncertainty (Tabak, 2004), access to robust and accurate data set is not always possible in the case of property valuation, especially in an uncertain environment. Hence, the ability to get the best out of the available information becomes important in this circumstance (Tabak, 2004). Therefore, the issue of uncertainty in valuation requires a more pragmatic approach from both theoretical and practical perspectives.

THEORETICAL FOUNDATION OF PROPERTY VALUATION AND BEHAVIOURAL STUDIES

The application of theory is essential in the search for a better understanding of any phenomenon. Property valuation, including all its conventional methods, derives its theoretical foundation from the neoclassical economic theory (Mooya, 2016). Parker (2006) describes this theory as a limited economic theory which is insufficient to provide explanation for changes in the behaviour of market and hardly applicable globally. The foundation of this theory has been described to be weak in many respects. For example, Parker (2006) establishes various limitations of the

conventional valuation theory which include the lack of ability to handle different eventualities brought about by the realities of markets, limited in conceptualization and inability to accommodate differences between markets geographically. This has led to the development of various other new methodologies and concepts, which valuation theory still lacks maturity to accommodate (Parker, 2006).

Describing various attributes of the neoclassical economics, Colander (2000) states, among others, that; neoclassical economics assumes perfect allocation of resources, that is, buyer and seller have perfect information about market prices and perfect interaction of demand and supply determines the market price; assumes rationality, that is, individual decision maker has unrestricted capacity and complete information to make optimal decision; and, accepts methodological individualism, which means that individual's decisions are mainly objective and not influenced by any external factors. These stands of neoclassical economics have however been criticised on a number of grounds and its relevance to explaining the workings of the real estate market refuted (see Agboola, 2015).

Based on the foregoing, it is reasonable to say that the neoclassical economics (the foundation of the conventional theory of valuation) lacks the required provisions to deal with the three sources of uncertainty in valuation earlier identified. First, the assumption of perfect market conditions and adequate knowledge among market participants cannot provide explanations for the behaviour of market participants under the reality of imperfection and lack of adequate market information. Second, its assumption of rational being cannot deal with the condition of limited rationality which, as earlier established, is the actual nature of human beings. Third, the assumption of methodological individualism has limited the capacity of the neoclassical economics in explaining the decision maker's behaviour under certain influences, like clients' influence.

The search for a better explanation for valuers' behaviour around uncertainties has led to a shift towards behavioural studies in property valuation in recent times (Diaz 2010). Such studies have been conducted in varied dimensions across the globe (see Diaz and Hansz, 2007; and Klamer et al., 2017). However, the persistence of accuracy challenge in valuation points to the need for a more pragmatic research approach to valuers' behaviour. Behavioural research in valuation has its root in the human problem solving theory from cognitive psychology developed by Newell and Simon (1972 and Simon (1978) (Diaz and Hansz, 2002; Diaz and Hansz, 2007). This theory assumes that human being resorts to heuristic behaviour as a shortcut when faced with uncertainty. However, such behaviour generates biases and the theory itself lacks the capacity to offer the economic explanation of such behaviour. Diaz (2010:204) confirms this lack of economics footing in the present psychological based real estate researches and calls for a more pragmatic theoretical approach by asserting that:

"I have heard the argument that all real estate research is behavioural because every one of us is trying to model human behaviour in real estate environments. Of course, I agree with this broad generalisation, yet it does trivialise the distinctiveness of a behavioural point of view, for along with the point of view comes a set of theories and methods that are not yet compatible with the theories and methods attached to the economics/ finance approach to real estate research. We all look to the enriching day when the various theories and methods can come together in an overarching approach to research that will doubtlessly quicken the pace and deepen the reservoir of knowledge generation in the real estate discipline".

It is therefore obvious that both the theoretical foundation of property valuation and the theory upon which behavioural studies in property valuation is based are not adequate to offer a proper conceptualization of uncertainty and explanation for valuers' behaviour around it. Thus, there is a need for an alternative theoretical approach to addressing the phenomenon.

THE PROPOSED CONCEPTUAL FRAMEWORK: A TRANSACTION COSTS ECONOMICS APPROACH

Transaction Cost Economics (TCE)

TCE is the approach towards operationalizing the concept of transaction costs (Williamson and Ghani, 2012) and it occupies the centre position among the theories of New Institutional Economics (NIE). The exchange process within the market gives rise to transaction costs and these costs include the cost of information search, cost of bargaining and decision-making, and the cost of policing and enforcement (Furubotn and Richter, 2005). This is distinguished from the production cost being emphasized in the neoclassical model (Eggertsson, 1990). While Dahlma (1979) believes that the definition of transaction costs could be simplified as costs of imperfect information, Rao (2003) is of the opinion that such a simplified definition has lost some vital parts of transaction costs like differential costs and behavioural effects of each elements of transaction costs. Rationally, while several options of transactions are available, economic agents would carry out transaction in such a way to generate least transaction cost (Liang and Huang, 1998), that is, they would put up cost minimizing behaviours which represent the behavioural consequences of positive transaction costs. Hence, transaction costs are seen as opportunity costs arising from the choice made among these alternatives. For example, various sources of information are available to a valuer, the choice of one or combination of channel(s) is based on a number of factors of which transaction costs is a fundamental underlining principle. Therefore, the concept of TCE provides a theoretical explanation for the choice of transactions among economic agents (decision makers).

What constitutes transaction costs has been conceptualized differently based on the context and the field of discussion. Hence, there is yet to be a clear-cut definition for transaction costs (Eggertsson, 1990; Benham and Benham, 2010). For example, transaction costs are seen as 'all costs other than the cost of physical production' (Lai, 1994:84 cited in Buittelaar, 2004), therefore, they are different from cost of production. In line with this, the term 'transaction' has been conceived as the delivery or movement of material or information for the production purpose; however, the delivery itself is not the production process (Miller and Vollmann, 1985; Furubotn and Richter, 2005). Transaction costs are also defined as the costs of 'resources utilized for the creation, maintenance, use, change and so on of institutions of and organizations' (Furubotn and Richter, 2005:48). For Buittelaar (2004), transaction costs are what organizations incur to make information available and reduce uncertainty. Therefore, transaction costs cover the costs involved in developing exchange process, maintaining such process, monitoring the exchange behaviour, and minimizing opportunistic behaviour within the exchange relationship (Williamson, 1985; Pilling et al., 1994).

TCE is now gaining wide acceptance as a viable theoretical lens in explaining human behaviour especially when information sharing and exchange is concerned. There has been a considerable and growing body of literature from various fields of endeavour where TCE has been used and has proven to have revealed deeper insights into the

description human behaviour. For example, online buyers' behaviour (Liang and Huang, 1998; Teo and Yu, 2005), and, outsourcing behaviour of accounting services (Everaert et al., 2010), among others. In this sense, TCE has been a viable tool for analysing and addressing real-life challenges in many disciplines. This is evident in the volume of literature especially the empirical articles on TCE across different fields. For instance Macher and Richman (2008) conducted an extensive review search on studies focused on TCE and identified about 900 articles containing the empirical application of TCE theory across various fields. These articles spread across fields such as economics, law, political sciences, and marketing, among others. The TCE theory has also been used to analyse issues in IT outsourcing (Aubert, et al., 2004), Marketing (Williamson and Ghani, 2012), and the link between property market and poverty (Mooya, 2009). It is however surprising to discover that despite the wide application of TCE in explaining diverse behavioural issues in various other fields, such theoretical approach to explaining a phenomenon is scarce among real estate literature, especially among valuation studies. A theoretical study by Mooya (2009) seems to be the only study to have given a glimpse of the potential applicability of TCE in valuation studies. Hence, there is an obvious lack of theoretical underpinning in empirical studies among property valuation literature and this has limited the available understanding of valuation uncertainty and valuers' behaviour from the theoretical point of view. This study, therefore, seeks to present a theoretical framework explaining the relationship between valuer and uncertainties surrounding the market and valuation process using the TCE theoretical tool. Specifically, this study presents the conceptualization of uncertainty in valuation from a theoretical lens of TCE.

Suitability of TCE for Property Valuation Study

The suitability of TCE for analysis in property valuation domain is influenced by the fact that the property valuation is information driven and it is operated by economic agent within the frameworks of human and institutions. Valuation process involves collecting, analysing and presenting market information combined with the property specific information to arrive at an objective value opinion. It also requires that the valuer interacts with information, persons and institutions within the market environment. This, however, involves information costs and time, and effort. Behavioural studies have shown that human beings (valuers) make decisions under the constraints of resources, knowledge, time etc (Gigerenzer and Selter, 2001; Furubotn and Richter, 2005), and therefore bounded rationally within these constraints. However, according to Furubotn and Richter (2005), many mistakes or errors can be avoided if decision makers can expend resources to secure information. This means that the reliability or certainty of decision (valuation outcome) depends on the decision makers' (valuers) disposition to the costs necessary to mitigate the constraints. Hence, the identification of transaction costs involved in the process and the disposition of the economic agent towards these costs could give an explanation for the suitability or otherwise of the decision outcome.

The neoclassical concept of perfect market and costless transaction has been refuted as unrealistic especially in the real estate world (Slovik, 2011; Furubotn and Richter, 2005; Agboola, 2015). As earlier stated, most property markets in developing economies are immature and far from the description of a perfect market (JLL, 2016). Therefore, market participants generate enormous costs in the process of assessing the market value of properties. And since valuers take the place of their clients in the analysis of market (Mooya, 2016), they are faced with the same transaction costs.

Buitelaar (2004:2540) succinctly describes sources of transaction costs by asserting that ‘transaction costs emerge because we do not have perfect rationality and complete information, as is assumed in many neo-classical models. Instead, there is bounded rationality, incomplete information and opportunism’. This typically depicts the position of a valuer because, first, the valuer (the decision maker) is limited in capability (that is, bounded rationally); second, the valuer operates in a market where information is not perfect (imperfect market); and third, the valuer is involved in contractual relationship with clients who may want to take advantage of valuers for their self-interest (opportunism). Buitelaar (2004:2540) further adds that ‘transaction costs are the costs that are made to increase the information available to us and reduce uncertainty’. Therefore, these circumstances generate transaction costs that need to be borne in order reduce the effects of uncertainty on the valuation outcome. This shows the potentials TCE holds in explaining the behaviour of valuers.

However, the majority of available behavioural studies in property valuation lack such theoretical underpinning to give deeper explanation and understanding of the phenomenon and behaviour. For this reason, Hardin (1999) calls for a more pragmatic research in real estate domain to look beyond just the existence of heuristics behaviour among valuers into probing for reasons for such behaviour; and a need for theory development research within real estate research domain. A similar call was reiterated by Mooya (2009) who also observes this degenerating research trend in property valuation and advocates for a shift from mere descriptive research to research grounded in economic theories as property valuation is grounded in economics (Parker, 2006). To address this gap, Mooya (2009), argues for TCE as a viable theory in this regard. However, considerable effort is yet to be invested in this research direction.

The Framework

The TCE theory postulates that the imperfection in the market makes market information to be scarce and thereby gives rise to transaction costs; and, as long as human beings are rationally limited, they must incur certain costs as trade-offs for the inefficiency (Furubotn and Richter, 2005) (see Figures 1 and 2). Eggertsson (2013) describes this concept as the most essential contribution of NIE as it is applicable to every aspect of the social system. Therefore, a valuer is expected to incur certain costs in searching, validating, and processing of market data during the process of valuation exercise. This is of more concern in an environment where there are no official assemblage of market transactions or property databank like it is the case in most developing countries. The valuer is expected to incurs costs in managing the personal limitations and external influences alongside, sometimes in terms of trade-offs.

The TCE further postulates that institutions are created to reduce the uncertainty arising from human interaction as a result of the complexity of tasks and human cognitive limitation (North, 1990). Institutions are both formal and informal rules that guide and provide structure for social interaction; and they are expected to provide such structure to reduce uncertainties in the market (North, 1990). Where institutions are weak and structures are ineffective, they fail in achieving the goal of reducing uncertainties in the market. In such circumstance, high uncertainty breeds high transaction costs. However, when the transaction costs involved in market dealings are too high, it hinders exchange process, thereby causing market failure (Furubotn and Richter, 2005). The theory therefore predicts that decision makers generate cost minimizing behaviour when faced with uncertainty.

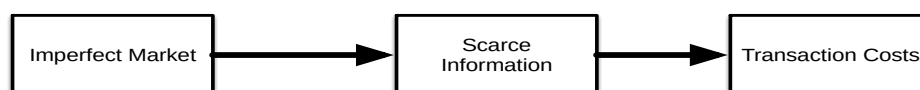


Figure 1: Market Imperfection and Transaction Costs

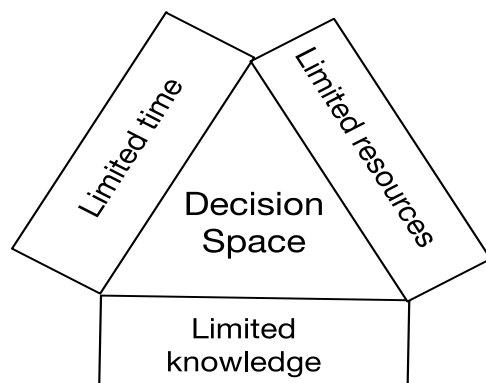


Figure 2: Human Cognitive Limitations (Bounded Rationality)

The above theoretical perspectives are therefore entrenched into the conceptualization of uncertainty in property valuation as depicted in Figure 3.

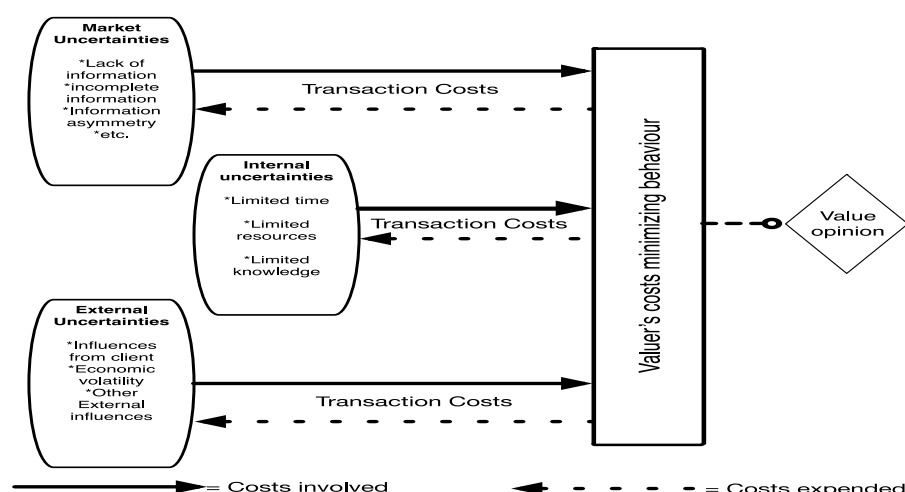


Figure 3: Framework for Understanding of Valuation Uncertainty

The framework (Figure 3) conceptualizes valuation uncertainty from the perspective of how the valuer relates with the three major sources of uncertainties in valuation. The framework brings out channels of transaction costs involved in the relationship. The value opinion produced by a valuer is a product of how the valuer is able to manage the challenges of lack of information in the market, external influences (e.g. clients' influence) and the valuer's own cognitive limitations. All these generate enormous transaction costs as shown in Figure 3. Transaction costs, in this sense, include all monetary and non-monetary costs like effort, time and resources required to minimize uncertainty associated with valuation inputs.

Operationalizing the Framework

An important aspect of the operationalization of the framework is the development of assessment tools needed to extract the extant transaction costs from varied channels as

presented in the framework. One of the challenges of the application of TCE is the development of appropriate tools of measurement tool to gather proper data to test the theory (Mayer, 2015). While this study is not about the development of comprehensive instrument to measure the transaction costs (which is being developed for the extensive study), a brief explanation of the operationalization of the framework is presented here for the purpose of this paper.

The imperfection in property markets give rise to high transaction costs and this is what distinguishes the property market from other markets (Clapp, et al. 1995). Bowles et al., (2001) observes that the property market, unlike equity market, is characterized by the disparity in prices as a result of high search risks, relative illiquidity, bargaining process, and relatively small number of buyers and sellers. Also, describing market uncertainty, Slovik (2011) divides market information into 'known' and 'unknown' and asserts that while one expands, the other shrinks, depending on the availability of information. Slovik (2011) position can be likened to the argument of Mooya (2009)'s 'thought experiment' which describes market continuum between 'no market' and 'perfect market' differentiated by the quantity of market participants, information and product heterogeneity. As shown in Figure 4, the journey between the two ends of the continuum involves series of transaction costs and it is obvious that the closer the position is to the end of 'unknown' market information or 'no market', the more immature the market becomes and the higher the transaction costs, especially in terms of effort and time required to produce a reliable value opinion. Therefore, the behaviour of a decision makers (valuers) within this continuum depends on their understanding of and disposition to the costs involved. This forms the basis of this framework.

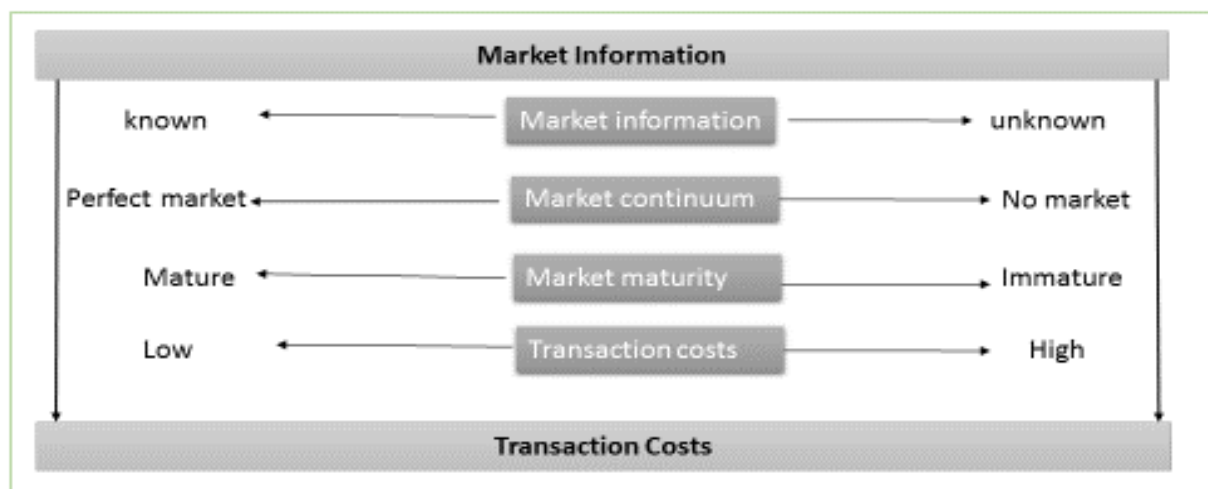


Figure 4: Market Information and Transaction Costs (Adapted from Slovik (2011); Mooya (2009))

Exchange in real life markets is not costless as expected of behaviour of market under neo-classical economics theory (Moya, 2009). This revelation represents the major contributions of NIE to economics knowledge domain. In the real-life property market, information of the market transactions is shrouded in secrecy, and products (properties) are not homogenous in nature. As earlier stated, the need for valuers or real estate brokers is necessitated by the reason of high transaction costs faced by market participants like property seller, property buyer, and mortgagee, in aggregating the market information needed to make a decision about the monetary worth of a given property having specific characteristics. Hence, a valuer serves as a specialist

information aggregator thereby standing in to lowers the transaction costs for market participants (Baryla and Zumpano, 1995; Mooya, 2009). The value opinion produced by the valuer is therefore considered as the rule of the game for the market participants (Mooya, 2009). However, the process of aggregating the information by the valuer involves time, effort and resources for such information to be a true reflection of the market. How much of such costs is required depends on a number of factors including the nature of the property market and market institutions, the complexity of task, and the specificity of the asset being valued, among others. For instance, Baffour- Awuah and Gyamfi-Yeboah (2017) found that higher valuation variance (disparity between value of opinions of different valuers on a property) is associated with valuation tasks with higher complexity, suggesting that different dispositions of valuers to the complexity of the task produce widely differing opinions. The authors also observe that when properties are non-standardized, the process of comparison among properties requires an increased information processing task (high transaction costs).

In summary, the framework presented in Figure 3 combines the three sources of uncertainty in valuation as earlier enunciated. That is, market, internal, and external uncertainties. Each block contains variables which, depending on the prevailing circumstances, are expected to be utilized in generating the related costs. The first block, market uncertainty, deals with all transaction costs required to minimize the effects of data challenges on the valuation outcome. These include, for instance, what is required to search for sufficient information, verify and confirm circumstances surrounding the transactions, enforcing the application of appropriate input in the valuation, and ensuring the necessary due diligent/quality control is put in place during valuation process, among others. The second block comprises the internal uncertainty which deals with the framework of limitations within which the valuer operates. Transaction costs arising from this include what is required to deliver an optimum professional service under these different categories of limitations. Each of these limitations come in varieties of forms according to the prevailing circumstance. The third category, the external uncertainty, concerns influences that valuers may face from clients and the volatility in economic variables which may have significant effects on valuers' ability to predict the market and ascribe value accurately. Therefore, transaction costs here include the likely trade-offs for the possible threat from clients and other efforts that may be required to manage the volatility of the economy and reduce its effects on the valuation output.

CONCLUSIONS

This research has highlighted the limitations in the existing conceptualization of valuation uncertainty in the real estate literature and proposed a framework for a better understanding of the phenomenon. A review was conducted on the concept of valuation uncertainty from real estate literature by highlighting some pertinent issues bothering on the causes, effects, the conceptualization and approaches towards addressing it. It was found that uncertainty has been an issue of concern in property valuation for decades while the actual debate in literature started as a result of the fallout of the recommendations of Mallinson Report in 1994 which was also reinstated in the Carsberg report of 2002. The subsequent contributions to this debate were found to be patterned towards the submission of the two reports which is to find a unified means of reporting the uncertainty in valuation to clients. It was also found that the conceptualization of valuation uncertainty has been on the valuation output rather than input which has also made the effort towards addressing it to focus more on valuation

accuracy and variance. The study also established that the use of theory, especially TCE, in explaining phenomenon is scarce among valuation literature compared with other fields.

This study, therefore, argues that uncertainty is more attributable to valuation input and would be better understood if conceptualised as such. To provide a better conceptualization of valuation uncertainty and the behaviour of valuers around it, the study proposed a conceptual framework based on the theoretical lens of TCE. The framework was built upon the three identified sources of uncertainty in valuation. This study also provides useful insights into the applicability of TCE to valuation studies and provides a preliminary views into the identification of costs associated with property valuation process. It is also argued that the framework has the potential for the conceptualizing and explaining the transaction costs associated with the uncertainty valuers are exposed to under any property market condition, as well as valuers' dispositions toward such costs.

The position of this paper is that, though it is been widely documented that valuers resort to heuristic behaviour when faced with uncertainty, it is not enough to state that valuers resort to heuristic behaviour when faced with uncertainty without making further inquiries into the theoretical explanation of why they do so. This study also concludes that though every property valuation involves a certain level of transaction costs, but these transaction costs are rarely measured or seen as an object of discourse in literature.

This study forms a part of an on-going extensive research aimed at providing a better understanding of the behaviour of valuers operating in an uncertain environment. These preliminary findings provide an impetus for the need to embark on the research as a way to contribute uniquely to the body of knowledge in property valuation, especially among behavioural studies.

In summary, this paper introduces a new dimension to the study of uncertainty in property valuation by taking a theoretical perspective to the understanding of the phenomenon with focus on valuation inputs rather than output. This study is, therefore, the first to provide insights in this direction among valuation literature. In addition, findings of this study pose some interesting questions to stimulate debate and research agenda in this direction.

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BARRIERS TO ATTAINING QUALITY IN CONSTRUCTION: A SOUTH AFRICAN PERSPECTIVE

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The purpose of the research reported in this paper is to explore barriers working against the achievement of quality from the clients and contractors' perspectives in the South African construction industry. The study was guided by using the mixed method research strategy. The primary data for the study were collected from both structured questionnaire and interview survey from construction professionals who were purposively selected. The professionals selected for the study are working for contracting and client organisations. The use of contractors and clients in this study is because of the notion that contractors' survival depends on repeat work from clients. A repeat work from a client is often determined by previous project performance. Based on the influence level computed, major quality barriers were ranked in their order of influence: (1). Lack of training of skilled and unskilled workers. (2). Lack of top management commitment to TQM and quality management systems (QMSs). (3). Lack of monitoring and supervision during the construction process. (4). Lack of quality culture. (5). Poor tendering. (6). Use of subcontractors leading to fragmentation of work. The study confirms that South African construction abhors variety of quality problems that cannot be effectively solved without cooperative efforts from all industry stakeholders. The sample for the study was drawn from the built environment professionals in Bloemfontein, South Africa. A similar study that would cover all the South African Provinces would yield more results that are beneficial. The paper provides insight on the state of quality in the South African construction sector considering client-contractor relationship.

Keywords: Clients satisfaction, Construction, Contractors, Quality, South Africa

INTRODUCTION

Although a significant number of practices have been introduced in the industry, establishment, and attainment of reasonable levels of quality in construction is still a problem (Heravitorbati et al., 2011). According to the South African Construction Industry Development Board (CIDB) (2011), studies conducted among architectural practices and general contractors, consistently identified procurement and construction barriers as dominant in the achievement of quality in South Africa, and also design related barriers were deduced as factors. Under design related factors, small details, inadequate specifications, and poor design coordination, were discovered as factors that are barriers to achieving quality. Under procurement related factors, lack of emphasis on time and budget, shortened project periods, lack of pre-qualification, competitive tendering and awarding of contractors primarily by price were deduced as being the most dominant. Lastly, under construction-related factors, skills shortages and insufficient workforce training, lack of management commitment, and lack of strict quality control were identified as significant factors.

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Owing to the importance of quality, Cao (2010) elucidates that quality should be viewed as the symbol of human civilization and its progress. According to Ranjit (2006: 3), "Quality is not evangelism, suggestion boxes, or slogans. It is a way of life." In other words, quality should not be seen as just 'conformance to requirements,' but a way of life. To achieve this view of quality, Hugo and Badenhorst-Weis (2011) call for the adoption of the concepts of 'do it right the first time' and 'quality is free,' which were the cornerstones of the original philosophy of Total Quality Management (TQM). However, it appears that these perceptions of quality are missing in how stakeholders implement construction projects in South Africa. For example, the CIDB (2011) shows that clients are neutral or dissatisfied with the quality of construction on around 20% of all projects. This study further reports that around 12% of the projects surveyed had levels of defects, which are regarded as inappropriate. In line with the CIDB report of 2011, it is argued that clients should not be complacent with these levels of dissatisfaction. Kakitahi et al. (2014) add by stating that a pragmatic client, particularly for the public sector, is a prerequisite for quality achievement in construction. The CIDB (2011) report further highlighted stakeholders' perceptions of barriers to construction quality. The important barriers reported upon by the CIDB in 2011 include poor site management, lack of contractor expertise, corruption, inadequate resourcing by contractors, lack of understanding of quality, the level of subcontracting, insufficient information, detail, focus on cost by contractors, and poor constructability. It is important to note that the study of CIDB (2011) is mainly focussed on the barriers to attaining quality from the clients' perspective only. A similar study by Joubert et al. (2005) indicates the fact that commitment to top management, training of skilled and unskilled workers, the use of subcontractors, monitoring and supervision, tenders, and culture form significant barriers to quality in construction in South Africa.

Joubert et al. (2005) reiterated a claim that one of the barriers to quality in the construction industry is the fact that contractors are expected to deliver products of certain standards (embodied in specifications) within extremely tight time constraints. Furthermore, Verster (1998) cited by Joubert et al. (2005, p. 30) mentions that clients want returns within specified time frames and often sell developments within a short period. Schedule pressure of work and its ramifications for quality is well documented in the literature (Zhang and Russel, 2014; Hoonakker et al. 2010; Karim et al., 2006; Sommerville, 2007; Watson & Howarth 2011). Pressures from project complexity and the nature of work in the industry is also a major concern regarding the delivery of product quality required. For instance, Hoonakker et al. (2010) state that the clients are moving forward with demands for improved service quality, faster construction timescales and innovations in technology. This all makes it a challenge to achieve a perfect building. These difficulties are rooted in the diversity and complexity of transformation processes and outputs produced by the construction industry and the fragmentation of quality management tasks (Zhang and Russell, 2014).

The achievement of construction quality is the central goal of all the construction industry practitioners throughout South Africa. Even though the preparation of the brief and the layout design are of crucial, all the subsequent parts of the design and construction stages have to be executed well to ensure superior quality. The concern with regards to the achievement of quality in construction is not new in South Africa. What is new is the fact that adequate progress is failing to emerge through various interventions. Achieving a perfect building is the primary motive of quality improvement. This means that quality must be improved to achieve the required

quality at a building level. When one is considering a quality improvement, Joubert et al. (2005) suggest that it is important to recognize that there is a definite link between quality and productivity. Although there is a connection between 'quality improvement' and 'productivity,' a distinction regarding the aim of each can be made. With that being said, Joubert et al. (2005) state that quality improvement is just aimed at doing things better with the same resources, while productivity improvement is aimed at doing the same work with fewer resources.

In brief, quality should be addressed in all the stages of design, procurement and construction in South Africa (Rossouw & Smallwood 2008) and every place where construction projects are executed. These quality stages play a crucial role in bringing about adequate quality in the construction industry and are directly linked with quality management in every stage of the project lifecycle. Ignoring the importance of quality in each of the stages may prove to be problematic. However, focussing on quality issues during the actual execution of construction projects is important. If anything goes wrong during this stage, it will definitely affect the project negatively. It is also important to consider the fact that complexities in construction projects is on the increase and therefore makes it worthwhile to take a second look at the issue of barriers to quality, especially during construction. One of such complexities, for example, is a kind of client-contractor relationship, which is compounded by the fact that the client can also be the contractor. Evidently, it is yet unclear on how the issue of quality would play in this type of scenario considering the rising profile of corruption cases in all spheres of South African economy. Consequently, getting impactful insights into the problem of barriers to attaining quality within the South African construction industry, especially the clients and contractors' perspectives, it is crucial to conduct a carefully designed scientific inquiry into the problem. As such, this study explores barriers working against the achievement of quality within the South African construction industry with a view to establishing whether barriers reported by CIDB (2011) are still evident in the industry now, especially from the perspectives of the contractors and clients. The next section of the paper presents a short version of the research approach before the results of the study.

RESEARCH APPROACH

The research philosophy underpinning this study is situated within the pragmatist research paradigm, which is guided by the mixed method research strategy. This then involves the triangulation of data collection methods involving collecting both the quantitative and qualitative data in order to get robust insights into the research problem. Specifically, for the purpose of this study, the convergent design was used. Creswell (2014) call this a 'Convergent Parallel Mixed Methods Design' and defines it as a form of mixed methods design in which the researcher converges or merges quantitative and qualitative data to provide a comprehensive analysis of the research problem. So the primary data for this study were collected from both structured questionnaire and interview survey. Since it is extremely difficult to establish the population of the study, the sample for the questionnaire survey was purposively drawn from the available built environment professionals in the Bloemfontein area of South Africa to include project managers, construction managers, quantity surveyors, architects, and engineers. One hundred and sixty copies of questionnaire were sent out to these professionals out of which only thirty-three copies of questionnaire were returned producing 21% response rate. The survey respondents work for both clients and contractors. Additionally, three semi-structured face-to-face interviews with construction practitioners were conducted. One interview was conducted with a senior

quantity surveyor of a general contractor (GC) with more than ten years' industry experience; a managing director of a small contractor with 15 years of experience; and a foreman for a GC with more than 15 years of experience. The interviews were tape recorded, reviewed and summarized, after transcription. It is also important to highlight the fact that notes were also made during each interview session.

Calculation of the Influence Index

For the questionnaire survey, the evaluation done by the respondents was converted into an index called "Influence Index (II)". The calculation of the influence indexes was based on the following formula:

$$\text{Influence Index (II)} = \frac{\sum_{i=1}^5 (w_i)(f_i)}{\sum_{i=1}^5 f_i} \quad (1 \leq II \leq 5)$$

Where w_i is used to represent the constant for weight given to each factor by the respondents ranging from 1 to 5 with:

1 = minor influence

2 = Near minor influence

3 = Moderate influence

4 = Near major influence

5 = Major influence

f_i represents the number of respondents with the i^{th} rating where i ranges from 1 to 5

The scale used for the influence level of each barrier according to the influence indexes was based on the scale formulated by Kazaz, Manisali and Serdar (2008) and modified for this study as follows:

$$\left\{ \begin{array}{ll} 1.0 < II < 1.8 & \text{minor influence} \\ 1.8 \leq II < 2.6 & \text{near minor influence} \\ 2.6 \leq II < 3.4 & \text{moderate influence} \\ 3.4 \leq II < 4.2 & \text{near major influence} \\ 4.2 \leq II \leq 5.0 & \text{major influence} \end{array} \right.$$

FINDINGS FROM THE SURVEY AND INTERVIEWS

Demographic Information

The demographic data of the respondents about their experience, qualification, occupation, and age is shown in Table 1. It can be seen from Table 1 that over fifty-five percent of the respondents are with years of experience of more than six years, while the remaining about forty percent are with years of experience less than six years. Specifically, twenty-four percent of the respondents have industry experience of over 20 years. This by implication means that majority of the respondents are knowledgeable enough in the construction industry to make meaningful contributions to the research. Also, all the respondents are educated to the minimum of undergraduate degree, which means that the respondents are well grounded academically to partake in the survey. Roles of the respondents for the survey vary along the path of professionals in the built environment. For example, construction managers and quantity surveyors are 30 percent each, engineers are 10 percent, while project managers and architects are 10 percent each. This by implication attests to the

fact that all the respondents are seasoned professionals. Additionally, none of the respondents is less than 20 years of age, which implies that all the respondents are matured enough to partake in the survey.

Table 1: Demographic summary

EXPERIENCE	Years	NUMBER	PERCENTAGE (%)
	0 – 5	14	42
	6 – 10	4	12
	11 – 15	4	12
	15 – 20	3	10
	>20	8	24
TOTAL		33	100
QUALIFICATION	Undergraduate	15	46
	Postgraduate	18	54
TOTAL		33	100
OCCUPATION	Project Manager	3	10
	Construction Manager	10	30
	Quantity Surveyor	10	30
	Architect	3	10
	Engineer	7	20
TOTAL		33	100
AGE	20 – 29	15	46
	30 – 39	3	10
	40 – 50	8	24
	> 50	7	20
TOTAL		33	100

Results from the questionnaire survey

This section represents the significant quality barriers ranked in their order of influence. A quality barrier with the most influence index and level will be ranked

first (see Table 2). Under each barrier, sub-barriers are also ranked in order of influence. The idea is that solving each of the sub-barriers will contribute to eventual solving of the main barrier. The results as shown in Table 2 indicate that all the main barriers are of near major influence.

Table 2: Major quality barriers recorded in the study

Major Barrier	Influence Index	Influence Level	Rank
Training of Skilled and Unskilled Workers	4.07	NJI	1
No active participation to quality improvement due to lack of leadership	4.27	MAI	1
Lack of understanding of quality	4.15	NJI	2
No training due to lack of training programs	4.00	NJI	3
No training due to high labour rotation	3.97	NJI	4
Lack of education and training	3.94	NJI	5
Top Management Commitment to TQM & QMSs	3.97	NJI	2
Focus on profit maximization, not on quality	4.18	NJI	1
Unclear management to TQM and QMSs	3.97	NJI	2
Emphasis on time, not on quality	3.94	NJI	3
Unclear quality policies and goals	3.91	NJI	4
Lack of motivation to deliver quality products	3.85	NJI	5
Monitoring & Supervision	3.85	NJI	3
Shortage of trained and experienced supervising personnel	4.18	NJI	1
Poor site management	4.15	NJI	2
Continuous rectification of the work	3.91	NJI	3
Defects during construction not identified at an early stage	3.70	NJI	4
Monitoring and supervision not taking place at regular bases	3.33	MOI	5
Culture	3.80	NJI	4
Lack of quality culture	3.88	NJI	1
Culture that views quality improvement as a cost	3.85	NJI	2
Culture that is contrary to TQM	3.67	NJI	3

Tendering	3.75	NJI	5
Tenders awarded solely on price	4.06	NJI	1
Poor tender documentation and specification	3.73	NJI	2
Fast track construction that hinders quality achievement	3.64	NJI	3
Poor service quality due to outsourcing	3.58	NJI	4
Use of sub-contractors	3.47	NJI	6
Rushed work to quickly get remunerated	3.97	NJI	1
Use of less expensive and unskilled labour	3.94	NJI	2
Completing part of the work as quickly as possible	3.33	MOI	3
Isolated task execution	3.06	MOI	4
Fragmentation of the overall construction process	3.03	MOI	5

MAI = major influence; NJI = near major influence; MOI = moderate influence

As shown in Table 2, the six major barriers to attaining quality during construction projects as evidence from the study are given. The result indicates that ‘training of skilled and unskilled workers’ was ranked first with an influence index of 4.07. This by implication means that the ‘training of skilled and unskilled workers’ has near major barrier to quality. It is important to note that five sub-factors under the ‘training of skilled and unskilled workers’ contributed to this index. Similarly, ‘lack of top management commitment to TQM and QMSs’ is ranked second as the most influential quality barrier with near major influence index of 3.97. This is immediately followed by the ‘lack of monitoring and supervision’ as the third most influential quality barrier with an influence level of near major influence (NJI = 3.85). Following on from the results in Table 2, ‘culture’ forms the fourth most influential quality barrier in this study with an influence index of 3.80 implying near major influence level. The results also indicated that ‘tendering’ and ‘use of sub-contractors’ have influence indices of 3.75 and 3.47 respectively. The results for the barriers show that both ‘tendering’ and ‘use of sub-contractors’ form the fifth and sixth most influential quality barriers respectively.

Results from the interviews

The transcribed interview data reveal that the contractors did not find any significant problems when it comes to client documentation. Overall, they were satisfied with client documentation on previous projects. Under design challenges, contractors pointed out that sometimes the designs are not easy to practically construct. It is hard to incorporate some of the designs during the construction process. Poor tender documentation was pointed out as one of the major challenges under procurement challenges. Poor site management and lack of monitoring and supervision during the project are major problems that cause inadequate quality delivery in a project. Despite the challenges as mentioned above, the interviewees were satisfied with the quality performance on their projects. One of the contents of the interviews that materials to be used are mostly specified; the quality of work delivered, therefore, will not be affected. Where certain materials are not specified, the contractor might opt for less

quality material at a lower price. Contractors agree that some specifications are indeed outdated, but the quality is not affected. The specifications are outdated in the sense that the work will take more time than it would have. Some industry practitioners are not flexible enough to change, they still believe in traditional ways of doing things. A minority of tender documentation was not satisfactory; some details and specifications were unclear. Specifications are sometimes not adequate, and this can affect quality.

The interviewees were, also, of the view that the payment period will affect the quality of work delivered when the contractor does not have enough cash flow to carry on with the work. Where the contractor has some financial reserves, quality of work performed will not be affected. It was also revealed that contractors do not just construct for profit, but also build a reputation and therefore, even if the work is not profitable, the contractor is forced to deliver quality as required. Most large contractors offer education and training to their employees. Few small contractors offer such training programs due to high labour rotation and lack of future work (uncertainty in repeat work). The CIDB register of contractors that is used to match contractor capabilities with project requirements has been of help to contractors in achieving quality projects because the contractor must show capabilities before a contract is awarded. The interviews also suggest that most SME contractors struggle to deliver quality as required due to lack of plant and equipment to execute the work. This category of contractors is constrained by finance, and as such, they tend not to invest in plant and equipment. Similar to plant and equipment, the worries of SME contractors extend to the education and training of their employees. For instance, training programs for workers are not usually offered by due to high labour rotation. In brief, financial assistance for SME contractors is required if they must be held accountable regarding quality products.

Discussion of findings

The findings emanating from the study are discussed on the basis of the results from the questionnaire survey and interviews conducted. The finding from the interview survey suggest that the lack of training of skilled and unskilled workers is ranked 'first' as near major barrier to quality. This is consistent with the finding from CIDB (2011), which reveals that shortages of skilled artisans and first level supervisors are impacting negatively on construction quality. Other studies have highlighted the acute shortages of trained/skilled artisans in South Africa. These studies always highlight the impact that the shortage is having on quality control, standard operating procedures, and training of apprentices in the industry. The CIDB (2011) also added that these skills shortages are further exacerbated by the aging profile of artisans in South Africa for which the average age of the country's artisans is reportedly around 55 years old.

Lack of top management commitment to TQM and QMSs is ranked 'second' as the most influential quality barrier (near major influence level). This is, also, consistent with the work of Mane and Patil (2015) (cited in Samson et al., 1999) where he described that leadership and human resources management are among reliable predictors of performance quality management (QM) practices. Additionally, Low and Teo (2004) state that top management commitment is one of the elements that would reflect QM performance measures in construction firms. Chin and Choi (2003), also, revealed that top management commitment is the most critical factor for the successful implementation of ISO 9000. Mane and Patil (2015, p. 126) cited Hakim et al. (2006) defining QMSs as "all activities of the overall management function that

determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system". To ensure the continual improvement of quality management system, it is essential that the top management gives their full support and commitment especially to the development and implementation of construction projects (Mane and Patil, 2015).

Lack of monitoring and supervision is ranked as the 'third' most influential quality barrier with an influence level of near major influence level. The interviews conducted also revealed that poor site management and lack of monitoring and supervision during the project are major problems that cause inadequate quality delivery in a project. These insights are consistent with the findings from existing literature. For example, the study of Serpell et al. (2002) claims that the purpose of construction monitoring and supervision is to verify that designers and contractors satisfy the real needs of the client. To do this, inspection professionals should be present at the site from the beginning of the project. This will ensure that the design is executed according to specification. According to Joubert et al. (2005), two South African studies (Grobbelaar, 2001; Zietsman, 1997) revealed that a shortage of trained and experienced supervising personnel results in a situation where monitoring and supervision do not take place on a regular basis so much so that defects are not identified at an early stage. The contributing factors to poor monitoring and supervision of construction work include the shortage of trained and experienced construction workers, poor site management practices, unending corrections on badly executed work, late identification of quality deviations (defects), and irregular supervision and inspection of works.

Value, idea, and attitudes are known elements of culture in a workplace. Culture thus form the fourth most influential quality barrier from the questionnaire survey for this study with an influence level of near major influence level. This is crucial because even the prominent quality experts (such as Deming, Juran, etc.) recognize the importance of an appropriate quality culture. Joubert et al. (2005) state that Ngowi (2001) conducted a study based on the application of TQM in the construction industry in Botswana. As a result of Botswana's proximity to South Africa, many of the following findings resonates with evidence coming from South African construction (Joubert et al., 2005). Ngowi (2001) found that a culture exists, which is mostly contrary to a TQM culture. Quality culture plays a significant role in bringing about quality as it becomes a part of a daily routine. Quality culture must be a way of life, and this will ensure that achieving quality does not become a daunting task. For example, an appropriate quality culture will not view quality improvements as an extra cost to the company.

Tendering presents some sociological problems to make it the fifth most influential quality barrier observed in this study with an influence level of near major influence level. The findings from the interviews conducted, also, suggest that the interviewees are of the opinion that a minority of tender documentation was not satisfactory with some details and specifications unclear and specifications sometimes not adequate, which can affect quality. This perception is corroborated by CIDB (2011) and Joubert et al. (2005) who stated that competitive tendering and awarding of contractors primarily on the basis of price is one of the dominant barriers to quality as, at times, the documentation of the tender is poor and the specifications are unclear (CIDB, 2011). Thus, tenders awarded solely on price, poor documentation, and unrealistic schedule tend to impact negatively on quality.

The use of subcontractors is the sixth barrier against the delivery of quality projects with an influence level of near major influence level. Zietsman (1997) cited by Joubert et al. (2005) mentions that main contractors found that the increasing use of subcontractors leads to fragmentation of the process, with the result that such subcontractors perform their tasks almost in isolation. It is said that a subcontractor's aim is to complete his part of the work as quickly as possible, to use as little expensive labour as possible and to get remuneration as soon as possible. These tendencies from subcontractors are not conducive to the achievement of agreed project quality standards (Joubert et al., 2005). When a contractor rush works to get early payment, use unskilled labour that is cheap, and complete tasks in isolation, quality of the work may suffer.

CONCLUSIONS

The CIDB (2011) report provides an overview of the state of quality in South African construction. The report shows that clients are either neutral or dissatisfied with the quality of construction on around 20% of all projects. It further reports that around 12% of the projects surveyed had levels of defects that are regarded as inappropriate. The data from the CIDB report flag the need to investigate the possible barriers that hinder the achievement of adequate quality to determine their influences on individual projects. More so, the evolution of sufficient quality is important in bringing about client satisfaction. This will only be possible if the barriers to quality are identified and eradicated. The study thus outlines the persistent of certain barriers to quality in the industry. These obstacles have been ranked in their perceived order of influence in the industry. In particular, the barriers include:

(1). Training of skilled and unskilled workers: the workers that are responsible for the solid execution of projects do not have sufficient training to deliver the required specifications and requirements as required by clients. (2). Commitment by top management: top management does not show any commitment when it comes to quality or TQM. There is a lack of leadership that encourages continuous quality improvement. (3). Monitoring and supervision, shortage of trained and experienced supervising personnel results in a situation where monitoring and supervision do not take place on a regular basis. This affects the quality of work delivered. The construction process and design will be negatively affected; poor quality will surface. (4). Culture: there is a culture that contradicts TQM, this results in poor quality. (5). Tenders: tenders are awarded solely on price and that this has a negative influence on the quality of projects. This results in poor quality delivery. (6). Use of subcontractor: the increasing use of subcontractors leads to fragmentation of the process, with the result that such subcontractors perform their tasks almost in isolation. This can affect design execution that is according to clients' needs and requirements.

The insights from the interviews contend that quality should be addressed in all the stages of design, procurement, and construction. These quality stages play a crucial role in bringing about adequate quality in the construction industry and are directly linked with quality management in every stage of the project lifecycle. The cross analysis of the exploratory data leads to the compilation of eight working hypotheses that can be used to drive future studies. The hypotheses and the corresponding explanations are examined as follows:

- The use of subcontractors results in constructability problems that occur in construction.

- Lack of integrative work ethos between contractors and designers results in constructability problems.
- Lack of quality culture results in constructability problems that occur in construction.
- Fraud and corruption during the tendering phase result in a bad compilation of tender documentation.
- Tendering system that is solely based on price without considering quality results in the wrong collection of tender documentation.
- Lack of monitoring and supervision during construction result in constrained quality delivery capacity among contractors.
- Lack of training of workers results in limited quality delivery among contractors.

As mentioned in the literature reviewed, this study has confirmed that quality in South African construction is confronted with significant challenges that are socio-technical in nature, especially the complexity arising because of the client-contractor relationship. However, to evaluate the extent of the influence of these difficulties and to see how widespread the problems in South Africa, a larger sample for both survey and interviews is required. A similar study that would cover all South African provinces would yield more results that are beneficial. Such a study should compare and contrast the cost of quality conformance against the expense of quality non-conformance. The proposed hypotheses from this study is a starting point for future research in this regard.

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THE INFLUENCE OF CONSTRUCTION CONTRACT PROCUREMENT STRATEGIES ON SUSTAINABLE HOUSINGS DELIVERY IN SOUTH AFRICA

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The contract procurement strategy adopted for a project execution influences the project delivery in quite a number of ways. Wrong conceptualization by the project team often lead to untimely and poor quality delivery (with associated environmental, economic and social effects), increased cost and thereby leaves the involved construction stakeholders unsatisfied. The study analyses the influence of the different construction contract procurement strategies on sustainable housing delivery in South Africa. The quantitative research approach was adopted to analyse the influence of construction contract procurement strategies on project key parameters (project cost, time and quality), towards the enhancement of sustainable housings delivery in South Africa and surveys were conducted among construction professionals in Cape Town, South Africa. Quantitative data was descriptively analysed and findings reveal that traditional and design and build contract procurement strategies are cost, time and quality effective and satisfactory. Furthermore, findings indicate that traditional contract procurement system is a contractual approach that meets involved construction stakeholders' satisfaction, to a significant extent. South Africa as a developing country is faced with quite a number of socio-economic challenges and these challenges have an influence on the South African construction industry. The South African construction industry has quite a number of completed construction projects with time and cost overruns. The impacts of these in term of the delivery of a sustainable housing are quite enormous. However, several thousands of projects have been constructed and many more are still in the pipeline but the problem still seems far from being solved. This study thus recommends the adoption of contract procurement methods that best address project objectives and requirements to enhance housing sustainability. The study provides research information on construction contract procurement strategies and measures the effectiveness on construction project key parameters – cost, time, quality and stakeholders' satisfaction.

Keywords: Construction contract procurement, Project key parameters, Strategy, Sustainable housing.

INTRODUCTION

Every institution needs a procurement system that is within the legislative framework, fair, equitable, transparent and cost effective (CIBD, 2012a). Morledge and Smith, (2013) opines that the efficient procurement of construction work through the choice of effective procurement strategy is one of the major determinants of success or failure of project delivery. Essentially, there is a definitive need to continually

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examine the influence of construction contract procurement strategies to enhance sustainable housings delivery. The procurement systems of concern for this study include the traditional method, design and build method, labour only method, direct labour method, project management method, management contracting method, build-operate-transfer (BOT) method and design-build-operate-transfer (DBOT) method, among others.

Construction contract procurement has been described as an organized method, approach, strategy or process and procedure for clients to obtain or acquire construction products (Abdul Rashid et al., 2006). Apart from the well-known traditional approach, there are now other “fast-tracking” (as the name being called) or innovative procurement strategies used in the construction industry worldwide. In essence, a sustainable housing is described as the supply of a housing product that is durable, attained at optimum cost and available in the shortest time possible, to meet housing demand of clients, now and thereafter (present and future). The contract procurement strategies differ in terms of allocation of responsibilities, activities sequencing, process and procedure and organisational approach towards affordable housing delivery. Procurement is derived from the word ‘procure’ which literally means ‘to obtain by care or effort’, ‘to acquire’ (Masterman 2003). Strategy is organized method, approach, technique, process or procedure and the skillful planning and managing of the delivery process, which involves a carefully devised plan of action that needs to be implemented.

As aforementioned, the introduction of different “fast-tracking” project procurement systems is the effort by the construction industry to provide better deal to clients that increasingly insist for “best value for money” from construction projects in terms of cost, time, quality and involved stakeholders’ satisfaction, thus, the different contract procurement systems present different methods, process and procedure of designing and constructing projects for the clients. In essence, the concern is how the different contract procurement systems influence project key parameters - cost, time and quality, given that the strategy, process, procedure and organisation vary according to the systems. This study examines the influence of the different contract procurement systems on project key parameters – cost, time, quality.

CONSTRUCTION CONTRACT PROCUREMENT SYSTEMS IN SOUTH AFRICA

According to Masterman (2003), contract procurement is the organizational structure needed to design and build construction projects for a specific client. Deciding what method to use in executing a housing project is a challenging task as a client’s objectives and priorities need to tally with the selected method, so as to improve the likelihood of the project being delivered successfully. Thus, in considering a strategy to deliver a project, a client should be made aware of the complex array of activities and processes that are involved with the contract procurement process for it to be appropriately managed (Gordon, 2004).

Quite a number of contract procurement strategies have been developed to deal with the need to successfully deliver sustainable housings. However, not all forms of contract procurement strategies are effective for particular project types, as client objectives and priorities invariably differ (Skitmore & Marsden, 2006; Love et al, 2006). The objectives and priorities of a client with regard to delivery of a sustainable housing need to be matched to a procurement system. To do this effectively, it is essential that the characteristics of procurement systems and selection criteria

available are understood by clients and their advisors before a procurement method is selected.

The procurement strategies according to Ashworth 2006; Hughes and Greenwood 2008, are:

Traditional approach

Design and construct approach

Management contracting approach

Construction/Project management approach

Direct labour approach

Labour only approach

Private Finance Initiative (PFI) / Public-Private Partnership (PPP).

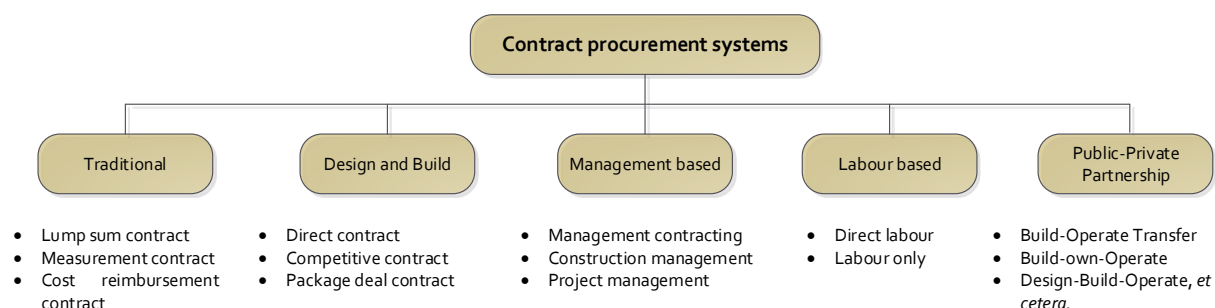


Figure 1: Classification of Contract procurement systems
Source: Masterman (2002: 67)

Traditional contract procurement system

The traditional system of contract procurement has been in existence since the origination of the main contractor, Architectural and Quantity surveying professions at the end of the 18th century and beginning of the 19th century (Mbanjwa, 2004). Traditional method of contract procurement is the most common, well established and recognized model of project delivery (Ashworth, 2006). In this contractual arrangement, a single main contractor is responsible for executing all construction works in line with an agreed program, pre-existing design and other project documentation and he then sublets elements of the work to sub-contractors.

Design and build system

This method of contract procurement is prevalent in middle sized and larger projects and it was introduced in the 1980s (Gordon, 2004). Design and build is a generic term, describing a procurement route in which the main contractor is appointed to design and construct the works, as opposed to a traditional contract, where the client appoints consultants to design and then a contractor is appointed to construct the works (Clamp, 2007).

Management based system

It is an arrangement that gives more emphasis on the management and integration of the design and construction of projects (Abdul Rashid et al, 2006). Under this system, the management of the design and construction phase of a project is contracted out to an independent contractor that acts as a management consultant in favour of the client (Ashworth, 2006). The construction aspect is sublet to many package-contractors or sub-contractors that enter into direct contract with either the management contractor or the client. This procurement approach that was introduced based on the conception that a builder or contractor has more expertise to manage the design and construction of a project (Abdul Rashid et al, 2006). The appointed contractor does not execute the design or construction of the project as the sole responsibility is to manage the design and construction by the design consultants and the many specialist contractors, respectively.

Direct labour contract procurement system

Adenuga (2013) defines direct labour procurement method as a system whereby a construction project is executed by the workers of an organisation rather than the project contracted out. According to Adenuga (2013), direct labour procurement method involves a client employing, organizing and mobilizing all necessary resources either in-house or outsourced to execute a construction project, using the required professional that he pays directly. Direct labour procurement method is usually used for small scale projects and maintenance works, especially by the Government department (Oladiran et al, 2007).

Labour only contract procurement system

Labour only procurement method is the arrangement under which the client contracts out the “labour only” aspects of construction works (Ogunsanmi, 2016). The client is responsible for the provision of all necessary construction materials and resources to be used by the labour only contractor for the execution of the project (Emmanuel, 2013). Labour only procurement method is mostly used for minor alteration or modification of construction works involving repairs, maintenance and refurbishments.

Public-Private Partnership procurement system

Public-Private Partnership method of contract procurement is the cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards (Akram et al, 2012; Casey & Bamford 2014). In practice, PPP method of contract procurement is a concession reached by the private sector company to take total responsibility for the full delivery of a service in a stipulated area including operation, maintenance, collection, management, construction and rehabilitation of the project (Casey & Bamford 2014). The common variants of a PPP arrangement are:

Build-Develop-Operate (BOT)

Build-Own-Operate (BOO)

Design-Build-Operate (DBO)

Rehabilitate-Operate-Transfer (ROT), to mention but a few.

INFLUENCE OF CONTRACT PROCUREMENT STRATEGIES ON SUSTAINABLE HOUSINGS DELIVERY.

The influence of contract procurement strategies on sustainable housings delivery is hereby analysed based on key project parameters – cost, time and quality:

Traditional procurement method

Cost

Abdul Rashid et al. (2006) posit that traditional method of contract procurement provides cost certainty to clients at the early stage of the project; also, traditional procurement method gives clients stability of price in the sense that the design and complete working drawings of the project have been fully developed and detailed prior to tendering.

Time

Traditional procurement method has the slowest delivery approach due to the linear or sequential process of activities (Emmanuel, 2013). However, Abdul Rashid et al., (2006) explains that the traditional procurement strategy is preferable to alternative strategies in the sense that it provides accountability and better design and construction control by the client: there is ample time for the client and the project team to examine and evaluate the design before construction.

Quality

Ogunsanmi, (2016) is of the opinion that the traditional procurement method provides a high standard of quality, as it creates an opportunity for the client to syndicate the best design and management expertise between professional consultants and the contractor.

Design and build procurement method

Cost

Masterman, (2003) notes that although the construction cost is fixed at the tender stage and subject to design changes, the cost incurred in construction while adopting the design and build procurement method is often higher when compared to the cost incurred using the traditional procurement method. Abdul Rashid et al. (2006) posit that lack of design and specification details during tender has allowed contractors to inflate the construction sum to cover for all uncertainties that could possibly arise during the execution of the project, unless there are variations instructed by the client.

Time

According to Griffith and Watson, (2003) design and build procurement method is primarily referred to as the ‘build-it-fast’ project delivery system as the design and construction phases are integrated. Design and build method allows design and construction process to run in parallel, thereby reducing the overall construction period considerably (Abdul Rashid et al., 2006).

Quality

The integration of design and construction allows the contractor to utilise his knowledge and experience to develop a more efficient design and construction control programme, which, as a result, allows the contractor to be innovative in improving the

construction process and techniques and thereby provide a good quality standard (Turner 1997).

Management based procurement method

Cost

Ramus, Birchall and Griffiths (2006) opine that there is typically no fixed cost at the commencement of the project except a cost plan prepared by the quantity surveyor. During project execution phase, however, the cost plan could increase or decrease in the anticipated trajectory. Consequently, close cost monitoring must be ensured to prevent cost overrun.

Time

The entire construction work is divided into a number of smaller work packages, tendered for and constructed in accordance with the construction programme. Construction work takes off as early as design information is available, taking cognisance of project duration (Masterman 2003).

Quality

Management based procurement method allows design change fairly late into the programme, and because of this, enhances higher work quality, provided the design change does not affect that which had already been built (Ramus et al., 2006).

Direct labour/labour only procurement method

Cost

Emmanuel (2013) claims that direct labour and labour only procurement method is a cost saving strategy, as the client purchases all the necessary construction materials from inception to completion and pays all employed labour. This way, there is usually no contractual obligation.

Time

A tendering and negotiation process is not necessary as the procedure for carrying out construction works is significantly simplified, thereby substantially reducing the construction period (Adenuga, 2013).

Quality

Iyagba and Idoro (1995) and Oladiran et al, (2007) posit that labour employed directly by clients ease client communication problems, thereby promoting an effective working relationship and environment, controlling quality.

Public-Private Partnerships procurement method

Cost

The close collaboration of the design and construction team results in more excogitative and less expensive designs; hence, the total cost of services rendered by construction professionals – such as supervision and reviews and contract management activities – can be abridged (Li et al., 2005b). Private partners utilise economies of scale, excogitative technologies, procurements and compensation that are more pliant, reducing overhead, facilities maintenance or operating costs (Li et al., 2005a)

Time

The PPP model offers both the public client and private contractor freedom to choose excogitative methods in the provision of assets and services, resulting in time saved because it accelerates project development by avoiding unnecessary delay in project delivery (Hall, 1998).

Quality

The PPP model provides better quality standards on projects through improved operational efficiency and excogitation (Li et al., 2005a).

METHODOLOGY

The quantitative research approach was adopted to analyse the influence of construction contract procurement strategies on sustainable housings delivery in South Africa. Quantitative research is a methodical process of using numerical data from a selected sample group of a population to generalise the findings to the study population (Pietersen & Maree, 2007a:145). Kothari (2004:30) posits that the measurement of quantities, numbers and amounts is fundamentally quantitative research; thus, the quantitative research method adopts the use of statistical analysis with results presented numerically. The reviewed literature focused on both national and international texts and journals.

The population of this study is; contractors, architects, quantity surveyors, project managers, engineer and sub-contractors in the South African construction industry. Taking the large population size into consideration, a sampling technique was used to select respondents for the study. Considering the complex nature of the construction industry in terms of operations, management and geographical distribution, construction professionals have been observed to operate on a very busy schedule; thus, construction professionals in Cape Town were selected by the adoption of “simple random sampling and convenience sampling technique”. Biggam (2015:25) Maree and Pietersen (2007b:42) define simple random sampling as a subset of [individuals](#) (a [sample](#)) chosen from a larger set (a [population](#)) for data collection and result generalisation. The authors posed further that a simple random sample is an unbiased surveying technique. The simple random sampling technique was adopted in this phase of questionnaire administration for easy and fast generalisation of findings.

The research data was obtained with the aid of a structured questionnaire survey (quantitative method). Questionnaires for the quantitative data were self-administered to elicit opinion from study respondents. One hundred and fifty-six (156) questionnaires were administered to construction professionals in Cape Town, South Africa (Architects, Consultant Quantity Surveyors, Contracting Quantity Surveyors, Project managers and Contractors). A total of eighty-eight (88) questionnaires were duly completed, retrieved, and analysed. The elicited data was descriptively analysed with the use of Statistical Package for Social Sciences (SPSS) software (version 24) and the influence of contract procurement strategies on sustainable housings delivery were rated by the respondents based on a four (4) Likert scale: Highly satisfactory =4, satisfactory =3, Less satisfactory =2 and Not satisfactory =1.

FINDINGS

Research participation

Table 1 presents the positions and work experience of survey participants. The largest group of respondents (29.5%) were contractors, while 22.7% were quantity surveyors, 21.6% were architects, 17% project managers and 9.1% were sub-contractors; thus, the survey respondents represent a broad specimen of different profession in construction, hence, could provide reliable information based on the various positions held in the construction industry. Table 1 also shows that the majority of survey respondents had worked more than five years in their current positions. Nonetheless, this inference doesn't imply that the inputs of the respondents with work experience of 10 years and less is not significantly reliable for this research study.

Table 1: Profile of participants

Profile of participants	Frequency	Percentage
Position		
Contractor	26	29.5
Architect	19	21.6
Project manager	15	17.0
Quantity Surveyor	20	22.7
Sub-Contractor	8	9.1
Total	88	100
Work experience		
1-5 years	21	23.9
6-10 years	33	37.5
11-15 years	24	27.3
16-20 years	10	11.3

Influence of construction contract procurement strategies on project cost

Table 2 presents the explored perception of survey respondents on the influence of construction contract procurement strategies on project cost. Findings reveal competitive contract (mv=3.84) under the design and build procurement method was identified by 97.7% of the respondents as a contractual arrangement that is cost satisfactory, while a minority (2.3%) of the respondents indicated this as not satisfactory. A highly significant percentage of the respondents affirmed that lump sum contract (mv=3.42) under the traditional procurement method is a cost satisfactory procurement approach. Direct contract (mv=3.33) under the design and build procurement system and construction management (mv=2.75) under the management based procurement system were also identified by respondents as approaches that are satisfactory on project cost. Masterman, (2003) contradicts that although the construction cost is fixed at the tender stage and subject to design changes, the cost incurred in construction while adopting the design and build

procurement method is often higher when compared to the cost incurred using the traditional procurement method.

Table 2: Influence of construction contract procurement strategies on project cost

Contract Procurement Strategies	No.	4(%)	3(%)	2(%)	1(%)	MV	Std. D	R
Competitive contract (Traditional)	88	86.3	11.4	2.3	0.0	3.84	0.43	1
Lump sum contract (Traditional)	88	42.0	58.0	0.0	0.0	3.42	0.50	2
Direct contract (D&B)	88	36.4	60.2	3.4	0.0	3.33	0.54	3
Construction management (Management based)	88	5.7	65.9	26.1	2.3	2.75	0.59	4
Project management (Management based)	88	0.0	54.5	45.5	0.0	2.55	0.50	5
Measurement contract (Traditional)	88	0.0	52.3	47.7	0.0	2.52	0.50	6
Cost reimbursement contract (Traditional)	88	3.4	44.3	52.3	0.0	2.51	0.57	7
Buy-Build-Operate (PPP)	88	19.3	23.9	40.9	15.9	2.47	0.98	8
Package deal contract (D&B)	88	19.3	6.8	71.6	2.3	2.43	0.83	9
Build-Lease-Operate-Transfer (PPP)	88	5.7	37.5	40.9	15.9	2.33	0.82	10
Build-Operate-Transfer (PPP)	88	19.3	4.5	60.2	15.9	2.27	0.96	11
Management contracting (Management based)	88	0.0	38.6	42.0	19.3	2.19	0.74	12
Develop-Operate-Transfer (PPP)	88	2.3	20.5	61.4	15.9	2.09	0.67	13
Design-Build-Operate (PPP)	88	2.3	20.5	58.0	19.3	2.06	0.70	14
Lease-Renovate-Operate-Transfer (PPP)	88	2.3	18.2	60.2	19.3	2.03	0.69	15
Labour only (Labour based)	88	2.3	20.5	20.5	56.8	1.68	0.88	16
Direct labour (Labour based)	88	0.0	19.3	6.8	73.9	1.45	0.80	17

Influence of construction contract procurement strategies on project time

Table 3 presents the explored perception of survey respondents on the influence of construction contract procurement strategies on project time. Direct contract (mv=3.08) under the design and build procurement system was ranked as the most satisfactory approach on project time by 88.6% of the respondents, while a minority (11.4%) of respondents disagreed. Significantly, 88.6% of the respondents indicated project management (mv=3.06), under the management based procurement method, as a satisfactory approach with regards to project time, while 71.6% of the respondents identified lump sum contract (mv=2.75) under the traditional procurement strategy as

satisfactory on project time; similarly, 71.6% of the respondents rated management contracting (mv=2.72) under the management based procurement system as a time satisfactory contract procurement approach. Kumaraswamy & Dissanayaka, (1998) supports that the design and build procurement method ascertains a quicker start of construction works on site, as the close integration of design and construction can result in more effective programming.

Table 3: Influence of construction contract procurement strategies on project time

Contract Procurement Strategies	No.	4 (%)	3 (%)	2 (%)	1 (%)	MV	Std. D	R
Direct contract (D&B)	88	19.3	69.3	11.4	0.0	3.08	0.55	1
Project management (Management based)	88	17.0	71.6	11.4	0.0	3.06	0.53	2
Lump sum contract (Traditional)	88	3.4	68.2	28.4	0.0	2.75	0.51	3
Management contracting (Management based)	88	0.0	71.6	28.4	0.0	2.72	0.45	4
Labour only (Labour based)	88	19.3	34.1	44.3	2.3	2.70	0.8	5
Construction management (Management based)	88	2.3	59.1	38.6	0.0	2.63	0.53	6
Competitive contract (D&B)	88	2.3	55.7	42.0	0.0	2.60	0.54	7
Direct labour (Labour based)	88	0.0	53.4	46.6	0.0	2.53	0.5	8
Build-Operate-Transfer (PPP)	88	36.4	12.5	18.2	33.0	2.52	1.29	9
Package deal contract (D&B)	88	17.0	19.3	61.4	2.3	2.51	0.80	10
Measurement contract (Traditional)	88	0.0	40.9	59.1	0.0	2.41	0.50	11
Cost reimbursement contract (Traditional)	88	0.0	54.5	14.8	30.7	2.24	0.90	12
Design-Build-Operate (PPP)	88	22.7	9.1	35.2	33.0	2.22	1.14	13
Build-Lease-Operate-Transfer (PPP)	88	3.4	45.5	18.2	33.0	2.19	0.95	14
Buy-Build-Operate (PPP)	88	19.3	9.1	38.6	33.0	2.15	1.09	15
Develop-Operate-Transfer (PPP)	88	0.0	45.5	21.6	33.0	2.13	0.88	16
Lease-Renovate-Operate-Transfer (PPP)	88	0.0	9.1	55.7	35.2	1.74	0.62	17

Influence of construction contract procurement strategies on project quality

Table 4 presents the explored perception of survey respondents on the influence of construction contract procurement strategies on project quality. Findings reveal a significant percentage (80.7%) of respondents affirmed that lump sum contract (mv=3.03) under the traditional contract procurement method is an approach that satisfactorily meets project quality. 71.6% of the respondents indicated that package deal contract (mv=2.99) under the design and build contract procurement system best

satisfies project quality requirement. Cost reimbursement contract (mv=2.87) under the traditional procurement strategy, and competitive contract (mv=2.83) under the design and build procurement system, were also rated as satisfactory approaches by the respondents. Ogunsanmi, (2016) supports that the traditional procurement method provides a high standard of quality, as it creates an opportunity for the client to syndicate the best design and management expertise between professional consultants and the contractor.

Table 4: Influence of construction contract procurement strategies on project quality

Contract Procurement Strategies	No.	4 (%)	3 (%)	2 (%)	1 (%)	MV	Std. D	R
Lump sum contract (Traditional)	88	22.7	58.0	19.3	0.0	3.03	0.65	1
Package deal contract (D&B)	88	30.7	40.9	25.0	3.4	2.99	0.84	2
Cost reimbursement contract (Traditional)	88	2.3	81.8	15.9	0.0	2.87	0.41	3
Competitive contract (D&B)	88	5.7	71.6	22.7	0.0	2.83	0.51	4
Measurement contract (Traditional)	88	1.1	79.5	19.3	0.0	2.82	0.42	5
Project management (Management based)	88	2.3	75.0	22.7	0.0	2.80	0.46	6
Construction management (Management based)	88	0.0	77.3	22.7	0.0	2.77	0.42	7
Direct contract (D&B)	88	19.3	55.7	2.3	22.7	2.72	1.03	8
Build-Operate-Transfer (BOT)	88	19.3	46.6	3.4	30.7	2.55	1.12	9
Direct labour (Labour based)	88	20.5	19.3	53.4	6.8	2.53	0.9	10
Management contracting (Management based)	88	0.0	46.6	51.1	2.3	2.44	0.54	11
Build-Lease-Operate-Transfer (PPP)	88	19.3	29.5	20.5	30.7	2.38	1.12	12
Design-Build-Operate (PPP)	88	0.0	33.0	64.8	2.3	2.31	0.51	13
Labour only (labour based)	88	19.3	20.5	25.0	35.2	2.24	1.13	14
Develop-Operate-Transfer (PPP)	88	20.5	29.5	2.3	47.7	2.23	1.25	15
Lease-Renovate-Operate-Transfer (PPP)	88	0.0	46.6	31.8	21.6	2.25	0.79	16
Buy-Build-Operate (PPP)	88	0.0	29.5	42	28.4	2.01	0.77	17

CONCLUSION AND RECOMMENDATIONS

Conclusion

Findings from study respondents in the Western Cape, South Africa, revealed that traditional and design and build contract procurement systems are positively satisfactory on project cost time and quality. In other words, it can be concluded that construction clients in the Western Cape Province of South Africa receive best value-

for-money on construction projects with the adoption of either the traditional method of contract procurement or the design and build method.

Recommendations

The supply of housing products that are durable, obtained at optimum cost and available within the shortest time possible is described as sustainable housing; hence, the enhancement of sustainable housing delivery requires the integration of a number of factors including the adoption of an effective contract procurement system. To achieve the best value-for-money with construction products (housing projects, in particular), the study recommends the following:

Traditional (regardless of its aged existence) and design and build contract procurement systems are cost, time, quality and satisfactory; thus, the delivery models should be adopted.

Construction stakeholders in the building sector of the South African construction industry should consider the findings obtained in this study as the results will further enhance the delivery of affordable, sustainable housings.

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FACTORS RESPONSIBLE FOR INCREASE IN THE COST OF BUILDING MATERIALS THAT HINDERS SUSTAINABLE HOUSING DELIVERY IN SOUTH AFRICA

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Increase in the cost of building materials prohibits sustainable housing delivery in South Africa. The impact of the economic related factors, building production related factors, stakeholders' related factors and external related factors on the cost of building materials cannot be ruled out. This study therefore evaluates factors responsible for increase in the cost of building materials that hinders sustainable housing delivery. The Quantitative research approach was adopted to evaluate the factors responsible for increase in the cost of building materials. Surveys were conducted among the stakeholders in the construction industry in Cape Town, South Africa. The quantitative data were analysed with descriptive statistics. The study revealed that inflation, wastages of building materials by labourers, design changes, cost of transportation and distribution of labour, client contribution to change in design and change in government policies and regulation were factors responsible for increase in the cost of building materials. The identified findings that are responsible for increase in the cost of building materials during, if effectively considered by stakeholders during the production process, will improve delivery of a project at construction budgeted costs satisfactorily to the client. South African construction industry is faced with number of threats, which majorly affect its performance in sustainable housing delivery. Practically a few number of construction projects do experience time overrun as well as cost overrun in South African. One of the factors affecting construction costs is cost of building materials. One of the major factors responsible for excessive cost overrun during construction is the cost of building materials.

Keywords: Building materials, cost of materials, cost overrun, sustainable housing and housing delivery

INTRODUCTION

Housing is a key factor in the sustainable development of a nation and a basic human need (Ganiyu, 2016). Developing nations are continuously challenged with issues of inadequate housing (du Plessis, 2002). Adedeji (2012) revealed that the cost of building materials has been one of the factors prohibiting successful housing delivery. Previous studies in building sector have indicated that between 50 to 60% of the total construction input goes into building materials (Adedeji, 2012; Ogunsemi, 2010). However, in order to meet the present needs of humans without compromising the ability of the future generations meeting their own needs, housing should be less expensive to build, durable with modest maintenance, and ability to return completely to the earth when abandoned (Bainbridge, 2004). This paper aims to identify factors responsible for increase in the cost of building materials.

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The process of housing development must be based on principles of sustainability, which should be applied throughout the process from conception, construction and final use of the buildings (Adededeji, 2012). Akanni et al. (2014) explained that building materials remain the most substantial input in project development and, because of this, play an undeniably significant role in the delivery of construction projects. The enormous percentage of building materials in construction project costs make it an essential component with a massive effect on the cost of construction and basically the affordability (or lack of) of proposed construction projects (Windapo & Cattell, 2012). However, this could be exacerbated to the significant loss of performance capacity encountered within the South African construction sector. Windapo and Cattell (2013) explored thirteen critical factors that influence the performance, growth and development of the South African construction industry; the top critical challenge facing the construction industry was increase in the cost of building materials. Clearly, then, is it imperative to find solutions to these factors, and others, resulting in increase in building materials cost.

FACTORS RESPONSIBLE FOR INCREASE IN THE COST OF BUILDING MATERIALS

The cost of building materials has presented a formidable challenge to the construction industry (Akanni et al., 2014). Windapo and Cattell (2013) are in agreement, contending that the preeminent challenge affecting the performance of the construction industry and projects in South Africa is primarily the increasing cost of building materials. Factors responsible for increase in the cost of building materials fall into four categories namely: economic related factors; building production related factors; external factors; and stakeholder related factors.

Economic related factors

Several studies (Windapo & Cattell, 2013; Udeh, 1991; Oladapo, 2008; Oladapo & Oni, 2012) identifies that exchange rate, inflation and interest rate as economic related factors responsible for increase in the cost of building materials.

Exchange rate: South Africa produces its own strategic materials and yet relies on imported equipment. Therefore, increases in materials cost within the industry are a cause for concern (Windapo & Cattell, 2013). However, about 50% of all building materials and components incorporated into construction, or parts of the material ingredients required for the manufacture of the materials, are sourced from overseas (Udeh, 1991).). Oladapo and Oni (2012) opined that the introduction of the foreign exchange market has had a detrimental impact of the prices of building materials

Inflation: According to Adamu (2013), inflation is an upsurge in general price level in any economy. It is primarily the measure of how the price of goods and services increase over time (Fichtner, 2011). Clearly, any other factor that delays a project will further expose the project to the risk of inflationary cost increases. Due to the nature of the process and the rate of return for work undertaken on construction projects, the effects of inflation can mean loss of profit to contractors and higher cost overrun to project owners (Nega, 2008).

Interest rate: Many construction and profitable real estate projects and housing have either been put on hold or abandoned half way because of the scarcity of capital or because of the sky rocketing cost of borrowing (Oladapo, 1992).

Building production related factors

According to Nagapan et al. (2012), the majority of waste generated during construction is materials waste, primarily as a result of the use of un-reusable materials, leftovers and debris. Unfortunately, this material waste amounts about 9% of the weight of materials purchased

(Azis et al., 2012). Material mismanagement during construction can lead to an increase in costs of construction, whereas effective management of materials can bring extensive savings to project costs (Rajaprabha et al., 2016).

There are three typical resources associated with construction: material, machinery and manpower (3Ms). Manpower is the source of more threats than construction materials and machinery (Hanna et al., 2005). In the study of Windapo and Cattell (2012), as they sought to benchmark respondents' perceptions against actual factors that may affect future building material prices in South Africa, it was revealed that labour cost had the highest correlation with building material prices, followed by transport cost. A construction project performance is inevitably impacted by design changes (Olawale & Sun, 2010). Design change is a kind of change that impacts the method of work as was originally planned budgeted or scheduled (Abdul-Rahman et al. 2015). However, it was further revealed by researchers that changes do frequently arise at any stage of a project due to a variety of reasons stemming from diverse sources – with significant impact.

Stakeholder related factors

Construction project stakeholders are a group of intellectuals incorporated in the scheduling/development phase of a building project to achieve cross-functional construction responsibilities (Isa et al. 2014). Takim (2009) and Yudelson (2010) added that for effective management of any construction project, an integrated project team is comprised of a wide range of professionals such as users (owners), general contractors, architects, project managers, consultants, engineers and government agents/commissioning authorities depending on the complexity of the project. Manavazhi and Adhikari (2002) found the factors responsible for supplier default emanate from the fact that some suppliers control a monopoly of the market by keeping the price high and restricting the output, showing little or no awareness of the needs of the customers. Manavazhi and Adhikari (2002) further stressed that because of the high demand of some building materials, some suppliers wait for a high accumulation of orders, thereby generating problems associated with importing raw materials as well as increased exchange rates. Change in a project's design can arise for any number of reasons; Ogunlana, Promkuntong and Jearkjirm (1996) acknowledged that clients are actually the major cause of change for many reasons: it could be for marketing purposes or due to an economic situation to meet customer demands. Also, adjustment or change might occur as a result of newly-emerging concepts perceived by the client for the project to achieve anticipated functional requirements. Alsuliman et al. (2012) further confirmed that clients initiate most of changes in building design which are likely to extend the delivery of projects at construction costs higher than budgeted cost. Improper planning is one of the most important factors affecting the cost of building materials. Contractors should utilise all resources in effective ways. Proper scheduling is essential in project resource utilization, as the reverse, inadequate planning, will increase the project cost (Eshofonie, 2008).

External factors

Weather conditions

While building materials are a significant component of any building project, climate change directly or indirectly will also have an effect on the use of building materials before or during building construction. Climate changes contribute a vast challenge to global warming emission of CO₂ by buildings under construction and in use (Windapo & Cattell, 2013). As actual site conditions for a construction project are not usually determined until construction begins, some changes may occur due to hostile weather conditions or changes in sub-soil conditions (EU Framework, 1998).

Force majeure

Force majeure, otherwise known as ‘Acts of God’, is a term that covers a range of events, including revolution, war, riot, earthquake, landslide, fire, political and economic instability and other such risks (Nega 2008). Where it occurs, it will result in significant increase in the cost of building materials.

Government policies

In the findings of Dlakwa and Culpin (1990) and Adekoya (2003), one of the factors affecting the cost of building materials in the Nigeria construction industry was identified as government fiscal policies. According to Mansfield et al. (1994), governments may also invoke their powers to initiate or halt projects on political, social and environmental grounds.

RESEARCH METHODOLOGY

The Quantitative research approach was adopted to evaluate the factors responsible for increase in the cost of building materials. Quantitative research is a methodical process of using numerical data from a selected sample group of a population to generalise the findings to the study population (Pietersen & Maree, 2007). This paper adopts purposive sampling techniques, considering the complex nature of the construction industry in relation to management, operations, geographical distribution and the often chaotic schedule of construction stakeholders. Purposive sampling is a form of non-probability sample in which the researcher aims to sample cases/ participants in a strategic way, so that those sampled are relevant to the research questions that are being posed (Bryman, 2015). One hundred and thirty-seven (137) questionnaires were administered in person to construction stakeholders (architects, site engineers, project managers, quantity surveyors, contractors, building materials suppliers, site managers and government workers) in the Western Cape Province respondents. A total of sixty-nine (69) questionnaires were retrieved and used for analysis. Quantitative data was analysed with the use of Statistical Package for Social Sciences (SPSS) software (version 24). Respondents were requested to indicate the extent to which each of the identified factors affected the cost of building materials, following a four (4) point Likert scale: scale: 4=Strongly agree, 3=Agree, 2=Disagree and 1=Strongly disagree.

FINDINGS

Research participation

Table 1 presents the positions held by survey participants. The largest groups of the respondents (20.3%) were project managers, followed by quantity surveyors which represented 17.4%; and site managers at 11.6%; construction managers at 13%; 11.6% were sales consultants; contractors at 7.2%, site managers at 5.8%; and architects at 13%. The outlook of results in table 1 shows that the geographical spread of the respondents within the building construction industry can be declared nearly perfect even and thus serve as reliable data. Similarly, the opinions of various stakeholders in the construction will enhance the result reliability. Table 1 presents the work experience of respondents in the construction sector reveals respondents with one to five years’ work experience in the construction industry represented 7.2% of respondents. Respondents having six to ten years construction work experience represented 10.1% of the total. A substantial 36.2% of study participants had been involved in construction work for eleven to fifteen years, while 21.7% had sixteen to twenty years’ experience, and 24.6% had construction experience of greater than twenty years. The years of experience of respondents are significantly worthy to achieve the purpose of the study, as a significant 83% of study respondents have more than ten years work experience in the construction industry. Nonetheless, this is not to suggest that the input and

work experiences of the respondents working only between 1-5 years is not significantly reliable for this research.

Profile of participant	Frequency	Percentage
Site Engineer	8	11.6
Project manager	14	20.3
Construction manager	9	13.0
Sales consultant	8	11.6
Contractor	5	7.2
Quantity Surveyor	12	17.4
Site manager	4	5.8
Architect	9	13.0
Total	69	100
Work experience		
1 - 5 years	5	7.2
6 - 10 years	7	10.1
11- 15 years	25	36.2
16-20 years	15	21.7
20 years above	17	24.6
Total	69	100

Economic related factors responsible for increase in cost of building materials

Table 2 presents the perceptions of survey respondents in the order of severity of economic related factors affecting the cost of building materials. Respondents were requested to indicate the extent to which each of the identified factors affected the cost of building materials, following a four (4) point Likert scale: where: 4=Strongly agree, 3=Agree, 2=Disagree and 1=Strongly disagree.

In Table 2, inflation, with a mean value of 3.55, was identified as the most significant economic related factor affecting the cost of building materials. Addition of the 4 and 3 in table 2 shows that 94.2% of respondents strongly agreed that this factor affects the cost of building materials. However, it can be inferred that this factor is widely regarded as a major contributor to the increase in cost of building materials. A substantial 97.1% of respondents agreed that exchange rate of rand (mv=3.52) was a notable factor affecting cost of building materials. One of the principal goals in any economy is price stability. However, with the rate at which inflation is presently ravaging global economies, particularly in developing countries, this seems to be an uphill task (Monye-Emina, 2007). Kaming et al. (1997) indicated that inflationary increases in building material cost are the main cause of construction cost overrun. Windapo and Cattell (2013) observed that high interest rates pose as a huge challenge to the construction industry because they are the prime default by construction industry clients.

Table 2 Economic related factors

Economic related factors	No.	4	3	2	1	MV	Std.D	R
Inflation	69	60.9	33.3	5.9	0.0	3.55	0.61	1
Exchange rate of rand	69	56.5	40.6	1.4	1.4	3.52	0.60	2
Interest rate	69	44.9	47.9	7.2	0.0	3.38	0.62	3
Cost of building materials	69	44.9	43.5	11.6	0.0	3.33	0.68	4
Market condition	69	44.9	36.2	18.8	0.0	3.26	0.76	5
Fluctuation in the cost of raw materials	69	36.2	50.7	13.0	0.0	3.23	0.67	6
Local taxes	69	34.8	46.4	14.5	4.3	3.12	0.81	7
Supply and demand of building materials	69	31.9	44.9	21.7	1.4	3.07	0.77	8
Inadequate production of building materials	69	27.5	39.1	31.9	1.4	2.93	0.81	9
Scarcity of building materials	69	21.7	52.2	21.7	4.3	2.91	0.78	10

Building production related factors responsible for the increase in cost of building materials

Table 3 presents the perception of the respondents with respect to building production related factors responsible for increase in the cost of building materials towards enhancing sustainable housing delivery. The respondents were required to use a four (4) point Likert scale: 1=Strongly disagree, 2=Disagree, 3=Agree, 4=Strongly disagree. The findings from the table shows that wastages of building materials by workers (mv=3.31) and poor site planning preventing easy movement of materials (mv=3.15) are significant site related factors responsible for increase in the cost of building materials. Wastages of building materials by labourers on site can be attributed to lack of supervision or lack of skilled labour. This is in affirmation to the study undertaken by Nagapan et al. (2012) showing that a significant percentage of labour has little or no experience in construction. Therefore, inexperienced foremen add to more substandard works and reworks as well as inexperienced field supervisor (Nagapan et al., 2012). While cost of transportation and distribution of labour (mv=3.28) and cost of power supply (mv=3.24) were identified as top human related factors. High transportation costs have a knock on effect on the labours, as high transport cost has been acknowledged as a factor responsible for increase building materials costs in some developing countries in Africa (Windapo & Cattell, 2012). The table also shows that design changes (mv=3.36) and additional work due to change in design (mv=3.29) as design related factors responsible for increase in the cost of building materials towards sustainable housing delivery. Design changes may well contribute to additional works (Han et al., 2013). Change in construction design is inevitable and can arise for a number of reasons. However, these design changes do require extra time, extra cost and extra materials. This concurs with Al-

Dubaisi (2000) who determined that a change in design will have an impact on the material cost, schedule and cost of labour. Takim (2009) proposed that communication proficiency should be encouraged to attain greater efficiency and uniformity in decision making.

Table 3 Building production related factors responsible for increase in cost of building materials

Building production related factors	No.	4	3	2	1	MV	Std.D	R
Site related factors								
Wastages of building materials by labourers	69	40.6	50.7	8.7	0.0	3.31	0.63	1
Poor site planning prevent easy movement of materials	69	52.2	20.3	18.8	8.7	3.15	1.02	2
Inadequate infrastructural facilities	69	18.8	65.2	15.9	0.0	3.03	0.59	3
Unsuitable location for building materials storage	69	27.5	47.8	21.8	2.9	3.00	0.79	4
Cost of fuel	69	29.0	46.4	18.8	5.8	2.94	0.85	5
Pilferage of materials on site	69	18.8	56.5	24.6	0.0	2.94	0.66	6
Shortage of building materials on site	69	20.3	49.3	24.6	5.8	2.84	0.82	7
Human related factors								
Cost of transportation and distribution of labour	69	40.6	46.4	13.0	0.0	3.28	0.68	1
Cost of power supply	69	43.5	39.1	15.9	1.4	3.24	0.77	2
Cost of labour	69	44.9	33.3	15.9	5.8	3.17	0.91	3
Cost of plant	69	31.9	52.2	13.2	2.9	3.13	0.74	4
Communication problem between labourer and supervisors	69	34.4	39.1	24.6	1.4	3.07	0.81	5
Cost of fuel	69	31.9	39.1	21.7	7.2	2.96	0.91	6
Lack of discipline among labourers	69	24.6	40.6	26.1	8.7	2.81	0.91	7
Delay in the payment of construction labourers	69	15.9	42.0	29.0	13.0	2.81	0.91	8
Design related factors								
Design changes	69	37.7	49.9	11.6	1.4	3.36	0.75	1
Additional work due to change in design	69	37.7	55.1	5.8	1.4	3.29	0.64	2
Wrong method of estimation by quantity surveyor	69	42.0	43.5	11.6	2.6	3.24	0.77	3
Construction design complexity	69	43.3	42.0	10.1	4.3	3.24	0.71	4
Additional work due to errors	69	37.7	49.3	11.6	1.4	3.23	0.79	5
Design team experience	69	39.1	39.1	20.3	1.4	3.16	0.79	6
Inadequate coordination among design team	69	26.1	59.4	14.5	0.0	3.12	0.63	7

Stakeholder related factors responsible for increase in cost of building materials

Table 4 presents findings on stakeholder related factors responsible for increase in the cost of building materials. The respondents were required to use a four (4) point Likert scale: 1=Strongly disagree, 2=Disagree, 3=Agree, 4=Strongly disagree. The majority of the respondents (89.9%) agreed on client contribution to design change (mv=3.28) as a top stakeholder related factor responsible for increase in the cost of building materials. Most of the respondents (92.8%) indicated that incorrect construction method (mv=3.19) was also a notable factor responsible for increase in the cost of building. Change might occur as a result of newly-emerging ideas perceived by the client for the project to fulfil desired functional and socio requirements. Irrespective of the client's reason, change ordered by clients will arguably have an effect on the cost of construction activities, especially major changes. The investigation of Yana et al. (2015) revealed that a client is the chief significant factor in the incidence of design changes

Table 4 Stakeholder related factors responsible for increase in the cost of building materials

Stakeholder related factors	No.	4	3	2	1	MV	Std.D	R
Client contribution to design change	69	37.7	52.2	10.1	0.0	3.28	0.63	1
Incorrect construction method	69	29.0	63.8	4.3	2.9	3.19	0.64	2
Improper planning	69	39.1	42.0	15.9	2.9	3.17	0.80	3
Client demand on high quality project delivery	69	39.1	42.0	15.9	2.9	3.16	0.72	4
Supplier default	69	34.8	49.3	11.6	4.3	3.14	0.79	5
Delay in the supply of materials on site	69	21.7	52.2	11.6	8.7	3.09	0.87	6
Fraudulent activities	69	21.7	52.2	23.2	2.9	2.92	0.75	7
Contractor issue (change initiated by contractor to improve quality)	69	23.3	43.5	26.1	7.2	2.82	0.87	8

External factors responsible for increase in the cost of building materials

Table 5 presents external factors responsible for increase in the cost of building materials. The respondents were required to use a four (4) point Likert scale: 1=Strongly disagree, 2=Disagree, 3=Agree, 4=Strongly disagree. Increase in cost of hiring construction machineries (mv=3.02) emerged as the highest rated external factor responsible for increase in the cost of building materials. Increase in cost of hiring construction machineries (mv=3.02) emerged as the highest rated external factor responsible for increase in the cost of building materials. A high percentage (82.6%) of respondents agreed that this factor significantly affected cost of building material. Government legislation (mv=3.01) and change in government policies and regulations (mv=3.00) were seen as notable external factors, as indicated by respondents in Table 5. Dlakwa and Culpin (1990) and Adekoya (2003) noted government fiscal policies as one of the factors affecting the cost of building materials.

Table 5 External factors responsible for increase in the cost of building materials

External factors	No.	4	3	2	1	MV	Std.D	R
Change in government policies and regulation	69	21.7	60.9	15.9	1.4	3.02	0.66	1
Government legislations	69	18.8	66.7	11.6	2.9	3.01	0.65	2
Lack of substitute for product	69	23.2	55.1	17.4	4.3	3.00	0.76	3
Level of advanced technology	69	23.2	53.6	18.8	4.3	2.95	0.77	4
Increase in cost of hiring construction machineries	69	21.7	52.2	24.6	1.4	2.94	0.73	5
Poor nature of construction site	69	21.7	56.5	14.5	7.2	2.92	0.81	6
Weather condition	69	26.1	44.9	23.2	5.8	2.91	0.85	7
Effect of rainfall on building materials	69	20.3	50.7	23.2	5.8	2.85	0.81	8
Political interference	69	17.4	53.6	20.3	8.7	2.80	0.83	9
Force majeure (natural occurrences)	69	17.4	47.8	30.4	4.3	2.78	0.78	10

CONCLUSION AND RECOMMENDATIONS

Conclusions

All the evaluated factors attracted more than a 50% agreement rate from respondents. Therefore, it can safely be concluded that the majority of the identified economic related, building production process related factors, stakeholder related factors and external factors are significant factors responsible for increase in the cost of building materials that hinder sustainable housing delivery in the Western Cape of South Africa. Nonetheless, the most influential factors responsible for increase in cost of building materials are essential to be noted, if improvement in cost effectiveness is to be achieved.

Recommendations

The evaluated findings that are responsible for increase in the cost of building materials during a production process, if effectively considered by stakeholders during the production process, will improve delivery of a project at construction budgeted costs satisfactory to the client. Effective material procurement management is required to avoid wastage of building materials during building production process. Moreover, timely delivery of building materials to site enables the effective usage of materials during construction and reduces material wastages during production processes. . To achieve effective design, objectives must be clearly presaged by the client to the designer at the conceptual phase, ensuring that client requirements are met while still maintain timely project delivery. In order to provide lasting solutions, and bring about steady building material prices and avoid circumstances of constant price increases, the Government should assemble building material monitoring committee that will bring innovations in construction methods and materials research. Quarterly material research will help curb the continuous increases in building material price.

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ADDRESSING CHALLENGES IN THE SOUTH AFRICAN AFFORDABLE HOUSING MARKET: A CRITICAL REALIST PERSPECTIVE

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Since the advent of democracy, South African policy makers and researchers have been focussing on housing solutions. The South African affordable housing market has been battling with undesirable outcomes in terms of the location, density, integration and affordability. Housing is a complex multidimensional phenomenon that has been analysed from various perspectives. Various scholars have adopted either mainstream or institutional approaches in trying to explain housing outcomes through examining the effects of regulations on housing provision. Oftentimes, such analysis has reached unfavourable conclusions on the actual causes of the outcomes in the housing market. The purpose of the paper is to present a philosophical, theoretical and conceptual understanding to the study of affordable housing which is critical in identifying variables for creating interventions to address challenges in the affordable housing market. This paper employs a literature based analysis of the theories and ontological approaches to housing development; key concepts of critical realism and the relationship with structure-agency theory. The structure-agency theory is then applied to the South African affordable housing market. The challenges experienced by the South African housing market are synonymous with both the developed and developing world. The current view to the South African affordable housing market is not adequate to address the prevailing challenges. It is recommended that a conceptual framework that is guided by a critical realist perspective and structure-agency theory will give a better understanding to an interdisciplinary study like housing. It gives an insight into the structural dynamics that shape the roles, strategies, interests and decisions of various role players within a particular setting leading to various outcomes. While this paper draws on a critical realist perspective, it gives a platform to identify interventions in the affordable housing market that could influence policy formulation, implementation and subsequently the outcomes. The interventions identified shall be limited to specific geographical locations since there are various social and political factors at play; hence cannot be generalised. The interventions identified in the affordable housing market through a critical realist perspective would inform policy implementation on how to provide integrated affordable housing at appropriate locations and densities.

Keywords: Affordable Housing, Critical Realism, Interventions, Structure-Agency theory

INTRODUCTION

This paper focusses on the methodological approach which gives insight into the structural dynamics that shape the roles, strategies, interests and decisions of role players in an interdisciplinary study like housing. The South African affordable housing market has been battling with undesirable outcomes. The growing concern is on the pace, scale, location, density, integration and affordability associated with the affordable housing market despite a myriad of housing and planning policies aimed at addressing these challenges. The Department of Human Settlements defines the

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affordable housing market in South Africa as represented by those households falling within the R3 500 and R15 000 monthly income groups. This is the property segment valued at less than R500 000 (Rust 2010). Households in this segment earn too much to qualify for a fully subsidised BNG house and earn too little to access a conventional mortgage loan. This category is known as the “gap market”. According to Rust (2010), the gap market is an important emerging sector in the South African property market, with the most people and the most properties both for rental and for sale.

In the South African context, the problem is not only about the failed efforts by both the government and the private sector to provide housing for the gap market, but the unavailability of well-located land, bulk infrastructure and inefficiencies in the housing delivery process (Financial and Fiscal Commission 2013), which are all key to housing development, in a country battling with the spatial legacy of apartheid. According to Tissington (2011), the affordable housing market is still characterised by non-availability and high cost of housing units. FFC (2013) concurs that the key challenges in the supply side of the affordable housing market include insufficient delivery to scale and lack of sustainability, an increase in the gap market, the lack of well-located land attributed to the lack of assembling of public land for affordable housing by local authorities and bulk infrastructure and housing delivery inefficiencies. The main challenge for affordable housing is a shortage of well-located land for housing development (Rust 2010; FFC 2013; Tissington 2010), despite 70 000 Hectares of state owned land having been identified for housing developments and none have been made available for this purpose (FFC 2013). This is exacerbated by poor land assembly mechanisms, greater affordability of land at the urban periphery as opposed to expensive land in more central areas coupled with insufficient subsidy amounts to build at higher densities to offset the higher land costs (Venter et al 2004). A lack of well-located land leads to the development of settlements on the periphery of towns, far away from amenities, thereby intensifying urban sprawl and increasing the daily reproductive costs of the poor (Newton & Schuermans 2013; Seekings 2000; Jenkins 1997)

Furthermore, findings from an analysis prepared for one of South Africa’s largest affordable housing investment funds suggests that it took almost double the time allowed for in regulations for a housing project to proceed from inception to bond application. The township application process, including township application, survey and approval of the general plan, conclusion of services agreement and council consideration took 157 months, thus 69 months longer than the 88 months set out in guideline documents (FFC 2014). As this cannot be generalised for all developments, the essence of the matter is that it takes longer for a housing project to pass through inception to completion, thus increasing the cost of delivery, reducing the profit margins of developers and reducing the affordability of the houses thus shrinking the pool/ scale of affordable housing. It can be concluded that the pace, scale and cost of delivery of affordable housing can be attributed to the execution of regulatory mechanisms at the local authorities. The Banking Association of South Africa (2011) concurs that the high cost of labour and building materials are also contributing factors to the lack of housing delivery in the affordable housing market.

The challenges associated with the South African affordable housing market are highlighted above and are synonymous with challenges experienced in both developing and developed world. This paper argues for a critical realist perspective in addressing the challenges faced in the South African housing sector. This paper is structured as follows: a critical analysis of the ontological perspectives in housing

research will be discussed in section 2 and the theories of housing development in section 3. Section 4 argues for a conceptual framework that is guided by a critical realist perspective and structure agency theory in addressing the challenges in the South African affordable housing market, followed by the conclusions in Section 5.

ONTOLOGICAL PERSPECTIVES IN HOUSING RESEARCH

Housing is a complex multidimensional phenomenon that has been analysed from various perspectives. Various scholars have adopted mainstream neoclassical approaches, institutional approaches or both, either employing qualitative or quantitative analysis in trying to explain housing outcomes through examining the effects of regulations on housing provision. The varying methodologies are influenced by the ontological and epistemological views of the researchers as described by Fleetwood (2005): “the way we think the world is (ontology) influences: what we think can be known about it (epistemology); how we think it can be investigated (methodology and research techniques); the kinds of theories we think can be constructed about it; and the political and policy stances we are prepared to take”.

The powerful rhetoric of international literature has associated the outcomes in the housing market to the effects of the planning system. At methodological level, the mainstream approaches adopted the neo classical econometric modelling as the main approach which tends to neglect the social interactions in housing provision whereas the institutional approaches adopted institutionalism which is concerned with the social, political and economic factors influencing the housing processes. From an epistemological point of view, an institutional approach in housing studies recognises that the habits or behaviours of market actors shape housing market outcomes (Ball 1986) whereas the mainstream econometric modelling approach neglects institutions and its positivist-deductive approach employs assumptions in achieving its conclusions (Hamzah 2013).

The ontological stance of positivists is that an apprehendable reality is assumed to exist, driven by immutable natural laws and mechanisms (Guba and Lincoln 1994). This is because in this paradigm, human behaviour is believed to be subjected to the operation of laws of cause and the process of hypothesis testing can be used to develop laws that can predict patterns between concrete events. Its epistemological argument is that the social world exists externally from the researcher and that its properties can be measured directly through observations (Gray 2004). In this regard, positivists strive to find patterns of observable behaviour towards the development of predictive theories (Lawson 2003).

On the studies that sought to adopt the positivist approach on the relationship between planning and the housing market, Cheshire and Sheppard (1989), Bramley (1993) and Bramley and Watkins (1996) provided quantitative answers on the impact of planning on the housing market. For example, using a time series economic model Bramley (1993) examined the effects of planning controls over a period of time. Using the model to simulate the effects of the land use changes over time, he provided quantitative answers on the outcomes in the housing market when planning controls are relaxed. The World Bank housing researchers such as Bruckner (2007) have modelled the effects of government interventions such as urban growth boundaries, FAR restrictions, cost increasing regulations, bureaucratic control of development decisions and radically based land use interventions like apartheid in South Africa on housing and observed an increase in prices and densities.

According to Lawson (2003), this application of positivism shows the objectivity and the over reliance on empirical data by positivists. However, the complexity of the housing market detaches it from the positivists' experimental view which only exists in terms of actual, observed and measurable events. The application of positivism as a natural science approach to social sciences has a long-standing debate regarding its appropriateness. The criticism of positivism triggered alternative perspectives to social sciences such as interpretivism. Even though it has not been adopted in any known studies on the relations between planning and the housing market, interpretivists provide an anti- naturalist, subject oriented perspective as opposed to the deductive, predictive, observable, measurable and quantifiable perspective of positivists.

The interpretivists' paradigm maintains that reality is defined by meanings given by inhabitants thus meanings are defined by social actors. Their ontological perspective is that reality is multiple and subjective, and the behaviour of social actors is influenced by the unobservable meanings. There are numerous critics levelled against interpretivists, however, in relation to the planning system and housing market it should be noted that there exist complex underlying relationships between various actors operating within a certain structure (rules, policy frameworks). As such, these criticisms are on the level of consciousness held by actors; the implicitness of the researchers own critique; the disregard for institutional structures and material resources; the limits placed on causality; unintended consequences of actions; and existence of structures of conflict and social change (Sayer 2000). It is therefore important to acknowledge the importance of these interactions in bringing certain outcomes in the housing market.

From the preview on positivism and interpretivism, it can be discerned that the critical realists' ontological and epistemological views lie in between these two perspectives. As Sayer (2000) asserts, "Critical realism does not seek to strive for experimental conditions of closure, which ignore open, contingent laden context of reality, to produce regular outcomes and make law like generalisations; it also rejects strongly socially constructed world of multiple realities, which is sceptical of any kind of knowledge claims or scientific progress.

Critical realists believe that knowledge (epistemology) is different from being or existence (ontology). This implies that there is a reality somewhere that exists separate from human thought. As espoused by Bhaskar (1978), natural and social phenomena do not exhaust the category of what really exists in the world. He separates the domains of empirical, the critical and the real. In Bhaskar's opinion, the three domains are autonomous of each other. The domain of the empirical is made up of human sensory experiences and perceptions, while the actual refers to the events occurring in the world and the real consists of those mechanisms and structures that have causal powers and whose generative capacity creates the order we see in the world (Bhaskar 1978). The real is not the same as the empirical. The empirical gives an avenue to access the real, but only when the former is guided by theory (Olsen 2009). According to Warner (1993) for the realist, the goal of science is the theoretical identification of things and their causal powers. They argue for a more structured ontology with overlapping domains of experience, events, and necessary and contingent relations. Causal mechanisms may or may not be observable; they have emergent powers and generate tendencies for certain events to occur (Lawson 2003).

Easton (2010) asserts that events or outcomes are what critical realists investigate, that is the external and visible behaviours of people, systems and things as they occur, or

as they have happened. Thus, in order to understand the social world, it is important to understand the structures that created the events. Sayer (1992) reiterates that, “to ask for the cause of something is to ask what makes it happen, what produces, generates, creates or determines it, or more loosely, what enables or leads to it”. Realists argue that structure exists, and realists’ presuppositions tend to support the use of structural variables as either independent or dependent variables in regression (Olsen 2009). Further, agency and structure are central to their social ontology. They argue that agency and structure are internally related: one is what it is, and can exist, only in virtue of the other.

From the above discussion, it is argued that critical realism is the appropriate approach for the analysing the challenges in the affordable housing because it acknowledges and promotes an understanding of the influence of specific ideas and practices around housing provision and, importantly, recognises the existence of emergent real relations that may have generated these ideologies and practices. As such, critical realism provides a more fruitful basis for theoretical explanations in the housing development and structure agency theory offers that theoretical undertaking.

THEORIES OF HOUSING DEVELOPMENT

There are various models of the development process which could be used to provide the basic framework for the analysis of the housing market. The development process unpacks the activities that transform a property from one state to another. The focus of this section is on understanding the development process through the lenses of different models as they conceptualise such a process and interests of different actors. Healey (1991) grouped the land development models as follows:

Equilibrium models

Equilibrium models are best explained from the neo-classical perspective which focusses on demand and supply of commodities (Healey 1991). She further asserts that the development process is viewed as relatively unproblematic since transactions and investments are activated by market signals. In this model, actors with greater understanding of signals and least impeded by market constraints will successfully complete their projects. However, Healey (1991) argues that this model is only applicable where there are active property markets dominated by large developers.

Event- Sequence models

Event Sequence models unpack the complex development process into its constituent events to recognise the different social relations which might surround each event, and to appreciate the time scale of development projects. However, Healey (1991) argues that the event-sequence models focus on potential blockages to development activity but does not specify actors and interests. Further, they don’t explain the dynamics of the development process in terms of nature and time.

Agency models

Agency models bridge the gap left by event-sequence models. They focus on the actors and roles they play and the interests which guide their strategies (Healey 1991). They highlight the way agents focus on various sets of activities in the development process thereby analytically separating the agents and the roles they play. These models incorporate the element of time in the development process. However, Healey (1991) argues that these models tend to be too descriptive and lacks critical appraisal. They also fail to consider other forces that might drive the development process.

Structure models

Structure models attempt to explain the land development process by focussing on the way markets are structured through power relations of capital, labour and landowner (Healey, 1991). Such models can be traced to the work by Boddy (1981), Harvey (1978), Ambrose (1986) and Nabarro (1991). These models offer ways of linking events and agency behaviour to the dynamic modes of production and regulation of different economies even though their analytic concern has been with capitalist societies. However, according to Healey (1991), they barely penetrate detail or events of the development process and the nexus of agency relationships.

Healey (1991) acknowledges that structural models offer ways of linking events and agency behaviour to the dynamics of the modes of production and regulation of different economies; and they focus their attention on the way the relations of property development are structured by the broader dimensions of capital, labour, capital-landowner and state market relations. The main weakness on the structure models is that they barely penetrate into the detail of the events of the development process and the nexus of agency relationships surrounding each development. This background fundamentally influenced the approach Healey offered in analysing the property development process.

Healey's Structure-Agency Theory

Healey and Barrett (1990); Healey (1991); Healey (1992) called for an approach that generalises the nexus of roles and relationships in the property development process. Healey (1991) asserts that a theoretical model of the property development process is needed which would enable the detail of agency relationships in the negotiation of development projects to be captured while at the same time allowing generalisation about how these relationships might vary under different conditions. She further argues that an institutional approach is necessary because of the complexity of development processes and the need to avoid missing out on key links in understanding how and why a particular project took place.

Healey and Barrett (1990) are of the view that it is important to understand the relationship between agency and structure. Agency is depicted by the strategies, interests and actions of the various agents involved in the development process; and structure as the organisation of both economic and political activity and of values about land, property, buildings and environments which frames or structures their decision making. Furthermore, it is vital to establish the link between structure and agency empirically through relating the construction of roles, and the strategies and interests of agencies to the material resources, institutional rules and organising ideas which agents acknowledge implicitly and explicitly in what they do.

The relationship between agency and structure plays an important role in the property development process. Structure is defined in terms of the framework within which individual agents make their choices, may be seen to inhere in the various resources to which agents may have access, the rules which they consider govern their behaviour, and the ideas which they draw upon in developing their strategies (Healey and Berrett 1990). Healey (1992) further elaborates that structures are said to be the material resources (land, land rights, labour, finance, information and expertise), institutional rules (planning regulations and requirements governing the location of developments, parking, densities and height of developments), and organising ideas which agencies acknowledge. Ideas influence the dynamic of resource use and rule formulation because they inform the interests and strategies of actors as they define projects,

consider relationships, develop and interpret rules. These ideas carry assumptions about various developmental aspects which have an influence on how agents perceive their interests and devise strategies.

Healey and Berrett (1990) define agency in terms of the way individual agents develop and pursue strategies. This can be interpreted as the way various role players in the development process perform their roles. Agents that are involved in the development process vary and can include land owners, investors, developers, consultants, politicians and community groups. The act of agency is shaped by the structure (institutional rules of the game, material resources and ideas) thereby determining the outcome of a certain development i.e. understanding the behaviour of developers in choosing to invest in affordable housing.

From the discussion above, it can be discerned that the property development process involves a number of role players including private consultants, land owners, government departments, developers and financial institutions, amongst others. These role players deal with various factors such as economic considerations, political, social, government policies and regulations in their operations and interactions. The way they perceive these institutions shapes the property development process in terms of what can be developed where, when, how and for whom. Therefore, it can be argued that, a clear articulation of roles, perceptions and behaviour of various role players in the property development process; a clear identification of stages that shape the development process; and the interactions amongst the role players and various institutions gives a more accurate account of the property development process.

CONCEPTUALISING THE SA AFFORDABLE HOUSING MARKET

This research advocates for the methodological departure for analysing the South African affordable housing market to be based on structure agency theory and informed by critical realism. Critical realists acknowledge that structure exists; and structure and agency are central to their social ontology. The central principle of critical realists is to investigate events or outcomes; that is the external and visible behaviours of people, systems and things as they occur or as they have happened (Easton, 2010). Structure-agency theory offers a platform to investigate the resulting patterns of interactions and the outcome of the process. As such, this approach offers a view of understanding the complex, multifaceted and structured nature of affordable housing.

According to Sayer (2000), identifying causal mechanisms and how they work, and discovering how they have been activated and under what conditions creates explanations. Healey (1992) argues that the structure and agency theory is necessary because of the complexity of development processes and the need to avoid missing out on the key links in understanding how and why a particular project took place.

Housing development is shaped by actors through their response to a given structure, their views, goals and subsequent actions. One of the key issues of this study is with the structures or institutions in housing development that impact on the behaviour of actors. The importance of structures/ institutions has been elaborated elsewhere (Ball 1994; Healey 1992; Alexander 2001; Buitelaar 2004; Guy and Henneberry 2001). Institutions are defined by North (1990) as “humanly devised constraints that shape human action”. According to Shepsle (2014), an institution specifies the players whose behaviour is bound by its rules; the action the players must, may, must not, or

may not take; the information conditions under which they make choices; their timing, the impact of exogenous events; and the outcomes that are a consequence of these choices and events. From the various definitions and perspectives of institutions highlighted above, three main characteristics are of interest to this study. Firstly, it is in the ability of institutions to provide rules, norms and regulations to agents. Secondly, it is in its ability to influence the interactions of various agents. Finally, institutions provide certainty in the operations of agents and allow for analysis of outcomes that resulted from the operations of the agents.

The housing sector as a segment of the property market is guided by a cocktail of rules and norms that emanate from the planning system and the property market. The planning system and the property market have rules that enable or constrain the actor's behaviour and actions. The planning system has a pertinent role not only in affecting supply and demand, but in shaping the context for relations within the process of property development. The challenges in the affordable housing market can be addressed by opening the development process and identifying the key actors and their relationships, rules, resources and ideas that influence their decisions and the roles, strategies and interests that shape their actions leading to certain outcomes. Figure 1 below is an application of structure-agency theory to the affordable housing development process, identifying the key actors, institutions, actions and outcomes. This approach will give a different view in addressing the challenges in the affordable housing market.

The affordable housing market is characterised by agents which are the main actors; structure which are the rules, resources and ideas and agency shaped by the interests, roles and strategies. Structure enables or constraints the act of agency in the affordable housing market. The outcomes in the affordable housing market are a function of structure. The interaction of actors within a certain structure brings about the outcomes in the affordable housing market in terms of location, density, integration and affordability. In order to address the challenges in the affordable housing market, interventions should be targeted at specific variables that can be identified through the conceptual framework in Figure 1 below. For example; a change in rules (the planning system) can have an enabling or constraining effect on the density, location or affordability of affordable housing.

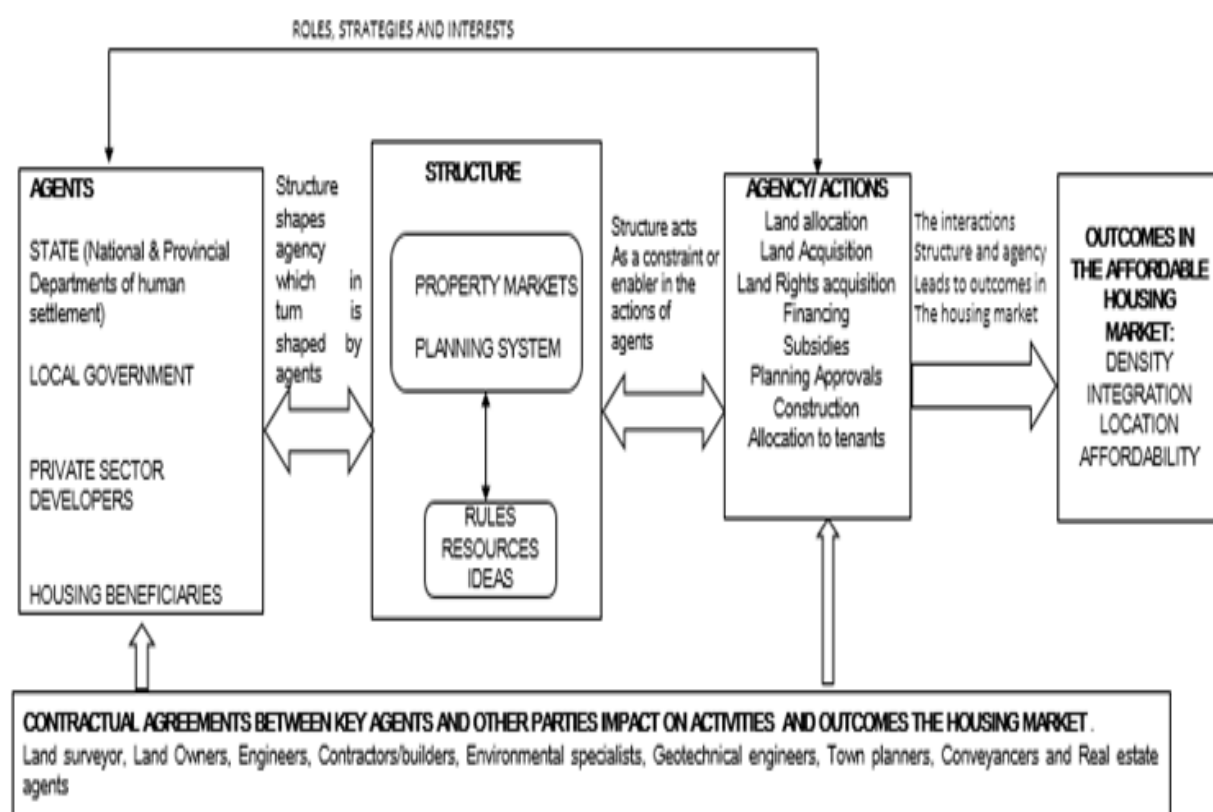


Figure 1: Application of Structure-Agency to Affordable Housing Development

CONCLUSIONS

This research does not offer solutions to the challenges in the affordable housing market; it recommends for a change in view and methodological approaches in addressing these changes. The unfavourable outcomes in the South African affordable housing market are both a cause and consequence of the inefficient policy framework. While policy makers and researchers have been focussing on providing housing solutions in terms of location, density, integration and affordability, the interventions have had a narrow focus on supply and demand focussing mainly on funding and subsidies. To address these challenges, there is a need to identify variables through the proposed conceptual framework and derive targeted interventions. This paper argues for a context-specific conceptual framework that is guided by critical realism and structure agency theory. The interventions identified through the application of this framework will have policy implications in the provision of integrated, well located affordable housing.

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THE INFLUENCE OF SUPPLY CHAIN MANAGEMENT ON CONTRACTOR PERFORMANCE

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Successful construction projects require cooperation among different parties along the supply chain (SC). With increased competitiveness in the South African construction industry, it is important that contractors adopt supply chain management (SCM) practices that will leverage performance by creating a competitive advantage. The study attempt to answer "how is SCM influencing contractors' performance in South Africa." The study explored the question with the case study research design which included observation and interviews of two contracting firms in the Eastern Cape Province of South Africa. Observations were conducted using a structured observation checklist. After the observations had been conducted with both contracting firms, structured interviews were held with the Site Agents on site. The findings of this study indicate that long-term relationships with SC actors that lead to trust are underpinned by mutual understanding and commitment of SC players to contractors' project. The study also affirms the view that contractors that analyse their scope and review and coordinate their SC are most likely to experience good performances. The dilemma noted is the observation that while contractors appear to understand the rationale for proper SCM in their projects, they are yet to evolve a standard approach for implementing it on their project. The findings emanating from the study are limited to two contracting firms in the Eastern Cape Province of South Africa used for the case study. There is, therefore, a conundrum that a future study should tackle.

Keywords: Construction, Contractors, Supply Chain Management, Performance, South Africa

INTRODUCTION

Almost a century ago, a business entity revolved primarily around itself (Asefeso, 2012). That has since changed, and the supply chain management (SCM) concept has become critical for companies. Firms have come to recognize that their ability to continuously create a competitive advantage for themselves depends less on internal capability and more on their capacity to look to their external networks of business partners (Ross, 2011). Based on contemporary realities, increased interest in construction supply chain management (CSCM) have emerged, but practitioners in the field are still facing difficulties to improve business performance through this concept (Aloini et al., 2012). The plethora of parties to a project and the range of actors in the construction industry is a reason to worry about how to manage a supply chain (SC). For instance, the industry is made up of all aspects of building, civil engineering, and the process plant industry and encompasses the planning, regulation, design, construction and maintenance of buildings and other physical structures (Cox, Ireland and Townsend 2006). These actors in different roles as clients, consultants, contractors, suppliers and fabricators are connected by links through knowledge

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transfer, information exchange, directions and financial and contractual relationships (Pryke, 2009). The web/network of actors in the industry thus presents considerable difficulties for contractors when attempting to manage their SCs. The pressures on contractors come from both internal and external processes. For example, contractors are keen to secure projects from clients within a highly competitive and adversarial supply market where attempts to obtain the value for money (VfM) when sourcing their construction requirements is never so important (Pryke and Smyth, 2012).

Whether through vertical integration or horizontal integration, contractors in Southern African are in the business of construction to make a profit through timely, quality and cost-effective delivery of projects (Kadangwe, 2013). However, the contractors in the region are faced with an industry known to be one of the most disconnected industries, characterized by adversarial practices, disorganized supply relationships, having many contributions from different SC members and a lack of trust between those involved on a construction project (Fearne and Fowler, 2006). According to Fearne and Fowler (2006), contractors often treat projects and related activities as a series of sequential and separate operations; individual players of the project team are thus not usually concerned about the long-term success of the resulting product. Individual players are more concerned about their well-being and make contributions based on their inputs and what is ideal for them and not for the project.

Given the implications of those above, the need to ensure that the contributions of suppliers and subcontractors project outcome is crucial. It is crucial because a subcontractor is "a business entity which has a contract agreement with the prime contractor to provide a portion of the work, material input, or services on a project which the contractor has agreed to perform" (Vilasini et al., 2012: 18). As stated by Fearne and Fowler (2006), subcontractors are usually focused on achieving high utilization rates for their labour and paying too little attention to completing tasks against the program. Due to the highly competitive nature of the construction industry, material suppliers and subcontractors are driven down a path whereby they are only focussed on efficiency and capacity utilization rather than project and client requirements. They usually lack the required focus on completing the project on budget and on time, every time. The illustration by Fearne and Fowler (2006) occurs where subcontractors may be nominated, selected or domestic subcontractors depending on the way in which they enter the construction contract. The nominated subcontractor is chosen by the client, and the domestic subcontractor is selected by the prime contractor. Selected subcontractors are chosen both by the client and the main contractor. Special purpose vehicles are established to streamline the establishment and management of subcontractor contracts.

The need for construction firms to become more efficient has resulted in interest in various management systems to improve efficiency with which it operates its supply network. SCM provides an important focus in recognizing the interface between organizations as a potential source of improvement in many aspects of the construction and design process (Pryke, 2009). Effectively managing the SC has become critical to competitive survival since it means that contractors must create market-winning partnerships with other companies that promote the competitive advantage of the whole channel system. Pryke (2009) crucial suggests that for SCM to be relevant to construction, contractors must be able to exploit the SC. He then explains that utilizing the SC involves communicating with the members of the SC that have been artificially separated by inhibiting contractual conditions. To successfully manage any SC, there needs to be a single actor with authority to deal

with all actors within the SC (Pryke, 2009). For example, traditional forms of contracts are based on the premise that, as an actor, one is in a relationship with another actor that instructs, pays, has control of a range of performance incentives and therefore manages one's activities. Each actor is therefore managed by the actor above in the SC, and in turn manages the actor or actors below (Pryke, 2009). The management of any process requires some focal point from which the manager can operate. With the construction industry being fragmented; design, site production, and component manufacture have historically been managed separately. These sectors have been managed poorly and have lacked coordination partly because of the conditions of contract which traditionally distinguished and separated these areas. The actor that manages the whole design/site production/component manufacture process must have a particular authority and capacity. For this study, this actor is the contractor (Pryke, 2009). While the concept of SCM has been widely applied within the construction industry to solve the above-mentioned problem has reported in the literature, there are limited studies about the effect of SCM on construction contractor's performance, especially in South Africa. As such, this paper dwells into that problem and seek to know how SCM is influencing contractors' performance in South Africa.

The next section of this paper highlights the research approach. After that, the findings of the study are presented in two subsections: observations and interviews. The paper then closes with a short discussion of the insights outlined in the study and the conclusions emanating from the findings.

RESEARCH APPROACH

Due to the nature of the research questions, the case study research approach was adopted for this study. Given that this research is aimed at determining the effects of SCM on contractor performance, and that the perspectives of contractors in South Africa cannot be generalized without potential errors in the process, the study opted to gain access to contractors' experiences and knowledge qualitatively. The study utilized observations and interviews to generate data from two contractors in the Eastern Cape Province of South Africa. The design and the data collection methods follow the guidelines in Yin (2013). In line with the guidelines, the validity and reliability of the observation checklist and interview protocol were ensured. With permission from site agents, observations were conducted using a structured observation checklist. The observations took place on each of the contracting firms' construction sites located in Port Elizabeth and were two hours in length per day for five working days in the month of October and November 2016. This is mainly to establish some baseline issues regarding the SCM and form the basis upon which the interviews were based. After the observations had been conducted with both contracting firms, structured interviews were held with the Site Agents on site from both companies to establish their views and opinions of various SCM related concepts. The interviews took place on-site in their site offices. With the focus of the study on project level concepts, the interviewees were Senior Site Agents (one from each firm). The data were tape recorded before transcription. The data were analysed in a thematic manner based on the observation checklist and the interview protocol.

Before the presentation of the data, a concise description of the two contractors is necessary. The first contractor, hereafter called Contractor A, is a medium sized building contracting firm which was formed in 1997. The firm undertakes work in both the public and private sectors. Projects conducted by the company are

commercial and industrial projects. The company makes use of subcontractors on its projects to perform a significant portion of work. The company, which operates in the two provinces in South Africa, is headed by a general manager with 39 years of experience in the construction industry. The second firm (Contractor B) is a large contracting company, which was formed in 1970. It is one of the biggest construction companies in South Africa and is listed on the Johannesburg Securities Exchange (JSE). The contractor has divisions that cover building construction, general civil engineering as well as roads and earthworks projects. The firm operates in multiple provinces in South Africa and is considered a national entity and undertakes building projects of all types. The contractor is headed by a chief executive officer who has considerable work experiences in several divisions of the firm.

FINDINGS FROM THE CASE STUDIES

The observation findings were as follows:

The type of work occurring on the project

Contractor A was undertaking a commercial building project, which was a single storey consisting of a mezzanine floor. The total building area is 2300m². The majority of the work consisted of civil engineering work, reinforced concrete work, steel framework, and brickwork. The contractor performed carpentry and general labour work; all other trades were executed by subcontractors. Contractor B was also undertaking a commercial project, which, similar to Contractor A, consisted of reinforced concrete work, steel framework, and brickwork. The building consists of two floors with a total construction area of 7200m². The contractor also made use of subcontractors for a majority of the work on the project. The contractor performed masonry and carpentry work; all the other trades were executed by their subcontractors. Both firms were the main contractors on their respective projects, with no collaborations or joint ventures with other major contracting firms. The contractors however worked with various firms employed as part of the project team in the form of subcontractors and suppliers.

The structure of relationships with subcontractors and suppliers

Contractor A received a quote from various selected and domestic subcontractors which were given all detail to allow them to price their work during the tendering stage. Upon being awarded the tender, the contractor notified the subcontractors and held a meeting with each subcontractor to discuss the subcontractor's role on the project as well as matters concerning the contract. There were two types of contracts used for subcontractors on the project; the Joint Building Contracts Committee (JBCC) Nominated/Selected Subcontractor Agreement and the Master Builders South Africa Domestic Subcontractor Agreement. The contractor (Contractor A) showed no particular interest in previous relationships with subcontractors as a primary selection criterion; the major criterion was the price. The subcontractor that provided the lowest rates was often awarded the contract. The relationships between the subcontractors on site did not seem healthy or long-term. The project team seemed to be only interested in achieving the required performance from their subcontractors. If there were problems or disputes the contractor's site agent made it clear that he had no problem terminating a contract with a subcontractor or supplier on site and finding a replacement to complete the work; this had already occurred earlier in the project. The site agent mentioned that it is important to be prepared for arbitration from the outset. He made sure to record all occurrences or retain documents that would assist in the

likely event of a dispute. There was a clear lack of long-term relationships with most of the subcontractors and suppliers that were on site. On the project, Contractor A had previous relationships with all other suppliers of major items. The accounts with selected suppliers were created through a process where the contractor analysed project requirements and evaluated quotes from well-known suppliers. The majority of the material that was ordered in bulk included; concrete, bricks, reinforcing steel, and other smaller items which formed part of those trades. The contractor sent a request for material that what was required and then received a quote from the supplier. After this, the contractor wrote the order in the order book including the order number. When the material arrived on site, the contractor was given a delivery note; if the order was correct, it was signed off. All accounts were paid to suppliers at the end of the month.

Contractor B employed its subcontractors differently to Contractor A. During the tender stage; the contractor was not given a full set of drawings and specifications for the project, so the bid was based on incomplete drawings and rough detail. As the project commenced, the subcontractors were appointed using a traditional selective tender approach. Three or four subcontractors were requested to tender, and the most suitable were appointed. The appointment of the subcontractor was based on the lowest tender price. This seemed to be justified by the fact that the subcontractors, which were invited to tender had previous experience with the contractor and were trusted to some extent. The project required specialist subcontractors to be appointed who were preferred for certain work; these subcontractors were selected by the client. The appointment of subcontractors for other trades such as plumbing and electrical work was based on a balance between previous experiences, the subcontractor's reputation, and the tender price submitted. Contractor B made use of the JBCC Nominated/Selected Subcontractor Agreement and the Master Builders South Africa Domestic Subcontractor Agreement as well. A majority of the subcontractors on the project, however, were nominated, subcontractors. Subcontractors on the project were only issued with invitations to tender once the project had reached a certain stage and required their services. They were made aware of their appointment a few months before them being needed on site. This method was different to Contractor A's where subcontractors were aware at the outset of the contractor being awarded the tender. According to employees of the contracting firm, views on subcontractors changed all the time with mention made to various occasions of disappointment on previous projects. It was notable that the nominated and selected subcontractors were declared to be harder to control than the domestic subcontractors. With regards to suppliers, Contractor B had a different approach to structuring their relationships with their suppliers. The contractor made use of a centralized buying system which allowed a buyer to contact some different suppliers which were in the firm's database when buying material. This system allowed the contractor to achieve the cheapest material of the required quality every time but was not used for suppliers of major items on the project.

Supply chain management practices implemented on a site

Both contractors relied on the programs they had developed as a basis to manage and coordinate the activities of various SC actors on site. Contractor A, using the drawings and the baseline program, developed a delivery and material schedule which were used to keep track of the requirements for material delivery from suppliers. The schedules also contained information about the supplier which was responsible for delivering certain materials on certain dates, as well as the quantities of the material.

Where necessary, members of the SC were provided with drawings and specifications for their respective sections of work on the project. Subcontractors and suppliers would be reminded by phone call or email when their services were required, or if there were a delay, they would be notified and asked to perform their duties at a different date to what was initially agreed upon. The management of the SC on the project was not structured and did not seem to be a core point of focus for achieving good project performance. The site diary was the only means of tracking work that was executed by SC actors besides physically observing on site. In contrast, Contractor B used an Excel spreadsheet containing a list of all of its subcontractors who were employed on the project. An information schedule was also created which detailed all duties and dates related to the work of SC actors and other project specifications. In addition to this, the contractor used the Construction Cost Management Software (CCS) to estimate, plan, and control the project budget. CCS was perceived as a useful tool for managing the SC. During the construction of the project, work progress was incorporated into the software and therefore, to some degree, could be used to track and manage the subcontractors and suppliers on the project.

Data from interviews

Similar to the previous section, the interviewed site agents will here on forth be referred to as Site Agent A and Site Agent B from Contractor A and Contractor B respectively. The Site Agent position in a firm involves the managing of time and budget of the projects, and other problems encountered on site. Site Agents are also participating in the management of quality, health, and safety, and have the duty of communicating with all actors in the SC.

Site Agent A had been working for the contracting firm for three (3) years at the time of the interview and was the holder of bachelor degrees in construction management and quantity surveying. In total, the site agent had nine years of working experience in the construction industry. Site Agent B had been with the GC for over ten years at the time of the interview and was the holder of a bachelor degree construction management. The site agents responded to six questions under the heading 'General Questions' and a further eighteen (18) questions on SCM. This section contains the finding from the structured interviews held with both interviewees.

General understanding of SCM

The interviewees were asked about their knowledge of SCM and whether they think it is an important concept. In responding to this, Site Agent A opined that SCM is very critical; from the first moment of communication with SC actors to the point of receiving the required service from them. He stated that it enables contracting firms to understand their relationships with subcontractors and suppliers; he also said that SCM assists companies in recognizing their SC's technical ability and payment structure. Site Agent B was also of the opinion that it is an important concept, stating that SCM is the only way that a contractor can have any form of control on their projects. He said that if firms do not have control over their SC and project objectives, they will be losing money on the project. He added to his comments by indicating that the most important principle is to establish relationships with SC actors for the firm to understand their needs and for the SC to understand the contractor's needs – creating mutual understanding.

When asked how important it is to maintain a healthy relationship with subcontractors and suppliers, Site Agent A noted that it is important to aim to build good

relationships with the SC because it enables contractors to gain insight on which firms they prefer and which firms are not to be worked with again based on past experiences with them. He continued by saying that particular work should be carried out by SC actors which the firm is familiar with, these mainly being civil works, electrical, and plumbing work. According to the site agent, this type of work is critical to the project and should only be executed by subcontractors with which whom the firm has a good relationship with. Site Agent B was also of the opinion that good relationships were critical; stating that discounts are a major plus of the relationships. Similarly, he said that subcontractors and suppliers which contractors have good relationships with may tender for work using more favourable rates than competitors, meaning that the contractor will have a better chance of securing future projects by using these subcontractors and suppliers in their SC. He also stated that a subcontractor, which a firm has a good relationship with is also more likely to add extra effort to assist the contractor in achieving its project objectives.

The next question was "what program/system do you use to manage your SC?" Site Agent A responded by saying that his primary focus was on the baseline program, which specified the project's milestone dates and detailed all work activities occurring on the project. He also says that communication and management of the SC could then be achieved through coordination of activities as sequenced by the baseline program and communicating this information to the SC actors. Site Agent B also made mention of using a benchmark program, which he said was developed by using the information in the design. He stated that information on the baseline program changed as new design information was received from the design team. The site agent also indicated that he developed a briefing schedule from the program and both were used to manage the SC.

When asked how they monitor project performance, Site Agent A discussed two ways in which he did this: cost and time performance measures. He opined that these were the most important. He explained saying that he weighed up the time taken to complete a certain portion of the building and the cost percentage versus the total cost of the project. He made an example of the project being 50% complete meaning that he would roughly expect to be around 50% of the total cost of the project. He failed to mention any performance measures that he made use of for the SC; it was clear that he was more focused on the outcome of the project and if this was satisfying then the SC was automatically thought to have been performing adequately. Site Agent B responded saying that forecasts were made at the start of the project regarding the financial aspect and actual work occurring on site; certain key dates were also stated. He revealed that meetings were held daily with relevant SC actors where key dates and financial matters were discussed. In such meetings, a reference would be made to the forecasts presented initially to gauge performance in this regard.

Following this, the interviewees were asked about the level of trust they had for the subcontractors appointed on their projects. Both site agents stated that they have a high level of confidence for subcontractors that they had worked with on previous projects. Site Agent A said that the trust stems from understanding individual subcontractor's work ethic and abilities. He continued saying that he does not usually have a high level of confidence for subcontractors that his firm is working with for the first time, and that he usually put more emphasis on supervising their job. Much like Site Agent A, Site Agent B responded saying that he had a high level of trust for subcontractors that he had a history with. His firm had contracts with subcontractors that were not based in the Eastern Cape which he expressed distrust for. He said that

the suspicion was caused by the risk of the subcontractors not returning to complete their work, a disappointment the site agent had experienced before. He noted that amongst other factors, this was why the subcontracts the firm used stipulated retention on payment to subcontractors.

Irregular and inflated prices paid for resources

Under this sub-question, the site agents were first asked how they assess price fluctuations on projects. Site Agent A said that this is the duty of the Quantity Surveyor (QS) on the project. He, however, stated that generally, suppliers would notify the firm regarding any resulting increase in prices for resources during the construction period. The site agent continued saying that the QS would be required to send the client a letter stating that an increase in the cost of a certain item is to occur as well as stating the amount it was agreed for at the start of the project. The QS would also be required to report that the firm would like to apply for an adjustment of contract value for the difference in these costs. Site Agent B responded saying that when his firm tendered for projects they would either tender at a fixed rate or with an escalation which was predetermined, the escalation would cover any price fluctuations on the project. He also noted that it was very difficult to convince the client to approve applications for adjustments, so it was important for his firm to focus on either attaining fixed costs for resources or to be provided with a sufficient escalation. Lastly, the site agent noted that it was very important to review prices during the tender stage ensuring that no assumptions were made based on previous projects.

Then next question was "in your opinion, does a good relationship with your SC lead to more favourable prices for resources and services." Both site agents responded saying that good relationship did indeed lead to more favourable prices for resources. Site Agent A added to this saying that personally, he did not only focus on the lowest prices by subcontractors and suppliers. He was more focused on the quality of service or resources provided by the SC actors saying that he would rather pay more money to attain a better quality product or service. Furthermore, he revealed that he's seniors in the firm were more fixated on attaining lower costs; this would make things more difficult regarding delivering a well-constructed building at a good quality according to the site agent. Site Agent B, being part of a larger firm indicated that the large amount of work the provided to subcontractors and suppliers resulted in a steady income for these firms. For some firms, it is not always easy to secure a good amount of work, so large-scale work was appreciated. He then said on top of that; the firm made sure to pay the subcontractors upfront and on time every time so that the subcontractors and suppliers established a trust for the firm's ability to make timeous payments and this led to them providing more favourable prices to the contractor based on these relationship dynamics.

The interviewees were then asked whether they aim to reduce costs associated with deliveries, lead times, and inventory - and how they did so. Site Agent A responded saying that his firm did aim to mitigate these costs. He explained the type of material, the storage capacity and storage costs had to be considered carefully when considering the stated aspects. Furthermore, he explained that a site storeman was responsible for reporting to him on some various materials that remained in storage. He would then plan the replenishing of the materials in storage on site at the appropriate time so as to not have too much material in storage but at the same time not facing the possibility of running out of material. Site Agent B responded saying that his firm did aim to reduce these costs through appropriate planning, programming, and communication with

suppliers to find out delivery information. He also noted the importance of communicating with suppliers directly from the site, while orders are made from the head office. Contractors are clearly required to communicate constantly with suppliers for materials delivery. It is also important for the contracting firm to distinguish between the different types of material, material storage, and delivery requirements that would create the most economical outcome when looking at the above-mentioned factors.

Revision of internal supply chain processes to reflect market changes

Under this sub-question, the interviewees were first asked how they kept track of internal SC operations. Site Agent A responded to this question by saying that he made sure that each major supplier on the project was provided with a delivery schedule and he held meetings with all appointed subcontractors to discuss their roles and duties on the project. Once this had been done, the interviewee then said that he would track the progress of the SC actors by ensuring that each member fulfilled their duties according to the discussed requirements. The interviewee also noted that this process became easier once a good relationship was established between the firm and the SC actor. The interviewee explained that members of the SC had many different ways of operating so it was important to learn about each SC actor and how the firm could maximize the services received from the actor effectively. Site Agent B said that he kept track of SC processes by making use of software; it contained a list of all subcontractors and suppliers and their contributions, which allowed him to monitor their progress.

When responding to the question "with regards to the construction market, what factors regarding the SC do you consider before bidding for a project?" both interviewees noted that the first consideration was the tendered amounts by the subcontractors and the different supplier prices for the required material. Site Agent A went further to state that market conditions were borne in mind when evaluating subcontractors' financial capacities and whether the stipulated prices were market-related or not. He then mentioned that his firm did not operate in all provinces in South Africa so the location would be a major consideration as well. Site Agent B said that his employer tendered on large scale projects where a significant profit could be made. On top of the tendered amounts by the SC, he stated that they would consider relationships and past performances when considering the SC actors to employ on a project.

With effects of demand in mind, the interviewees were then asked how demand levels affect relationships with their SC and project performance. In response to this, Site Agent A explained that during periods of high demand, suppliers supplying material such as concrete would be very busy providing services to other construction projects as well so it is hard to get them to focus on their project. The interviewee noted that this lead to relationships not being as robust because of the number of projects the supplier would be busy with. Site Agent B simply mentioned the fact that basic rules of economics apply when there is a high demand for a product or service – there are fluctuated tender and material prices in periods of high demand.

The last question under this sub-heading was "does the structure of your SC change according to market conditional changes?" Site Agent A responded saying that the structure of his firm's SC did not change, but his company would change certain conditions in the contracts with their subcontractors and suppliers which would be practical in the existing market conditions. He further stated that a clause would most

likely be included in the contract stating that should the subcontractor or supplier not be able to perform certain duties as agreed, the firm would make use of another subcontractor or supplier. Site Agent B was adamant that his company did not change the structure of their SC, he concluded by saying that this was not possible because the client was the one who mostly made decisions about the structure of the entire SC on the project.

Integrating site activities and the supply chain

Under the last sub-heading, the first question that the interviewees were asked was "how do you ensure that your supply chain is aware of all their duties on the project?", Site Agent A stated that the subcontractors on the project were required to sign a contract when they were appointed. The contract spelled out exactly what was expected from them on the project. He went on to say that a program was given to the subcontractor, which included additional detail on their work; an information schedule was also created and given to the subcontractors. The site agent then continued saying that the suppliers of major items were treated similarly on the project with the contract between them stipulating what was required from them; the program and material schedule were the best way of ensuring that the SC was aware of their duties. Site Agent B had a similar response to Site Agent A, mentioning the program and all relevant schedules. He however also refers to meetings; saying that site meetings and daily communication on the site were the most important method for ensuring activities on site and the SC were integrated.

The interviewees were then asked how they coordinate their activities across the SC. Site Agent A was of the opinion that to be able to coordinate activities on the project, a contracting firm should always familiarize itself with all required activities and each SC member that will be responsible for work on the project. He went on to say that once this had been done; there can then be a means to coordinate work on the project. The site agent stated that it was his duty to analyse the progress of work and then determine the required work to be done as the project continued. Site Agent B, as stated before, responded by saying that his firm makes use of a software and a well-designed program to coordinate the work by the SC actors. He further said that the subcontractors on the project were aware of their duties from the point they were appointed to work on the site after the initial meeting. According to him, the coordination of the SC was a combination of all of the interactions that took place between the firm and SC actors because in dealing with the SC the contracting firm is required to be the focal point in the SC, so all information, instruction or any other interaction falls under coordination activities.

The last question responded to by the site agents was "what do you think you could implement to improve your current method of communication with your SC?" Both site agents were of the opinion that their existing methods were adequate for their circumstances and contracting firms operating in South Africa. Site Agent A said that he did acknowledge the fact that there are certain programs and software that could be implemented to improve communication amongst the SC, but did not believe that they were an economical option in the South African construction industry, saying that they cost a lot of money and not all members of the SC would be able to operate them. Site Agent B was of the opinion that his employer methods of communication were good enough. He added saying that the important thing was treating each project as its own separate business and making sure that the project team remained stable throughout to have a team that was familiar with the project and each other.

DISCUSSION AND CONCLUSIONS

The findings of this exploratory study indicate that contractors do not have a clear picture of the structure of their existing SC and the way it operates on each of their projects. The responses to the interview questions did reveal that site agents are aware of the importance of a detailed analysis of each SC actor, but they lacked a standard approach concerning the integration of the entire supply chain to achieve good overall performance. The site agents failed to provide detail on how their firms considered the market conditions when reviewing the way that SC actors operated. The findings thus confirm claims by Cox, Ireland and Townsend (2006) that the construction industry consists of a very few construction firms who have both the internal competence and a sufficiently conducive external environment within which to develop SCM approaches. Cox et al. further explain that when a sufficiently conducive external environment exists, there is often a lack of internal competence to develop the practical operational and commercial leverage to make this approach work effectively.

With regards to demand levels, the findings suggest that when the market is experiencing high levels of demand contracting firms incur higher prices along the SC due to SC actors having more work and by extension, the ability to increase their prices. According to the Department of Innovation and Skills (2013), low levels of demand cause continued trading conditions which set back construction firms, relationships, and project performance. Thus, it can be seen that both high and low levels of demand set back project performance. This suggests once again that care should be taken when selecting SC actors; ensuring that the real actors are not going to inflate prices heavily during high demand or create harsh conditions during low demand.

The textual data from this study also show that contractors should make use of contracts which spell out exactly what is required from subcontractors and supplier when appointing them on a project. By clearly defining duties on their contract, the contractor will be able to enforce certain requirements which minimize the possibility of disputes. Over and above the contract; detailed programs and information schedules should be provided to subcontractors and suppliers which define all their work and work by other SC actors who affect them as well. This enables an integrated approach to site activities. The findings are in line with the literature, for example, Pagh and Cooper (1998) cited in Lee, Kwon, and Severance (2007) who claim that real-time information exchange with the SC will create an opportunity where optimization can take place on construction projects. However, it is important to flag the fact that contractors who made use of a majority of selected or nominated subcontractors may likely experience a lack of control over them because they are usually not familiar with them. Domestic subcontractors tend to be easier regarding control by contractors. This view implies that domestic contractors are easy to integrate into site activities effectively.

To sum up, the two case studies conducted have affirmed the importance of SCM regarding contractor performance, although there are gaps in how particular SCM concepts are understood by the interviewees. For example, the study suggests that contractors that analyse their scope and review and coordinates their SC are most likely to experience good performances regarding internal SC processes, and integration of site activities; and the South African contractors perceive that appropriate selection of SC in a project should consider, project requirements, previous relationships and prices for resources and services. The study also reaffirms

that widely held view that rancour-free long-term relationships between contractors and SC actors that lead to trust are underpinned by mutual understanding and commitment by the SC to the contractor's project. A lack of this type of relationship, therefore, results in SC actors on construction projects performing only their essential functions; no additional value is present where there are no guarantees of future collaboration between the firms. It is, however, notable that though the interviewees in the reported study had a measure of working experience in South African construction and were able to provide good responses, it is clear that there are many principles of SCM that are elusive to them; this study provides a way for them to comprehend certain issues and policies regarding SCM.

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COMPARISON OF DOMINANT AND SUBCULTURES OF CONSTRUCTION ORGANISATIONS IN NIGERIA

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The objective of this research is to compare the dominant and subcultural profile of construction firms in the federal capital territory, Nigeria. The survey, cross-sectional research was carried out by administering structured questionnaire to construction firms registered with the Federal Ministry of Works in Nigeria. A total of 200 questionnaire was administered and 97 were correctly completed and returned. The competing values framework was adopted to diagnose the cultural profile of the studied firms. The results were analysed using SPSS version 21. The findings revealed that there is no difference in the dominant and subcultural profile of construction firms. The firms studied showed the presence of all the four culture types (Clan, Adhocracy, Marketing and Hierarchical) based on the closeness of the means. However, there is a stronger loading on the Hierarchical culture than any of the other culture types for the dominant and subcultures. The findings further revealed that large firms have a higher loading on 3 of the four culture types and firms that have been in operation for over 20 years have high loadings on the four culture types. The finding of the study has shown that both the dominant and subcultural profile of construction firms are in harmony which is important for successful implementation programs. The research is a cross-sectional study that could be repeated over time to check if the results can change over time and if the findings will have relevance on a broader scale. Although carried out in the federal capital territory, can be carried out at the national level and also that organisational characteristics shape the cultural profile of the members of an organisation.

Keywords: Adhocracy, Clan, Hierarchical, Marketing, Organisational Culture

INTRODUCTION

With the worldwide globalization trends, special attention has been given to the study of organizations and their cultures. Empirical studies of organizational culture have been carried out across various countries and industries. Within the construction context, culture studies also have attracted interest Giritli, Oney-Yazıcı, Topcu-Oraz, Acar (2012)

Organisational culture can be defined as a pattern (general) of believes, values and mindset that members of an organisation have in common. This in turn shapes the practices, behaviors and other artefacts that are easily observable in an organisation (Shein, 1985). Sathe (1985) defined the culture of an organisation can be defined as an explanatory variable that makes an organisation different from others. Shein (1997) further describes Organisational Culture as a pattern of basic assumptions that can either be developed, invented or discovered by a defined set of people as it learns to cope with problems of external adoption and internal integration. These basic

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assumptions have worked well in the organisation and are considered valid enough to be taught to new members in the organisation as the right way to think and feel as it relates to the problems in the organisation.

In the late 1990s, a special task group TG23-culture in organisations was established within the International Council for Research and Innovation in Building and Construction (CIB). The TG23 became a working commission on its own and was named working Commission W112 in 2006. One of the most important reasons for specific difficulties related to the construction process identified was the culture of organisations.

The goals of TG23, recently W112 as highlighted by fellows (2011) are:

- To identify and define concepts of culture in the international construction industry and carry out research into the manifestations and effects.
- To discuss and develop appropriate methodologies for the study of culture in organisations
- To determine where appropriate, adopt methodologies for researching culture in the international construction industry

In the context of co-existence of cultures as found in this study, the previous research on organisational culture suggests that organisations are unlikely to reflect only one culture type (Valmohamadi & Roshamir, 2015) further more departments, units and divisions exists within organisation and each of these is likely to exhibit its cultural traits. previous researches see organisation as having only one culture. Few organisations are featured by only one culture type rather they have a profile consisting of different culture types. Emphasis on one single culture type is not the best for overall effectiveness (Zu, Robbin & Fredendall, 2010). Thus, there is a need to examine the relationship between the dominant and subcultural profile of construction firms.

LITERATURE REVIEW

Cultural assessment

Cultural analysis accommodates multiple philosophical positions (Martin, Frost & O'Neill, 2004), this allows researchers to draw on different standpoints. In diagnosing organisational culture, it is important to give attention to the role of cultural dimensions which emphasizes how culture is shared, how boundaries are conceived and how uncertainty is associated in organisations.

Cultural dimensions in organisations can be classified in to 3 cultural perspective

- a. Integration: Culture is shared across the entire organisation
- b. Differentiation: culture is shared by parts of the organisation within groups but not across the organisation
- c. Fragmentation: culture is not shared (Martin et al, 2004)

This study adopts the differentiation perspective which implies the existence of subcultures within an organisation. Consistency and inconsistency among cultural perspective is what lead to the promotion of diversity and differentiation among groups at levels in the organisation. In addition, consensus exists within subcultures and not necessarily between them (Naor, Goldstein, Linderman & Schoroder, 2008).

The differentiation perspective channels ambiguity to external subcultures this is often emphasized by disagreements.

The differentiation unlike the integration accepts the fact that levels of diversity exists among members of an organisation. The differentiation perspective supports the definition that cultural manifestations can be shared among members of a unit, department or groups within an organisation (Cameron & Quinn, 2005). This perspective arises from the opinion raised by Proverbs & Debra (2009) that culture is not to be considered to be monolithic but rather as a collection of subcultures. They further revealed that in tensions could arise in construction organisations for example between Managers and site workers or between consultants and contractors thus the need to establish the dominant and subcultural differences in organisations.

This perspective also acknowledges the fact that variation in culture within an organisation can develop through growth or new ventures. As the organisation grows, differentiation occurs (Martins, 2012). This view further emphasizes that the overall culture of the organisations becomes negotiated interactions between the subcultures. Organisations develop either by imposing overall culture for allowing a dominant culture that is better adapted to changing environment to become more influential (Hofstede, 1980). From the differentiation perspective, boundaries are not defined in legal or formal terms, the basis of definition is the identification and development of shared ideas and interactions. Virtual communication also communicates and express culture without bodily contact between group members (Baird, Jia & Reeve, 2011)

Competing Values Framework

The competing values framework (CVF) has been used in several studies as a method of analyzing Organisational culture, it explores the deep structure of Organisational Culture relating to compliance, motives, leadership, decision making, effectiveness and organisational forms within an organisation, CVF is shown to be theoretically sound in interpreting Organisational Culture and can be operationalized as a psychometrically sound instrument (Gambi et al., 2013; Ivana & Martina, 2016; Lapina, Kairisa, & Aramina, 2015; Ovbagbedia & Ochieng, 2015; Valmohammadi & Roshanzamir, 2015; Zu et al., 2010). This research will adopt the Competing Values Framework (CVF). The CVF is based on two major dimensions that organized the effectiveness indicators into four main clusters. (shown in Fig.1).

Internal Focus and Integration	Flexibility and Discretion		External Focus and Differentiation
	Culture Type: CLAN Orientation: Collaborative Leader Type: Facilitator, Mentor Team builder Value Drivers: Commitment Communication Development Theory of Effectiveness: Human development and participation produce effectiveness. Quality Strategies: Empowerment, Team building Employee involvement, Human resource	Culture Type: ADHOCRACY Orientation: Creative Leader Type: Innovator Entrepreneur Visionary Value Drivers: Innovative outputs Transformation Agility Theory of Effectiveness: Innovativeness, vision, and new resources produce effectiveness Quality Strategies: Surprise and delight Creating new standards Anticipating needs Continuous improvement Finding creative	

	development and Open communication	solutions	
	Culture Type: HIERARCHY Orientation: Controlling Leader Type: Coordinator Monitor Organizer Value Drivers: Efficiency Timeliness Consistency and uniformity Theory of Effectiveness: Control and efficiency with capable processes produce effectiveness Quality Strategies: Error detection, Measurement, Process control, Systematic problem solving, Quality tools (fishbone diagrams, Pareto charting, affinity graphing, variance plotting)	Culture Type: MARKET Orientation: Competing Leader Type: Hard driver Competitor Producer Value Drivers: Market share Goal achievement Profitability Theory of Effectiveness: Aggressively competing and customer focus produce effectiveness Quality Strategies: Measuring customer preferences Improving productivity Creating external partnerships Enhancing competitiveness Involving customers and suppliers	
	Stability and Control		

Figure 1: The competing values framework (Adapted from Cameron and Quinn, 2005)

The first dimension emphasizes on flexibility and discretion in the upper quadrant while the lower quadrant emphasizes on stability and control. The second dimension measures the focus of the organisation both internally and externally. A combination of the two dimensions bring about four quadrants as shown in figure 1 above. Each of the four quadrants stands for a distinct set of values that determine an organisations way of doing business. These 4 typologies of organisational culture simultaneously exist theoretically in every organisation as the

- a. Clan culture
- b. Adhocracy culture
- c. Marketing culture
- d. Hierarchical culture

Clan culture: Clan culture places emphasis on flexibility and internal orientation (Cameron & Quinn, 2005). Organisations with emphasis on this culture promote the development of human resources, emphasizing openness, participation, cohesiveness and commitment to membership. Such organisations are typified as a friendly place to work where people share a lot (Zu et al, 2015). It is akin to an extended family with best friends at work. Leaders are thought of as mentors, coaches, and, perhaps, even as parent figures. The organisation is held together by loyalty, tradition, and collaboration. Commitment is high. The organisation emphasizes the long-term benefits of individual development with high cohesion and morale being important. Success is defined in terms of internal climate and concern for people. The organisation places a premium on teamwork, participation, and consensus (Valmohamadi & Roshamir, 2015).

Adhocracy culture: Cameron and Quinn (2005) described adhocracy culture as one that emphasizes flexibility but with more focus on the external environment. The orientation is towards growth, creativity stimulation, resource acquisition, innovation, and continual adaptation to the external environment (Ivana & Matina, 2016). Organisation with adhocracy culture is characterized as a dynamic, entrepreneurial, and creative workplace. People stick their necks out and take risks. Effective leadership is visionary, innovative, and risk-oriented. The binding force that holds the organisation together is commitment to experimentation and innovation (Zu et al, 2010). The emphasis is on being at the leading edge of new knowledge, products, and/or services. Readiness for change and meeting new challenges are important. The organisation's long term emphasis is on rapid growth and acquiring new resources.

Marketing culture: According Cameron and Quinn (2005), the marketing culture is also focused on the external environment but is control-oriented. It emphasizes productivity, performance, goal achievement, and one of the primary motivating factors is competition. Such organisation is a results-oriented workplace. Leaders are hard-driving producers, directors, and competitors. They are tough and demanding (Baird et al, 2011). The binding force that holds the organisation together is an emphasis on winning. The long-term concern is on competitive actions and achieving stretch goals and targets. Success is defined in terms of market share and penetration. Outpacing the competition, escalating share price, and market leadership dominate the success criteria.

Hierarchical culture: According Cameron and Quinn (2005), the hierarchical culture is both control and internal oriented. It emphasizes rules and regulations, and standardization to achieve control and stability. Such organisation is characterized as a formalized and structured place to work. Procedures and well-defined processes govern what people do. Effective leaders are good coordinators, organizers, and efficiency experts. Maintaining a smooth-running organisation is important. The long-term concerns of the organisation are stability, predictability, and efficiency. Formal rules and policies hold the organisation together. The CVF has been used in a number of empirical studies to explore organisational culture and the effect of the culture types on various operational management studies such as performance measurement (Baird et al, 2011: Total Quality Management, Gambi et al, 2013, Supply chain integration Zu et al, 2010).

RESEARCH QUESTIONS

This paper addresses the following research questions:

- a. What is the dominant and subcultural profile of construction organisation in Nigeria?
- b. What is the similarities/differences between the dominant and sub-cultural profile of construction organisations in Nigeria?

RESEARCH METHODOLOGY

Comparing the dominant and subcultural profile of construction firms was considered a necessary foundation for this study. Based on the review previously presented, the Competing Values Framework and the Organisational culture assessment instrument developed by Cameron and Quinn (2005) was used to assess the cultural profile of construction firms. The framework has been adopted by several studies in diagnosing

the culture of organisations Prajogo & McDermott, 2005; Zu et al, 2010; Valmohammadi & Roshamir, 2015).

The organisational culture assessment instrument has six key dimensions:

- a. Dominant characteristics
- b. Organisational leadership
- c. Management of Employees
- d. Organisational Glue
- e. Strategic Emphasis
- f. Criteria for success.

These dimensions offer four alternative statements. Each of the four statements represent each of the four major culture types (Clan, Adhocracy, Marketing & Hierarchical). Theoretically, these four culture types can be used to describe the pattern for organisational culture at the dominant and subcultural level.

The research employed the Survey design using a structured questionnaire administered to construction firms in the Federal Capital Territory in Nigeria. A total number of 537 firms are registered with the Federal ministry of works with business addresses in the Federal Capital Territory. A total number of 200 firms were selected for the study, based on the classification by Saunders, Lewis & Thornhill (2009), they specified that within a 500-750 population range, 200 should be the minimum sample size at 5% margin of error. 97 of them participated giving a response rate of 49%. The response rate is higher than those obtained from similar studies (Oney-Yacizi et al, 2007; Baird et al, 2011; Roldan et al, 2012) The firms were selected by judgmental sampling procedure. The judgement criteria used for the selection was emphasis on medium and large firms registered with the Federal Ministry of works. They were selected because they are more likely to have departments. The federal ministry of works classified large based on annual turnover as organisations that have an annual turnover of N10 billion as stated in a verifiable tax clearance certificate for three preceding years while medium organisations are those that have an annual turnover of N5 billion as stated in a verifiable tax clearance certificate for three preceding years. Each department was treated as an organisation. Heads of Departments were selected to respond on behalf of each organisation.

To identify the dominant and subcultural dimensions of the firms the respondents were asked to rate the culture of their organisations based on statements from the Organisational Culture Assessment Instrument on a five point likert scale. A scale of 1-5 was assigned with the highest score of 5 being assigned to strongly agree. The overall cultural profile of organisations was derived by computing the mean scores of all respondents. Coefficient of reliability (Cronbach alpha) was computed for each of the different culture types (Clan 0.804, Adhocracy 0.744, Marketing, 0.768 and Hierarchical 0.793).

Table 1. Descriptive Statistics of the culture types

	DOMINANT CULTURE				SUB-CULTURE			
	CL	AD	MK	HR	CL	AD	MK	HR
Dominant	2.65	3.37	2.68	3.40	2.67	3.41	2.67	3.37

Characteristics									
Organisational Leadership	4.43	4.18	4.21	4.32	4.41	4.21	4.23	4.35	
Management of Employees	3.68	3.34	3.65	3.84	3.69	3.33	3.65	3.91	
Organisational Glue	4.12	3.97	3.98	3.99	4.13	4.00	4.00	4.00	
Strategic Emphasis	4.25	3.78	4.23	3.85	4.24	4.24	3.79	3.86	
Criteria for Success	4.25	4.05	3.62	4.01	4.29	4.29	4.09	4.03	
Grand Mean	3.89	3.78	3.73	3.90	3.91	3.81	3.75	3.92	

CL= Clan, AD= Adhocracy, MK= Marketing, HR= Hierarchical

Table 1 shows the descriptive statistics of the dominant and subcultural profile of construction firms in Nigeria. The findings reveal that the means range from 3.73 to 3.92 which is an indication that construction firms in Nigeria exhibit the characteristics of all the culture types based on the closeness of the mean. The descriptive statistics also revealed that there is no difference in the means of the dominant and subcultural profile of construction organisations. Both have the hierarchical culture as the strongest with a mean of 3.89 as the dominant culture and 3.92 as the subcultural profile. Next is the adhocracy culture with a mean of 3.78 for the dominant culture and the clan culture with a mean of 3.91 for the subcultures. The findings are similar to the findings by (Oney-Yacizi, Gritili, Topcuoraz & Acar, 2007) whose findings revealed the dominance of Clan and Hierarchical cultures the Turkish construction Industry.

Independent t test was conducted on the overall scores for each of the culture types to compare the statistical significance of the dominant and sub-cultural profile of construction firms in Nigeria, the results are presented in table 2.

Table 2: Independent t test

Characteristics	Clan	Adhocracy	Marketing	Hierarchical
Culture type				
Dominant	3.43	4.12	4.13	4.33
Subcultural	3.45	4.15	4.01	4.23
t value	3.333	0.799	1.132	4.367
Size of Organisation				
Medium	4.41	3.33	3.84	3.88
Large	4.43	3.67	3.65	4.01
f Value	7.022	4.761	1.928	9.433

Years of operation				
1-10	3.98	4.12	2.65	3.40
11-20	4.23	4.25	2.67	3.65
21-30	4.26	4.13	2.89	3.75
f Value	8.401	4.103	1.637	9.107

DISCUSSION AND FINDINGS

The findings revealed that construction firms exhibit the characteristics of all the culture types based on the findings of the four culture types and can be interpreted to mean that the firms are of mixed culture types though the hierarchical culture is the strongest culture type in both the dominant and subcultural profile. The t value scores for the hierarchical culture is the strongest with a t value of 4.367 while the clan culture has a t value of 3.333. this implies that the hierarchical and the clan culture are both significant at $p \leq 0.01$.

Analysis of Variance (ANOVA) test was conducted to compare the Cultural difference by size of firm and the number of years in operation. The Post hoc Scheffe test was conducted identify significant differences among subgroups. The result of Organisational culture by firm size (Large and Medium) revealed that three of the culture types i.e. Clan, Adhocracy, and Hierarchical are all significant at $P \leq 0.001$, while the marketing is significant at $P \leq 0.005$. The result of the marketing culture was higher for medium sized firms, the Clan, Adhocracy and Hierarchical culture types were higher for larger firms. Large firms are characterized by several hierarchical levels, standardized procedures, bureaucratic control and limited flexibility. Only the Marketing culture had a higher loading on medium sized firms. The marketing culture is however not significant.

The test result also compared the means of the firms based on the number of years they have been in operation the result of the findings is also presented in table 3. The findings revealed that firms that are within the range of 1-10 have the lowest loadings on the four culture types, the Adhocracy culture is the only culture that has the highest loading on firms within 11-20 years of operation while the Clan, Marketing and Hierarchical culture have highest loadings on firms within the range of 21-30 years of operation. This finding is consistent with the findings of Greenwood and Brown (2013) whose findings revealed that firms in operation for over 20 years have over the years stabilized and attained a level where they can exhibit high level of stability and flexibility in addition to internal integration and external orientation which is the major characteristics of the four culture types. This further confirms the fact that organisational characteristics also shapes the cultural profile of the members of an organisation. The clan, adhocracy and hierarchical were significant at $p \leq 0.01$ while the marketing culture is not significant.

CONCLUSION AND RECOMMENDATION

This paper presents the findings of a questionnaire survey carried out in construction firms in the Federal capital territory Nigeria. with a view of comparing the dominant

and subcultural profile of construction firms. The paper acknowledges that the findings of this study shows the dominance of hierarchical culture type, in both the dominant and subculture. the findings of this study substantiate the idea of the concurrent coexistence more than one culture types in construction organisations based on the closeness of the means of the Organisational Cultures. Such combination of cultures is consistent with the findings of previous studies on the composition of organisational culture (Zu et al, 2010; Nukik et al, 2106). In the context of co-existence of cultures as found in this study, the previous research on organisational culture suggests that organisations are unlikely to reflect only one culture type (Valmohamadi &Roshamir, 2015) and that to be effective, the adoption of some elements of each of the four ideal culture types (clan, adhocracy, marketing and hierarchical) is necessary. Therefore, a favorable mix of characteristics of organisational culture is desired, that not only meets the competing demands of change and stability but also provides enough flexibility to accommodate innovation and growth (Prajogo and McDermott, 2005). Nevertheless, the dominant culture will have an extensive impact on the character, behavior and performance of an organisation and ultimately this dominant culture is likely to be a major determinant of the success of improvement programme (Prajogo and McDermott (2005).

In this study, the data on organisational culture profile was collected only at each department/division or function that have subgroups of culture which are more homogenous within the department/division but are heterogeneous with respect to overall organisational culture because of the varied nature of their function. The findings.

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IMPORTANCE LEVEL OF ON-CAMPUS STUDENT HOUSING FACILITY SPACES: PERCEPTION OF POSTGRADUATE STUDENTS

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The level of importance students attach to the various spaces in on-campus SHF is not well known, as a result the managers of the SHFs are unable to appropriately prioritise them to reflect students' needs. The paper investigates students' perception about the level of importance of the spaces required in an on-campus student housing facility (SHF). A survey research approach was used for the study. The study is exploratory in nature; a post graduate SHF was purposefully selected and closed-ended questionnaire was administered to students who are registered members of the residence. Descriptive statistics was used to analyse the data. Spaces including; bathroom, laundry, kitchen, sleeping space, storage room, drying line area, parking space and study room were perceived to be more important than spaces such as; TV room, fitness area, salon, visitors lounge, balcony and summer hut. The study provides important information that could serve as a guide in the provision and management of SHFs. The study provides empirical information that could serve as a guide for the provision and management of SHF spaces for both property investors and university maintenance/facility/hostel managers.

Keywords: On-campus, South Africa, Student housing facilities, University.

INTRODUCTION

The physical facilities required in universities are wide ranging and will vary from one institution to the other depending on the requirements of the courses offered. Generally, the range of the physical facilities of a university may include but not limited to; administrative buildings, offices, library, lecture theatres, laboratories, workshops, student housing and staff accommodation, refectories, sports fields and other support facilities (Gruber, Fuß, Voss & Gläser-Zikuda, 2010; and Olanrewaju, Khamidi & Arazi, 2010a). A SHF is one of the facilities which play a critical support role towards the provision of a quality higher education. SHFs are developed in different forms; they could be developed in the form of dormitories, apartments, residential halls, student village, flats or studios (Department of Higher Education and Training, 2011; and Fields, 2011).

The configuration of rooms in SHFs differ as well; Bella-Omunagbe (2015) indicated that SHFs could be either a unit of an en suite single room or units of multiple single rooms in shared apartments or shared rooms with shared amenities. Furthermore, universities SHFs could be found either on the campus or outside; owned and managed by the university or by a private entity or by a partnership arrangement. On-

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campus SHFs provide students with accommodation within the boundaries of the university. The influence of on-campus SHFs on the well-being and learning experience of university students has been a topic of interest for researchers and universities for decades (Popelka, 1994; Khozaei, Hassan & Khozaei, 2001; and Rinn, 2004). Researchers have discovered that SHFs have significant impacts on students (Blimling, 1999; and Cross, Zimmerman & O'Grady, 2009). For instance, Lanasa, Olsen and Alleman, (2007) and Araujo and Murray, (2010) argue that apart from classroom or classroom-related activities', SHFs might influence the behaviour, growth and study performance of students. Furthermore, SHFs could: enhance the integration of students, who might otherwise find it difficult to integrate in big cities or big institutions; promote diversity and foster unity; provide an environment that stimulates intellectual development by allowing for easy interaction with fellow peers; make students see studying as their main occupation and also provide a community setting (Banning and Kuk, 2011; Department of Higher Education and Training, 2011). Although quite a number of studies on SHFs in the broader scope has been conducted (Hassanain 2008; Cross, Zimmerman & O'Grady, 2009; Araujo & Murray, 2010; Bondinuba, Nimako & Karley, 2013, Nimako & Bondinuba, 2013; Abubakar, Kasim & Mamman, 2015; Bella-Omunagbe, 2015), studies which primarily focuses on the on-campus SHFs spaces requirements from the perspective of students is quite lacking. In fact, there is a dearth of research on SHF spaces in the South African context. However, it can be argued that developers and facility managers would be well positioned to prioritise the delivery and management of the spaces to reflect the needs of students if the importance levels of the SHF spaces are known. Thus, the aim of the paper is to determine the level of importance students attach to the spaces required in an on-campus SHF.

STUDENT HOUSING FACILITY SPACES

The requirements of the general residential housing are often applied to student housing (Najib, Yusof & Osman, 2011a; Bella-Omunagba, 2015); however Najib, Yusof & Osman (2011b) contend that SHFs are different from residential housing in that they do not offer the same level of ownership and freedom as residential housing. Additionally, the spaces required in SHF will vary somewhat from residential housing. Amole (2009) stated that SHFs are unique in the sense that they are a major form of accommodation for tertiary education students; they have very peculiar characteristics; and the campus environment is regarded as the setting of SHFs rather than the urban setting. Additionally, the learning experience students derive from their housing makes the SHF peculiar (Bondinuba et al., 2013). Fields (2011) defines a SHF as an accommodation specifically constructed to create an environment that supports the living and learning experience of students while pursuing their education. Thus, SHFs must be well resourced with all the amenities, i.e. the facility services and spaces, which would both promote students learning and support their living experience. This paper concentrates on the SHF spaces only.

With respects to the spaces required in a SHF, few studies highlight spaces that students require in a SHF. A typical example is a study conducted in Malaysia by Najib et al., (2011a), titled "student residential satisfaction in research universities". The aspects of SHFs spaces studied were study-bedrooms, washrooms (i.e., bathrooms and laundry rooms), pantry, leisure rooms (i.e., study areas, computer centers, television lounges, meeting rooms and a 'musalla' or prayer room for Muslims) and other support areas (i.e., parking lots, cafeterias). Other studies which highlight SHF spaces include: Koch, Wesse and Stickney (1999), Torres-Antonini and Park (2008),

Abrahamson (2009), Amole (2009), Najib, et al. (2011a:200-212), Najib, et al. (2011b: 52-60) Bondinuba et al. (2013), Nimako and Bondinuba (2013), Abubakar et al. (2015). A summary of SHF spaces from the aforementioned authors (literature) is provided in the Table below.

Table 1: SHF spaces (Authors' construction)

Najib, et al. (2011a:), and Najib, et al. (2011b)	Abubakar et al., (2015)	Bondinuba et al. (2013), and Nimako and Bondinuba (2013)	Koch, et al.(1999)	Torres, et al. (2008)	Abrahamson (2009)
Study-bedrooms	Study bedroom	Bed room	Sleeping room	Laundry room	Parking space
Washroom	Toilet	Bath room	Washroom	Kitchen	Sleeping room
Laundry rooms	Bathroom	Toilet facility	Pantry	Sleeping room	Washroom
Pantry	Study area	Kitchen facility	Recreation room	Study room	Laundry room
Study areas	Mosque	Entertainment area	Parking lot	Television room	Kitchen
Computer centers	Parking	Reading room	Cafeteria	Washroom	Study room
T.V lounges	Sports facility	Garage facility		Parking space	Television room
Meeting rooms	Cafeteria				Cafeteria
Prayer room	Mini mart				
Parking lots	Laundry facility				
Cafeteria	Pantry/kitchen				
Mini mart					

The spaces used in this study are drawn from the above listed spaces. Other spaces are also included to the list of spaces used for this study. Thus, the spaces included in the questionnaire for this study are: sleeping space, washroom (toilet & bath), kitchen, laundry area, drying line area, TV room, storage room, parking space, conference

room, balcony, salon, dinning, visitors lounge, library, computer room, study area, summer hut, sports/fitness area, prayer room and cafeteria.

In terms of the level of importance attached to the SHF spaces; the study of Koch, Wesse and Stickney (1999) and Olujimi and Bello (2009) revealed that students perceived kitchens, bathrooms, sleeping spaces and study lounges to be more important. In addition, Torres-Antonini and Park (2008), Abrahamson (2009) and Khozaei et al. (2010) highlight communal spaces such as kitchens, study rooms, television rooms and laundry rooms as essential spaces in a SHF. Coincidentally, in most SHF satisfaction studies, bathrooms, study rooms and kitchens are the main spaces that students generally express dissatisfied with (Blimling, 1999; Cross et al., 2009, Araujo and Murray, 2010; Bondinuba et al., 2013; and Nimako & Bondinuba, 2013). This suggests that students place high importance on these spaces (i.e. bathrooms, sleeping spaces, study rooms, laundry areas and kitchens), probably because of the direct effect they have on their living and learning experience. Consequently, they get disappointed (i.e. dissatisfied) if these spaces do not perform to their expectations. This also implies that students would be very dissatisfied with their SHFs if these spaces are not provided.

RESEARCH METHODOLOGY

This is an exploratory study based on one post graduate SHF. The research strategy employed is a survey. Data was collected quantitatively by means of a questionnaire; closed-ended questionnaire was administered to all the students who were registered members of the post graduate SHF. The total number of registered students was provided by the residence manager as 71. Thus, a total of 71 questionnaires were distributed, out of which 31 representing a response rate of 43.6% were duly completed and returned. While the questionnaires were distributed the researchers observed the SHF. A dichotomy scale ('Yes' or 'No') was used to determine the spaces that were provided in the SHF. On the other hand, a 5- point Likert type scale was used to determine the level of importance students attach to the various spaces used in the survey; the scale read as follows, 1 = Not relevant, 2 = Unimportant, 3 = Somewhat important, 4 = Important, and 5=Very important. Considering the five points Likert scale of measurement adopted for this study, 1 was subtracted from 5 which equals 4. After that, the 4 was divided by 5 which equals 0.8. Thus, the difference between values is 0.8. See Table 2 for the ranges and interpretations. The data was statistically analysed using the Statistical Package for Social Sciences (SPSS); only descriptive statistics was used.

Table 2: Interpretation of the Likert scale measurement

Mean score value range	Interpretation
$> 4.20 \leq 5.00$	Very important
$> 3.40 \leq 4.20$	Important
$> 2.60 \leq 3.40$	Somewhat important
$> 1.80 \leq 2.60$	Unimportant
$> 1.00 \leq 1.08$	Not relevant

FINDINGS

Profile of respondent

Table 3 indicates that 74.2% (23) are male and 25.8% (8) are female. 54.8% (17) of the respondents are Masters students and 45.2% (14) are PhD students. 22.6% (7) of the students have been living in the hostel for about 1year, 32.3% (10) for 2 years, 19.4% (6) for 3 years, 12.9 % (4) for 4 years and 12.9% (4) for 5 years. In essence, about 77% of the respondents have stayed in the SHF for at least two years. This gives indication that majority of the respondents have a good understanding of the SHF spaces that have high level of importance and those that have less level of importance on their living and learning experience.

Table 3: Profile of participants

Profile of respondents	N	%
Gender		
Male	23	74.2
Female	8	25.8
Total	31	100
Level		
Masters	17	54.8
PhD.	14	45.2
Total	31	100
Year		
1 yr	7	22.6
2yrs	10	32.3
3yrs	6	19.4
4yrs	4	12.9
5yrs	4	12.9
Total	31	100

Spaces available in the SHF

Table 4 shows the spaces perceived by students to be available in the SHF. It is evident from the percentages recorded that sleeping space, washroom (toilet and bath), kitchen, laundry area, drying line area, TV room, storage room, parking space and dinning were available in the SHF. Furthermore, the findings show that 21(67.7%) students indicated that a conference room was available while 10(32.3%) perceived it as unavailable. It was, however, observed that there is a conference room on the ground floor of the SHF. It is possible that some of the new students are unaware of the conference room; hence, indicated that there is no conference room. Similarly, in

the case of the visitors lounge, 10(32.3%) students indicated that this space was available while 21(67.7%) indicated otherwise. It is possible that some of the students mistook the reception space which is at the entrance of the SHF for a visitors lounge. From the percentages obtained, it is evident that library, computer room, study area, cafeteria, prayer room, summer hut and sports/fitness area are unavailable in the SHF. It is important to note that although there was no cafeteria in the SHF, there was a nearby SHF which had a cafeteria. Similarly, there was a library, IT centre, chapel and a gym on campus which students could utilise. However, it is quite surprising that as many as 5 students indicated that balcony and a salon are available in the SHF. It was observed that there were corridors in the SHF; perhaps the 5 students mistook the corridor for a balcony. No possible explanation can be provided for the 5 students who indicated that there is a salon in the SHF.

Table 4: Spaces available in the SHF

Spaces	Yes		No	
	N	%	N	%
Sleeping space	31	100	0	0
Washroom (toilet & bath)	31	100	0	0
Kitchen	30	96.8	1	3.2
Laundry area	30	96.8	1	3.2
Drying line area	27	87.1	4	12.9
TV room	29	93.5	2	6.5
Storage room	30	96.8	1	3.2
Parking space	28	90.3	3	9.7
Conference room	21	67.7	10	32.3
Balcony	5	16.1	26	83.9
Salon	5	16.1	26	83.9
Dinning	24	77.4	7	22.6
Visitors lounge	10	32.3	21	67.7
Library	0	0	31	100
Cafeteria	3	9.7	28	90.3
Computer room	3	9.7	28	90.3
Study area	0	0	31	100
Summer hut	1	3.2	30	96.8
Sports/fitness area	1	3.2	30	96.8
Prayer room	0	0	30	96.8

Importance level of spaces

Table 5 shows how students rated the importance of the SHF spaces. The mean scores obtained were in the range of 4.96 (highest) and 2.41 (lowest). With the exception of balcony (2.87) and summer hut (2.41), all the other spaces obtained a mean score higher than 3.0. Ten spaces (bathroom, laundry area, kitchen, sleeping space, storage room, drying line area, parking space, study area, dinning and computer room) received a mean score of at least 4.00. Thus, students perceived all these spaces to be 'important'. While students perceived these spaces as 'important', the study shows that study room and computer room are not provided in the SHF. Furthermore, more than 90% of the students rated washroom, laundry area, kitchen and sleeping space as 'very important'; this is an indication that these spaces are very important for the living and learning experience of students. In fact, all these spaces were provided in the SHF. Further to this, the finding shows that washroom, laundry area, kitchen, sleeping space, storage room, drying line area and parking space are the most important spaces to students. All these spaces were provided in the SHF. Other spaces which were rated as important include: conference room, library, cafeteria, TV room and sports/fitness area.

Table 5: Importance level of spaces

Spaces	Yes		No	
	N	%	N	%
Sleeping space	31	100	0	0
Washroom (toilet &bath)	31	100	0	0
Kitchen	30	96.8	1	3.2
Laundry area	30	96.8	1	3.2
Drying line area	27	87.1	4	12.9
TV room	29	93.5	2	6.5
Storage room	30	96.8	1	3.2
Parking space	28	90.3	3	9.7
Conference room	21	67.7	10	32.3
Balcony	5	16.1	26	83.9
Salon	5	16.1	26	83.9
Dinning	24	77.4	7	22.6
Visitors lounge	10	32.3	21	67.7
Library	0	0	31	100
Cafeteria	3	9.7	28	90.3
Computer room	3	9.7	28	90.3
Study area	0	0	31	100
Summer hut	1	3.2	30	96.8

Sports/fitness area	1	3.2	30	96.8
Prayer room	0	0	30	96.8

Summer hut was the only space perceived as ‘unimportant’, whilst, prayer room, salon, visitors lounge and balcony were rated ‘somewhat important’. Thus, the findings indicate that all the spaces except (summer hut, prayer room, salon, visitors lounge and balcony) are important spaces that should be provided in a SHF. It is quite revealing that all the spaces rated as ‘unimportant’ and ‘quite important’ are not provided in the SHF. Studies on SHF spaces support that washrooms (toilet and bathe), laundry areas, kitchens, study rooms, sleeping spaces are very important for students living and learning experience (Koch et al., 1999; Torres-Antonini & Park, 2008; Abrahamson, 2009; Olujimi & Bello, 2009; and Khozaei et al., 2010). In addition, students generally express dissatisfaction with their SHFs if these spaces are not adequately provided (Blimling, 1999; Cross et al., 2009, Araujo and Murray, 2010; Bondinuba et al., 2013; and Nimako & Bondinuba, 2013). Thus, it is paramount that facility managers make every effort to ensure that these SHF spaces are well managed. Similarly, developers and university management ought to ensure that these space are provided when constructing SHFs.

CONCLUSIONS

One of the challenges of developers and facility managers is to provide and manage a facility to meet the genuine requirements of customers. SHFs are one of the most important facilities for students. Thus, it becomes important that the spaces required in this facility are appropriately provided and prioritised to meet students’ expectations without compromising value. The study sort to investigate students’ perception about the level of importance of the spaces required in an on-campus student housing SHF. It is evident that students have different perception about the importance level of the spaces required in a SHF. The majority of the SHF spaces were perceived as important. Very few of these spaces are perceived to be ‘unimportant’. At a minimum all SHFs should provide all the spaces – sleeping space, washroom (toilet & bath), laundry (drying lines), study area, kitchen, and car park – that are deemed to be critical for both the learning and living experiences of students.

Limitations

Data obtained for the study is confined to a postgraduate SHF of a University in the Western Cape province of South Africa. Therefore this may limit the representation of other SHFs in the country.

RECOMMENDATIONS

The following recommendations are made.

At a minimum, SHFs should be provided with all the ‘very important’ spaces such as washroom, laundry area, kitchen and sleeping space.

SHFs which do not have these ‘very important’ spaces should be upgraded.

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A STUDY OF CONSTRUCTION WORKERS MOTIVATION IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

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The issue of construction workers motivation becomes a subject of debate among construction project management professionals. Construction workers mostly work long hours in relatively disagreeable environments, far from their families. Most of the activities are done under difficult conditions including harsh weather conditions, and, to make it attractive, employees should be motivated to carry out different activities. The aim of this study is to identify and offer recommendations on ways to address the demotivating factors that affect construction workers in the Nelson Mandela Bay Metropole, South Africa with a view to enhancing better performance, which will, in turn, will lead to higher productivity. A quantitative research approach was employed to analyse data using a questionnaire to the construction workers which included bricklayers, plumbers, concrete workers, electricians, carpenters, and professionals. The findings revealed that motivational communication, rather than functional communication, would enhance worker productivity. It was found that both intrinsic and extrinsic rewards are needed to improve worker productivity. The study therefore concludes that motivational techniques are necessary to improve construction workers productivity on a construction site. It is recommended that organisations patronise motivation by awarding financial reward such as incentives, bonuses and promotions to motivate their workers to achieve higher levels of productivity.

Keywords: Demotivation, Employee, Motivation, Productivity, Workers

INTRODUCTION

The motivation of construction workers is one of the major factors that trigger productivity in the construction industry. It was seen that motivation is one of the key to improved productivity, rewards for diligent and growth of business. It aids in boosting the morale of employees in the construction industry and in turn, serves as compensation for the effort put to work (Barg, Ruparathna, Mendis, & Hewage, 2014). The construction industry is an important sector of the national economy for countries all around the world, as traditionally it takes up a large portion in the nation's total employment and its significant contribution to a nation's revenue as a whole (Attar, Gupta & Desai, 2012). It also provides employment opportunities to the nation and this is evident in the 2015 South African statistical report on employment which showed that there is a significant increase in the number of the employers from 1280 in 2014 to 1,460 in the construction industry (Statistics South African, 2015).

Employees who are motivated to assist in fulfilling the goal of the employer should be recognised with rewards or incentives. In order to consider the kind of rewards or incentives to use, two kinds can be considered, intrinsic and extrinsic. Extrinsic rewards are external rewards which happen separately from work, such as material

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things and money. On the other side, intrinsic rewards are inner rewards that a person should receive when doing a job, in as much that there is an immediate and direct connection between rewards and work (Cox, Issa & Frey, 2006). Although, The South African construction businesses reward their workers extrinsically in monetary terms, it has been proved that money is not always the best motivator (Robbins, Odendaal & Roodt, 2006).

South African industries neglect intrinsic rewards systems, which may motivate employees to greater productivity. Motivation is significant to the success of achieving the best benefit of skilled workers' performance in a team-based environment. There has been a good effort among researchers in distinguishing the influential drivers in the domain of motivation. (Doloi, 2007). However, the application of motivation in the construction industry is useful for effective workforce towards meeting organisational goals (Afuye & Munala, 2016). The construction industry in Sub-Saharan Africa has numerous aspects to other parts of the world. Physically speaking, building construction places a high request on construction workers as it is mainly in hard labour, these workers are opened to harsh weather conditions; motivation constructions are poor and the working environment conditions are dangerous (Alinaitwe, Mwakali & Hansson, 2007). In addition, motivating the workers is significant to attain labour productivity and achieving the nation's development goals.

LITERATURE REVIEW

The South African construction industry is still developing to measure up with the practices of the developed nations. The South African construction industry has not made use of all right ways to personalise motivation properly in order to improve the desired result (Ndiokubwayo, 2014). The awareness of the need for workers' motivation is the ultimate for construction workers performance. The motivation of construction industry workers is indeed of significance to the drive for improved productivity. However, motivating the workers is very importance because the essence of human attainment at the workplace relies predominately upon motivation ((Kazaz, Manisali & Ulubeyli, 2008).

Motivation has been defined as “providing a drive to act in satisfying needs or desires” (Cox; Issa, M. ASCE; & Ahrens, 2005). It was reported by various scholars ever since nineteenth Century that, motivation is one of the leading force that people use to attain their needs (Wang, Ardit, M. ASCE & Damci, 2016).

The motivational concept has been described by different motivational theories. The diverse narrative about motivation is considered to be the driving force behind human behaviour and they depend on code switch to each other to a greater or lesser extent. However, there seems to be a common union, informing that the level of reward is often linked to motivation and may produce a positive outcome, or the avoidance of a negative outcome Hollyforde & Whiddett cited by (Asad & Dainty, 2005).

The meaning of motivation is regarded as “the set of procedures that control the selections people make about their behaviours”. The motivation is a nonconcrete term. It imparts incentives that require a reply on part of somebody else so as to attain a defined goal. In commercial, motivation is not identical with salaries; money is a means for accommodating the economic wants of employee. The motivation is an inner healthy wish to exert effort without the external stimulus of money. The motivation is the ability of instructing the workers with an agreement of purpose and

upholding a continuing, melodious relationship among all employees. It is a power which inspires and endorses a readiness of all workers to collaborate with all member of the team. To uphold, it is to make and continue the climate which brings unity and balance to the whole work group where all the involved team members get the advantage – the entire industry Wilbert Scheer cited by (Thwala & Monese, 2008). In as much as the real motivation comes from the inner, by motivating others, the employer can do more rather than create good conditions that cause workers to improve their job readiness and eagerness. The construction industry has a serious part to play in growth of economic and development in the formal and informal sector of the South African economy (Thwala & Monese, 2008).

Alternatively, according to (Aiyetan & Olotuah, 2006), Herzberg's theory on motivation, the theory was considered as two categories in terms of person's needs: human needs to grow psychologically and animal needs to avoid pain. The theory differentiates between satisfaction and dissatisfaction. In relation to work, it contends that job satisfaction is not the opposite of job dissatisfaction, and the things that people find satisfying about their work are not always the opposite of the things that they find dissatisfying.

(Boeree, 2006) stated that Hertzberg identified factors which contribute to job satisfaction (motivating factors): achievement, recognition (for achievement), work itself, responsibility and advancement (Boeree, 2006). Besides, these factors stated that employee motivating factors, illustrate a person's relationship to what they do and their job content and, as motivators, lead to job satisfaction because they address a person's need for growth. According to this theory, it is the substance of the job which allows achievement of the growth goals, and therefore satisfaction. Lack of such factors does not in itself tend to lead to demotivation (Boeree, 2006).

Olabosipo, Ayodeji, & James, (2011) conducted a study which revealed that construction workers' motivation can be in the form of money, job security employee participation in various decision making roles, and presenting bonuses to employees. The South African construction industry is still developing to measure up with the practices of the developed nations. It has not adequately made use of all right ways to personal motivation properly to improve the desired result (Ndiokubwayo, 2014).

The motivation, particularly monetary rather than moral, has confirmed its influence on the productivity of workers, and the methods of motivating personnel to promote productivity have been validated using applications of different human relations theories of motivation. Over the years' research done had shown that there is a link between motivation and productivity in the construction industry (Khan, 1993; Kazaz, et al., 2008). Productivity is connected with workers motivations, while workers motivation is directly related to construction productivity (Kazaz et al, 2008). Besides, Kazaz et al, (2008) buttress (Parkin, Tutesigensi & Buyukalp, 2009) that construction workers can be more productive by using the right system of motivation.

RESEARCH METHODOLOGY

Collection of data was through primary source which were obtained for this study that was generated through the design of a structured closed ended questionnaire survey of quantitative approach. The questionnaire survey was conducted within Eastern Cape Province, Port Elizabeth, South Africa to the various levels of construction workers on different construction sites, namely, bricklayers, plumbers, concrete workers, electricians, carpenters, and professionals. This study is part of an investigation as an

integral part of an on-going research towards continuous construction workers motivation improvement in the South African construction industry. Through review of related literature, construction organisation motivation factors were explored and tested through a questionnaire survey. The population of the study include; both managerial staff (architects, builders, quantity surveyors, and engineers), non-managerial staffs (artisans, labourers, plumbers, electricians, carpenters, bricklayers), and contractors'. The questionnaire survey adopts "level of importance" on a five-point Likert scale where 1 = strongly disagree, 2 = Disagree 3 = Neutral, 4 = Agree and 5= strongly agree. Among the questionnaires distributed for the survey, 84.2% were retrieved, 15.8% were returned and invalid, and 84.2% valid questionnaires were analysed accordingly. Architects, builders, quantity surveyors, and engineers, artisans, labourers, plumbers, electricians, carpenter, bricklayer, and contractors are survey participants.

RESULTS

South African Construction Workers Motivation Level is Low.

On a scale of 1(strongly disagree) to 5 (strongly agree) rate the demotivating factors for Construction workers in the Nelson Mandela Bay Metropole, South Africa pertaining to financial and reward benefits in your organisation performance by addressing the following Statements.

Table 1: The demotivating factors for construction workers

Statement		Unsure	Strongly disagree-- Strongly agree				
			1	2	3	4	5
	The percentage increments of salary/wages are sufficient	U	1	2	3	4	5
	The frequency of salary/wages are sufficient	U	1	2	3	4	5
	The workers have no problem working extended working hours with little or no additional remuneration	U	1	2	3	4	5
	The contribution retirement schemes are adequate	U	1	2	3	4	5
	The payment of bonus/13th Cheque is enough compensation for work done through the year	U	1	2	3	4	5

	The payment of housing allowances are adequate	U	1	2	3	4	5
	The sick benefits for employees is sufficient	U	1	2	3	4	5

Table 2: Demotivating factors that affect Construction Workers in the Nelson Mandela Bay Metropole, South Africa

N	Valid	76	85	94	72	76	76	83
	Missing	25	16	7	29	25	25	18
Mean		2.99	2.98	3.05	2.83	2.92	2.20	3.36
Median		3.00	3.00	3.00	3.00	3.00	1.00	4.00
Std. Deviation		1.483	1.422	1.731	1.619	1.590	1.583	1.627
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

The statements in Table 1 and values in table 2 indicate what was posed to the respondents who showing the respondents were implored to respond by answering to (strongly disagree) to (strongly agree) rate the demotivating factors for Construction workers in the Nelson Mandela Bay Metropole, South Africa pertaining to financial and reward benefits in their organisation's performance. For the percentage increments of salary/wages are sufficient, it is clearly shown that the workers are demotivated as the mean value is 2.99, workers need more money or financial rewards for them to be motivated, some organisation do not take cognisance of these financial benefits, many workers life livelihood depends on these and some organisations do not make increment to their workers salary/wages. Also, for frequency of salary/wages are sufficient, this indicates that the worker's salary and wages is not often increase as shown from the mean score 2.98, this can demotivate workers, the trend at which some organisations pay their respective workers is not encouraging and is nothing to write about. For workers have no problem working extended working hours with little or no additional remuneration, this is evidently clear that when workers works more than the stipulated time they were moderately paid or fairly paid with the means score of 3.05, it should be that, the extended working hours being worked for, get more pay than the normal working hours. However, the contribution retirement schemes are adequate, the mean score 2.83 shown that the workers are not motivated since there is no assurance of their retirement scheme after working for years in their respectively organisations, no means of survival which should have been

lengthen their life span after retired from service. For the payment of bonus/13th Cheque is enough compensation for work done through the year, it is shown that compensation of works at the end of the year is not really in use with the mean score of 2.92, some organisations is not making use of it at all while some just give token to their workers as this can demotivate workers. Moreover, the payment of housing allowances are adequate, with the mean score of 2.20 it shows that there is low or no housing allowance for the workers, some workers needs housing allowance to make them put their minds on the task allocated for them but this is not available, as this can mar their productivity. For the sick benefits for employees is sufficient, with the mean score of 3.36 this indicated that the sick benefit is relatively made available for the workers, most organisation do make provision for this, but it seems not really adequate. This indicates that construction workers cherish their needs according to Maslow's Hierarchy of Needs (Cherry, 2011).

CONCLUSION AND RECOMMENDATIONS

Construction workers motivation is found to be important as this will enhance the performance of the workers. Nevertheless, higher motivation brings about higher productivity. The approach being used to motivate workers from various organisations are not the same for various sections of the construction industry. The organisations recognition with the construction workers motivation does not correlate with the significant of it to the organisations. It is recommended that organisations patronise motivation by awarding financial reward such as incentives, bonuses, and promotions to motivate their workers to achieve higher levels of productivity.

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MODELLING AND FORECASTING OF CONSTRUCTION COST: A LITERATURE REVIEW

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The efficient management of construction projects is a challenging task, mainly because of considerable uncertainties faced by construction professionals. One important source of this uncertainty is variation in construction cost, which fluctuates across different time periods. Also, construction cost is affected by changes in macro-economic environment. A reliable forecast of the future value of construction cost is a complex issue that is critical for making important operational decisions, such as the provision of contingency sum and contractor's bid price. In the study reported here, the existing literature on modelling and forecasting of construction costs were reviewed. It was found that economic factors are the principal driver of construction cost determination. The vast majority of previous studies focused on the application of econometric models to construction cost forecasting; however, the nonlinear modelling techniques (such as the neural network) provide accurate and reliable estimates of future construction cost. Finally, the areas for future research were discussed based upon the gaps identified in the existing literature. The findings of the current study may serve as a valuable platform for both construction professionals and researchers to appreciate the trends and gaps in the field of construction cost modelling and forecasting.

Keywords: construction cost, forecasting, modelling, system review, time series.

INTRODUCTION

The construction industry has been recognised as one of the main contributor to economic growth. Analysis of existing research shows that investments in construction projects and economic growth are positively related (Dang and Low, 2011). This has resulted into calls for increase in budgetary allocation to facilitate procurement of infrastructure projects (Anaman and Osei-Amponsah, 2007). However, infrastructure project often fails to meet its anticipated impact on the local economy. This observed occurrence could be attributed to poor performance of construction projects. For example, Lewis (1984) observed that an increase in infrastructure spending in Trinidad and Tobago due to surge in global oil prices led to wastage of economic resources (e.g. poor quality of works carried out and increase in construction cost). In addition, Abd El-Razek et al. (2008) identified that construction cost is one of the main causes of project performance. Thus, there is a need for models that can give reliable forecasts of construction costs. This would assist stakeholders to develop strategies for the minimization of construction cost.

A considerable amount of literature has been published on modelling and forecasting of construction costs. These studies are targeted at development of models for estimating changes in construction cost in the future. Generally, construction cost forecasting models are developed based on two main approaches: (1) models based on attributes of projects (see Aibinu et al., 2015) and (2) models based on time series

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approach (see Jiang et al., 2013). The reliability of construction cost forecast models would reduce the uncertainties associated with fluctuations in construction cost.

Several studies have produced models for construction cost forecasting (Akintoye and Skitmore, 1994; Wang and Ashuri, 2017), but no study has integrated the findings of disparate previous research into a whole. The purpose of this paper is to systematically review the existing studies on construction cost forecasting based on the time series approach. The findings of this study would provide answers to the following questions: (a) what are the methods for modelling and forecasting of construction cost and (b) what are the determinants of construction cost? Therefore, this study makes an important contribution to research on modelling and forecasting of construction cost by highlighting the trends and gaps in this area of construction economics

MODELLING TECHNIQUES FOR CONSTRUCTION COST FORECASTING: TIME-SERIES APPROACH

Several time-series models have been used for construction cost forecasting. In construction economics literature, the earliest work on this area was reported in Taylor and Bowen (1987). In Taylor and Bowen (1987), Classical Decomposition Method (CDM) and Box-Jenkins were used for construction cost forecasting. Bowen and Edwards (1985) suggested the need for a paradigm shift in construction cost modelling research. The application of artificial intelligence techniques was recommended. The modelling techniques used for construction modelling can be classified into four broad categories namely: econometric, artificial intelligence, hybrid models, and grey box. Detailed discussion on classification of modelling techniques used for forecasting can be found in Weron (2014).

Econometric modelling techniques

These are models which are estimated based on the functional relationship between the dependent and independent variables. This class of models can further be subdivided into univariate and multivariate models. Univariate models are used to predict future values of construction costs based on information contained in its previous values. The main assumption for univariate model is that the existing pattern in the time series data would not change over time (Blair et al., 1993). In contrast, multivariate models estimate future values of construction cost using information contained in the relationship between construction cost and its determinants (i.e. predictors). Blair et al. (1993) affirms that the main challenge with multivariate techniques relate to the identification of statistically significant predictors.

The econometric modelling techniques applied in previous studies on construction cost forecasting include: CDM, BJ, Regression, Exponential smoothing (ES), Neural Network (NN), Categorical regression (C-Regression), Linear regression (L-regression), Dynamic regression (D-regression), Holt-Winters exponential smoothing (HW-ES), Holt exponential smoothing (H-ES), Simple moving average (SMA), Seasonal autoregressive integrated moving-average (S-ARIMA), Autoregressive moving average (ARMA), Autoregressive (AR), Vector autoregressive (VAR), Vector error correction (VEC), Vector error correction with dummy variable (VECD), Cointegrated vector auto-regression (CVAR) and Generalized autoregressive conditional heteroskedasticity (GARCH). For details on the process of applying econometric models, interest readers can get additional information in (Hyndman and Athanasopoulos, 2014).

Artificial intelligence modelling techniques

Econometric models are linear; however, evidence from previous research shows that real world data are non-linear (see Goh, 1998; Cortez et al., 2009). Hence, econometric models may be able to capture the non-linearity present in real world data. This could be responsible for the improved performance of artificial intelligence models when compared to econometric models (see Wang and Ashuri, 2017).

Artificial intelligence techniques learn from data and trained model can be used for forecasting tasks. Artificial intelligence modelling techniques found in construction cost forecasting literature are: neural network, k-Nearest Neighbour (k-NN) and Perfect Random Tree Ensembles (PRTE).

Hybrid modelling techniques

Hybrid models are a combination of two or more modelling techniques. Hence, hybrid models harness the strengths of the models that are combined together. Shukla et al. (2010) asserts that hybrid models have additional capability which may improve the accuracy of forecasts generated by such models. A typical example of hybrid models in construction economic literature is the genetic algorithm-neural network (GA-NN) which was applied in (Goh, 2000). In the GA-NN, the genetic algorithm was used to optimize the parameters of the NN model. Examples of hybrid models used in construction cost forecasting research are Integrated regression (I-regression) and Self-adaptive structural radial basis neural network intelligence machine (SSRIM).

Grey box modelling technique

Grey box models are based on Grey systems theory (Liu and Lin, 2006). This class of model technique is particularly well suited for situations where the information available for developing models are incomplete. Interested readers can get additional information about grey box models from relevant materials (see Liu and Lin, 2006; Ho, 2013).

RESEARCH METHOD

A variety of methods are used to review and analyse existing published works focused on a research problem. Each has its advantages and drawbacks. Systematic review of literature offers an effective way of integrating previous studies into an organised whole. The main advantage of this approach is that its findings are replicable. Booth (2006) recommended that information on STARLITE (STARLITE represents Sampling strategy, Type of study, Approaches, Range of years, Limits, Inclusion and Exclusions - terms used and electronic source) should be provided in studies that adopted the use of systematic review. This would improve the quality of research (i.e. rigor) and replicability of its findings. Hence, the approach used in this study is similar to methods used in previous published systematic review studies (Kokkonen and Alin, 2015). This review is exclusively based on empirical studies on construction cost forecasting that have been published in peer-reviewed journals. Thus, conference papers, editors' notes and unpublished research studies are excluded.

To generate the sample for the study, the search for relevant works was carried out in two phases. First, a comprehensive search was conducted using the SCOPUS database. At the second stage, additional search was carried out in the database of selected journal. The search covers the following journals: Construction Management and Economics, Journal of Management in Engineering, Journal of Construction

Engineering and Management, and Engineering Construction and Architectural Management. The keywords and number of papers found during the SCOPUS search are presented in Table 1.

Table 1: Keywords used in the SCOPUS database search

Keyword	Number of papers found
"cost index" AND "forecast"	57
"tender price index" AND "forecast"	8
"cost index" AND "predict"	93
"tender price index" AND "predict"	8
"cost" AND "index" AND "construction" AND "forecast"	97
Total	263

Despite these search criteria, the results from the SCOPUS search included some irrelevant papers. After initial filtering, 43 relevant papers were identified. At the end of the second search, additional 56 papers were identified. Second stage of filtering was carried out to exclude publications classified as "book reviews", "editorial", "editor's notes", "letter to the editor" and "article in press". Also, duplicates from both searches were removed. At the end of the search process, a total of 22 articles with relevant content were selected for further analysis.

RESULTS

Holistic view of construction cost forecasting papers published in academic journals

The search through SCOPUS and selected journal databases yield 22 papers. The earliest paper amongst those selected for this review was published in 1987. The number of relevant papers published per year is presented in Table 2. Despite the evident importance of construction cost forecasting, the number of published studies have been relatively low. Three papers were published in 2013, which is the highest number of papers published in a single year. The low number of publication could be due to the unavailability of quantitative data for time series modelling (K'Akumu, 2007). In addition, 7 journals published construction cost forecasting papers. 3 journals published two or more papers over the study period (Table 3).

Table 2: The distribution of the number of relevant papers published annually

Year	Number of papers found
1987	1
1991	1
1993	1
1994	2
1998	1
2000	1
2004	1
2009	1
2010	2
2011	2
2012	1
2013	3
2014	1
2015	2
2017	2

Table 3: Journals that published the selected papers

Journal title	Number of papers found
Journal of Construction Engineering and Management	9
Construction Management and Economics	7
Journal of Management in Engineering	2
International Journal of Construction Education and Research	1
Journal of the Operational Research Society	1
Canadian Journal of Civil Engineering	1
Construction Economics and Building	1

Construction cost modelling and forecasting techniques

The need to identify reliable methods for construction cost forecasting has led to the application of several modelling techniques to this problem. The modelling techniques used for construction cost forecasting in previous research are presented in Table 4. Based on the classification of forecasting techniques presented in the preceding section, econometric models are the mostly used techniques for construction cost. Regression-based techniques are the most commonly used method for modelling and forecasting of construction cost. The percentage usage of econometric, artificial intelligence, hybrid and grey box models to construction cost forecasting are 87.9%, 6.9%, 3.5% and 1.7, respectively.

Table 4: Summary of previous studies on construction cost modelling and forecasting

S/N	Study	Forecasting technique(s)	Class of model	Class of technique
1	Taylor and Bowen (1987)	CDM	Univariate	Econometric
		Box-Jenkins	Univariate	Econometric
2	Fellows (1991)	Regression	Multivariate	Econometric
		Box-Jenkins	Univariate	Econometric
3	Blair et al. (1993)	ES	Univariate	Econometric
		Box-Jenkins	Univariate	Econometric
		Regression	Multivariate	Econometric
4	Akintoye and Skitmore (1994)	Regression	Multivariate	Econometric
5	Williams (1994)	ES	Univariate	Econometric
		Regression	Multivariate	Econometric
		Neural network	Multivariate	Artificial intelligence
6	Wang and Mei (1998)	Regression	Univariate	Econometric
7	Goh and Teo (2000)	Box-Jenkins	Univariate	Econometric
8	Ng et al. (2004)	Regression	Multivariate	Econometric
		Box-Jenkins	Univariate	Econometric
		I-regression	Multivariate	Hybrid
9	Hwang (2009)	C-Regression	Multivariate	Econometric
		L-Regression	Multivariate	Econometric
		D-Regression	Multivariate	Econometric
10	Ashuri and Lu (2010)	HW-ES	Univariate	Econometric
		SMA	Univariate	Econometric
		H-ES	Univariate	Econometric
		Box-Jenkins	Univariate	Econometric
		S-ARIMA	Univariate	Econometric
11	Wong and Ng (2010)	VEC	Multivariate	Econometric
		Box-Jenkins	Univariate	Econometric
		Regression	Multivariate	Econometric
12	Hwang (2011)	Box-Jenkins	Univariate	Econometric
		ARMA	Univariate	Econometric
		VAR	Multivariate	Econometric
		HW-ES	Univariate	Econometric
13	Xu and Moon (2011)	CVAR	Multivariate	Econometric
		HW-ES	Univariate	Econometric
14	Ashuri et al. (2012)	VAR	Multivariate	Econometric
		AR	Univariate	Econometric

15	Ho (2013)	Grey Box	Univariate	Grey Box
16	Jiang et al. (2013)	VEC	Multivariate	Econometric
		VECD	Multivariate	Econometric
		Regression	Multivariate	Econometric
		Box-Jenkins	Univariate	Econometric
17	Shahandashti and Ashuri (2013)	VEC	Multivariate	Econometric
		S-ARIMA	Univariate	Econometric
		HW-ES	Univariate	Econometric
18	Cao et al. (2014)	SSRIM	Multivariate	Hybrid
		Box-Jenkins	Univariate	Econometric
19	Shahandashti and Ashuri (2015)	VEC	Multivariate	Econometric
		S-ARIMA	Univariate	Econometric
		HW-ES	Univariate	Econometric
20	Joukar and Nahmens (2015)	GARCH	Univariate	Econometric
		S-ARIMA	Univariate	Econometric
		HW-ES	Univariate	Econometric
21	Oshodi et al. (2017)	Box-Jenkins	Univariate	Econometric
		Neural Network	Univariate	Artificial intelligence
22	Wang and Ashuri (2017)	k-NN	Multivariate	Artificial intelligence
		PRTE	Multivariate	Artificial intelligence
		S-ARIMA	Univariate	Econometric
		Box-Jenkins	Univariate	Econometric
		VAR	Multivariate	Econometric

Determinants of construction cost

One of the objectives of the study was to identify the determinants of construction cost. The ability to understand and capture the relationship between construction cost and its determinants is vital for developing reliable models for construction cost forecasting (Blair et al., 1993). A list of the determinants of construction cost, which were identified from selected papers, are presented in Table 5. Twenty-three (23) determinants were identified from previous research. It is worth mentioning that these determinants are used as inputs in multivariate models. However, the inclusion of these variables in multivariate models does not always lead to improved forecasts (see Hwang, 2011). This could be attributed to poor selection of significant determinants and/or excessive fluctuation of construction cost over time. A critical look at the identified determinants show that the factors influencing construction costs are large economic.

Table 5: Determinants of construction cost

Determinant	Study number
Construction output/housing starts	[4, 5, 9, 11]
Union wage rate index	[3]
Architectural materials index	[3]
Construction new orders	[4]
Output per person (construction industry)	[4]
Building cost index	[4, 8, 11]
Working days lost by workers due to disputes	[4]
Number of registered private contractors	[4]
Dummy variable (Oil crisis)	[4]
Unemployment rate	[4, 8, 16]
Manufacturing output price/input cost ratio	[4]
Wholesale Price Index	[18]
Gross national product/Gross domestic product	[4, 11]
Producer Price Index	[22]
Interest rate	[4, 5, 8, 9, 16, 18]
Consumer price index	[8, 9, 12, 13, 22]
Money supply	[8, 14]
Hang Seng Index 100 Days Moving Average	[8]
Crude oil price	[14, 17, 18, 19]
National income	[16]
Population	[16]
Tokyo's Nikkei NK-225	[18]
Average hourly earnings	[19]

Accuracy comparisons

There have been several attempts made by researchers to compare two or more modelling techniques. The modelling techniques are used to estimate and generate out-of-sample forecasts of construction costs. The performance of forecasting models was compared in 18 studies (see Table 5). Econometric models provided the best forecast in 13 out of the 18 cases (representing 72.2%). However, it was observed that artificial intelligence models outperformed econometric models in all cases where both techniques were compared (see Williams, 1994; Oshodi et al., 2017; Wang and Ashuri, 2017). This clearly shows that artificial intelligences models, which are non-linear, tend to produce better forecasts. These results are consistent with recent studies indicating the superior performance of artificial intelligence models when applied to real world problems (see Hu et al., 2005; Wang et al., 2009; Tinoco et al., 2016).

Table 5: Comparison of forecast accuracy

Study	Forecasting techniques	Most accurate technique
1	Box-Jenkins and CDM	Box-Jenkins
2	Box-Jenkins and Regression	Box-Jenkins
3	Box-Jenkins, ES and Regression	ES
5	ES, Regression and Neural network	Neural network
8	Regression, Box-Jenkins and I-regression	I-regression
9	C-Regression, L-regression and D-regression	D-regression
10	Box-Jenkins, HW-ES, SMA, H-ES and S-ARIMA	H-ES
11	Box-Jenkins, Regression and VEC	VEC
12	ARMA, Box-Jenkins, HW-ES and VAR	ARMA
13	CVAR and HW-ES	CVAR
14	AR and VAR	VAR
16	Box-Jenkins, Regression, VEC and VECD	VECD
17	HW-ES, S-ARIMA and VEC	VEC
18	Box-Jenkins and SSRIM	SSRIM
19	HW-ES, S-ARIMA and VEC	VEC
20	GARCH, HW-ES and S-ARIMA	GARCH
21	Box-Jenkins and Neural Network	Neural Network
22	Box-Jenkins, k-NN, PRTE, S-ARIMA and VAR	PRTE

Paths for future research

Developing models for construction cost forecasting is a complex task. The findings of this study highlight the trends and gaps which exist in the current knowledge on construction cost modelling and forecasting. Forecasting research contributes to development of new and validation of existing theory (Shmueli and Koppius, 2011). Also, (Runeson, 2011) asserts that this class of research contribute to bridging the gap between theory and practice. As pointed out earlier in the paper, the number of studies focused on construction cost modelling and forecasting are few. Thus, it can be said that there is a need for more studies exploring the opportunities to fill the gaps in this area of construction economics. Based on the gaps identified in the existing literature, future research should be undertaken to address the following:

1. The large majority of studies have focused on the using economic variables as predictors of construction cost. This is largely based on the law of demand and supply. There is a need to explore and identify other relevant predictors of construction cost. For instance, it is known that the weather conditions could reduce the rate at which construction works are executed at construction site. This results into reduced construction investment which could lead to a decrease in the cost of construction. Therefore, there is a need to assess the impact of weather patterns on construction cost.
2. With the advancement in technology and computing power, new artificial intelligence techniques are becoming available for application to construction cost forecasting. Due to the superior predictive performance of artificial intelligence

techniques, there is a need to continue to explore the efficacy of applying artificial intelligence models to construction costs.

3. The selection of relevant predictors (i.e. determinants) for development of multivariate models is one of the main factors affecting the performance of such models. Also, the studies that have developed multivariate models for construction cost forecasting are relative few when compared to univariate models. Future studies need to identify the 'best' variable selection method for selecting predictors for models used to produce forecasts of construction cost.

CONCLUSION

Research of construction cost modelling and forecasting provides information required to develop strategies for mitigating construction cost. The main goal of the current study was to systematically review the existing studies focused on construction cost modelling and forecasting. Although several studies are found in literature, the existing studies focused on this problem are relatively few. The results of the study present the trends and gaps in the construction cost modelling and forecasting. The authors of this paper conducted a two-round of literature search in the databases of SCOPUS and selected journals. Based on the selection criteria, 22 published paper were selected to study trends, identify the patterns and propose directions for future research on construction cost forecasting.

It was found that regression-based models are the most applied technique for construction cost forecasting. Econometric methods are the most dominant class of models used for construction cost forecasting. In addition, the findings of the study revealed that interest rate is the most common determinant of construction cost. The determinants of construction cost vary from study to study. This suggests that the factors influencing construction costs may be unique for each country studied.

Three gaps were identified in the existing research. The gaps identified are: (1) low usage of artificial intelligence modelling techniques; (2) the overreliance of economic variables as predictors of construction costs; and (3) the need to identify the best predictors of construction cost. The results of this study are subject to certain limitations. For instance, the search for relevant studies was limited to papers published in English. Also, conferences and unpublished research were excluded from the study sample. Despite these limitations, the findings of this research offer valuable insights into the current state of the literature on construction cost modelling and forecasting. Greater efforts are needed to address the gaps identified in the current literature on construction cost modelling and forecasting.

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EFFECTIVE CONSTRUCTION PROJECT LEADERSHIP: IDENTIFYING KNOWLEDGE GAPS

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An evaluation of leadership literature reveals that the understanding of construction leadership is slightly original, however failing to consider the relatively mature developments of mainstream leadership concepts. It is also sharp to note that research in construction has not paid much attention to construction project leadership. This is due to the traditional focus of researchers on technical and managerial features of construction projects. Construction being a widely diverse industry packed with innovation and change. It is imperative to understand construction project leadership and possible leadership development factors. In this review, the greater challenges faced by the construction industry is noted. These include both industry-specific challenges and others within the operating environment of construction. In addition to these challenges, the rapid growth and development of the construction industry in many countries poses new leadership demands and trends. It is pertinent to note that the value of the study is the validation and importance of leadership development in the construction industry for sustainable effective construction. The construction industry could use this knowledge to help in identifying effective leadership factors for construction project leadership. Interesting and valuable findings have emerged from the study, and this study was limited to leadership in the construction industry. The study is conducted by critically reviewing literature of selected papers from well-known academic journals in construction, management and leadership. Above all other variables stated, it also argued that authentic leadership is a desirable factor in the construction industry, given the contemporary unethical circumstances; moreover, such leaders have greater potential to perform effectively and minimize the corruptive nature of the industry. In addition to ethics, leadership education and training is important to develop this type of leaders, review clearly outlined the importance of understanding technology as project leaders in the construction industry. The study presents a robust background in identifying a new research agenda in construction project management that embraces the human behavioral aspects, likewise the nature of projects will be important to determine the effective leadership factors relevant for construction project performance.

Keywords: Construction, leadership, qualities, sustainable, ethical, project management

INTRODUCTION

The Construction industry is a key sector in every country as it is heavily interrelated with the economy as a whole. It affects, and is affected by; the gross domestic product of a nation. Moreover, the construction industry is dependent on different types of input such as human capital, financing and outcomes from other industries. With increased emphasis on project management systems, construction firms are now seeking professionals with better management and leadership skills rather than technical skills (Dulaimi, 2005, and Burns, 2007). Additionally, educational institutions and construction firms continue to produce and develop managers lacking

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leadership skills. This is in light of the fact that some researchers note that the construction industry needs major changes in the way it operates today (Winch, 1998; Koskela and Vrijhoef, 2006).

The industry has focused on management, to the exclusion of leadership (Skipper and Bell, 2006). Thus, construction project managers are barely perceived as leaders and are mostly termed as managers (Russell and Stouffer, 2003). Their day-to-day work involves the management of activities and achievement of short-term goals of the project. But they have to accomplish the key performance indicators: on time, under budget, of specified quality. This conventional outlook on project management hinders them from behaving as leaders and uninspiring to the project team to perform better.

Bonasso (2010) advocated that this traditional system produces project managers who frequently do not see widely or deeply enough in the designs they produce, and ignore issues of values, ethics, succession planning leadership education and technological understanding. The reasons cited for this include: technically focused curricula in engineering education and training (Dulaimi, 2005; Arcila, 2006).

Owing to the reasons discussed above, the construction industry faces an undersupply of project leaders although it has produced a large number of project managers (Havenga, 2002). There is a need for leadership development in conventional managers in an industry which has received enormous impact from changes in the business environment at both the national and global levels (Jarad, 2012). Moreover, the developments include the formation of collaborative alliances and partnering relationships.

The present authors argue that the construction industry is in a new field of a challenging socio-economic, cultural, political, and business environment. In addition to this complex array of challenges, many recent commercial scandals and occurrences in management, furthermore unethical practice in the construction business world also call for a different breed of construction project leaders in addition to the technological advancing world. This paper is structured to conduct an extensive and precarious review of relevant literature on construction project leadership.

LITERATURE REVIEW

Leadership in the construction industry

If one word could describe the essence of construction management, it is responsibility. Thus, project and construction managers are responsible for all that happens in a project. This doesn't mean that the project manager should or could do everything associated with the project.

However, it does mean that they have ultimate responsibility for the project. In other words, the buck stops with the project manager. It is also evident that the construction industry has a greater need for leadership and management than arguably any other industry. Many reasons support this notion and it is evident in the nature of the construction projects, and constructed products (Daft, 2007). Research has shown that a good project manager is one of the most important success factors of projects (Odusami, 2002; Toor and Ogunlana, 2005; Long et al., 2004). Haynes and Love (2004) cite examples from earlier research and note that the site managers have an impact on the overall quality and cost of the project and the quality of the individual site manager may affect the project cost by up to 10% (Herbert et al., 1970).

Leadership development in the construction industry

Allen and Roberts (2011) asserted that leadership development is a endless, systemic process created to expand the capacities and awareness of individuals, groups, and organizations in an effort to meet shared goals and objectives. Hence, it is important to develop leadership in the construction industry. According to Toor and Ofori (2008), development of leadership in the construction industry is a trip which requires fixed attention. Moreover, leadership education and training is paramount in the construction industry (Jarad, 2012). Chan and Chan (2005) recommend that building professionals should promote the use of transformational leadership in their interactions with employees in the workplace for greater employee performance and satisfaction. Toor and Ogunlana (2006) observed that the attributes of transformational leaders were rated high as compared to those of transactional leaders. They also observed that the use of authority and punishment was rated among the lowest of leadership behaviors. The discussion so far reveals that there has been no general agreement on what leadership style best suits construction professionals and project managers. The reasons are clear: no one best leadership style can be considered to be the best in all circumstances and at all times (Fiedler, 1967; Vroom and Jago, 1988); context is important when it comes to measuring management knowledge (Chanlat, 1996), and effectiveness of leadership style (Fellows et al., 2003). Moreover, most of the identified leadership styles are self-centered, task-centered, relationship-centered, or change-centered. These styles do not tell if the effort behind the leadership is genuine, authentic, reliable, ethical, and truthful. Leaders can pretend, and put such styles on show for certain personal purposes. Therefore, there is need for a leadership to evolve around the leader development.

The Missing Link

When construction entities speak of their success, they rarely mention ethical consideration throughout the project, though ethics and authenticity has become a defining issue for the construction industry. Focused in part by regulatory pressure, ethics programs are gaining prominence within firms whose leadership have made it a priority (Price 2009, Keller, 2010). To date, little research has focused on ethical practices within the construction industry, though we know the costs of unethical behavior are significant. Unethical behavior inhibits healthy competition and impacts the financial bottom line and reputation of the industry. When one contractor takes shortcuts or performs work of poor quality, they put other contractors at a disadvantage, and betray the owner's trust. Moreover, Kotter (1990) stated that ethics start from the top.

He further stated that, factors like integrity, honesty, fairness and ethics are often a part of company culture in multi- generational firms, but as a company grows, it becomes more difficult to instill those values into the culture. Vecchio (2003) was of the view that leadership theories specific to entrepreneurship have yet to be empirically established; entrepreneurship is simply a manner of leadership that occurs in a specific setting, either inside or outside existing organizational operations (Kuratko 2007).

Moreover, because there is a lack of entrepreneurial understanding in most of the leadership development models, the focus has been put on sociological understanding alone (Moore, 2006). Additionally, in line with the gap identification (see table 1 below), the lack of mentorship for future leaders is evident. In addition, the importance of understanding ICT is vital.

Table 1: Detailed Gap identification for leadership in the construction industry

	REVIEWED	FINDINGS
Challenges facing construction projects in developing countries.	Ofori (2012), Othman (2013), Posner (2002), Jarad (2012), Cooper (2007), Songer et al (2006), Archer (2010), Murimi (2016)	Focuses on leadership challenges in a generalized form, not country specific. More emphasis is placed on cost and time overrun challenges but the leadership challenges causes are not outlined, such as ethical behaviour and not having a technological understanding.
Leadership factors in the construction industry	Chan (2010), Havenga (2002), Ofori (2011), Hagberg (2006), Bekker (2012), NDP-2030	The influence of culture and organizational climate was captured. The impact of the ICT understanding by project managers was not determined. More focus is on technical and management skills.
Leadership development frameworks in construction	Moten (2011), Simons (2017), Stouffer (2003), Odusami et al (2003), Langford (1999), Ofori and Toor (2011), Kaulio, (2008), McDermott (2011), Hindle (2013), CCL (2012), Ganson (2011)	Leadership development of construction leadership is ignored in universities and in education and training. Not much work has been done on ethical leadership development in the construction industry, with the exception of Avolio. Studies on leadership in the construction industry concentrate on investigating the motivational factors and the personal characteristics of project managers. A few studies actually focus on leadership development in construction. Kaulio suggested the CIT Method for construction project leadership. However, he developed the overall-project-leader-role framework. One size fits all models are evident, individual tailored approach should be looked at. South Africa Construction industry has been neglecting leadership the need to have structured frameworks for the SA CI is Eminent Hindle (2013). SL (sustainable Leadership) and AL (Authentic Leadership) for construction industry have been developed. Most construction frameworks lacked ethical leadership.

Table 2: The occurrence of different leadership factors in the existing leadership development frameworks

LEADERSHIP DEVELOPMENT FACTORS	Transacti onal	Technical Capacity	Successio n Planning	Technolog ical systems	Ethics
Fiedler Contingency Model (Fiedler, 1960)	X	X		-	-
Navy Leadership Framework (J.M Richardson, 2017)			X		
Authentic Leadership (Luthans & Avolio 2003)					X
Navy Leadership Framework (J.M Richardson, 2017)			X		
SHL leadership model (Bartram 2002) Adopted	X		X		

RESEARCH METHODOLOGY

This study presents a thorough and critical review based on a literature survey in the well-known journals of construction research to map leadership development in the South African Construction industry. Research studies were accessed from leadership journals on leadership effectiveness for construction project leadership, authentic leadership and leadership development in construction. By examining the objectives of these studies and focus, a thorough assessment of articles was made. The results and discussions are presented in the following sections.

DISCUSSIONS

From a critical valuation and fusion of array in line with existing literature on the subject of construction leadership development, it can be stated that, notable studies have focused on operational, leadership types and technical aspects of the industry. However, in the study of effective leadership it is evident that ethical leaders and know the importance of succession planning attend to the development of their followers, and act as their role models to turn them into future leaders (Avolio and Gardner, 2005). They engage in monitoring follower performance and correct followers' mistakes by teaching and coaching them (Bass and Steidlmeier, 1999). This further encodes the importance of leadership education and training, mentorship and ICT understanding in the construction industry, moreover being entrepreneurial is being seen to be an added advantage to developing future leaders. Most of this variables are clearly noted in table 1 and 2 above, which aligns different leadership development theories with leadership development factors.

RECOMMENDATIONS FOR FUTURE RESEARCH

It is necessary to study the level of ethical considerations and ICT understanding at various levels of construction organizations and across different countries. A

comparison of the construction industry with other industries can also help to gauge the need for professional and leadership development. Research is required into leadership development initiatives through leadership interventions.

These should be multi-level cross-sectional and longitudinal studies which can give deeper insight into leadership challenges and needs in construction projects.

Future studies on leadership can examine the impact of mentorship on employees and on the success of the projects they lead. Another dimension on which project leadership research can focus is the organizational context, with categorization by type of organization (SME contractors, architects, designers, quantity surveyors and so on), size of organization (small, medium, large; local, multinational, and so on), and focus of organizational activity (building, roads, and so on). This multi-level and multi-dimensional analysis will help in the effort to comprehend specific leadership needs and demands of organizations belonging to different contexts; and what influences the strategies leaders use to be more effective and successful in different settings

CONCLUSIONS

The paper laments the need of research on leadership development in construction. It is suggested that the traditional behavior of construction project managers is due to several factors which are inherent to the construction industry. It further argued that there is a need for a major shift in the way the project managers function and lead the projects. They need to develop as effective leaders rather than managers.

Contemporary challenges and future leadership demands ask for a change in the way that project leadership has been perceived so far. The paper presents the importance of leadership education and training, mentorship, ethics and ICT knowledge in the construction industry for managers, in their leadership development trial. Moreover, ethical leadership including having an entrepreneurial understanding are presented as important factors for leadership effectiveness in the construction industry.

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RESOURCING SPECULATIVE AFFORDABLE-HOUSING DEVELOPMENT IN A DEVELOPING COUNTRY CONTEXT – EVIDENCE FROM BULAWAYO, ZIMBABWE

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Housing development projects always take place within a structural environment, which affects agency in the development sector mainly through the availability of development resources. Using the low-income housing sector, where the problem of housing shortages has been a perennial issue, the aim is to see how the speculative development is resourced in Zimbabwe. The study was set in Bulawayo, Zimbabwe and was framed using the structure agency theory. A total of 13 in-depth interviews with housing developers, financiers and the local authority were conducted. Secondary data in the form of Local Authority minutes were also used to supplement the data collected. Findings show that the ability to deliver affordable-housing to the low income group context hinges on access to resources and the study concludes that speculative developers need to be creative in order to navigate the terrain and contextual realities of developing country contexts.

Keywords: Affordable-housing, access to resources, structure–agency theory, developing countries

INTRODUCTION

Developing countries face a myriad of challenges, all of which exacerbate housing supply constraints for the low income group and make it difficult for the private sector to actively participate in the affordable-income housing sector. In many developing countries, formal sector employment rates are low and there is a relatively high unemployment rates (Awwad, Souki, & Jabbour, 2016; El Sakka, 2016) and the level of economic activity in the informal sector is high (Carnahan, 2015; Jorgenson & Rice, 2016; Sivam, 2002), all of which culminates in serious affordability problems as the target group normally has very low incomes that are unable to sustain mortgage payments (Aribigbola, 2008; Trangkanont & Charoenngam, 2014). Other challenges include housing finance systems that are unable to support low income housing developments at reasonable interest rates (Buckley & Kalarickal, 2005; Demirgüç-Kunt & Detragiache, 1998; Sivam, 2002). Corruption in public offices (Ameen & Mourshed, 2017; Andreas & Hans, 2014; Awwad et al., 2016; Trangkanont & Charoenngam, 2014) also clouds the development process and combined with political patronage (Trangkanont & Charoenngam, 2014) and an absent political will to support low-income housing development (Jorgenson & Rice, 2016) makes developing countries a difficult context for private sector participation.

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Urbanisation without growth is common in developing countries (Buckley & Kalarickal, 2005; El Sakka, 2016; Jorgenson & Rice, 2016) and has resulted in even more demand for affordable-housing, but in a more challenging operating environment. Given the notable failure of public sector efforts in housing the low income group (Andreas & Hans, 2014; Mukhtar, Amirudin, Sofield, & Mohamad, 2017; Trangkanont & Charoenngam, 2014), alternative financing sources other than public money may be the solution in solving the low income housing quandary (Andreas & Hans, 2014). Empirical evidence, despite the challenges noted above, points to spurts of private sector developments targeted at the low income housing group in various developing countries, supporting the view that private economic activity can develop in spite of the adverse institutional framework conditions that characterise poor countries (Altmann, 2011).

In terms of the Structure-Agency theory based on the work of Healey and Barrett (1990), these speculative developments attest to a case of ‘agency’ exploiting certain structural enablers. Structure is defined as the framework in which speculative developers make decisions, and this framework is inherent in three variables: institutions (both formal and informal), resources and ideology. Agency is the exercise of choice by the developers and is also described through three variables – interests, strategies and roles. Under the structure agency theory, structure enables and also constrains agency (Healey & Barrett, 1990; Lawson, 2009). Resources, as part of structure, thus can enable and/or constrain agency in the affordable-housing sphere, with the lack of resources constraining agency and access to resources enabling agency. The resourcing of affordable-housing in a developing country context is agency in action, with the speculative developers actively seeking means and ways of accessing resources in a given structural environment in order to achieve set objectives – provision of affordable-housing. In order to do this, developers have to form networks and come up with strategies that are aligned to their interest, and in all this, they are constrained and or enabled by the structural environment in the form of formal and informal institutions, resources at their disposal and the ideological orientations of the actors in the development process.

Successful private sector participation in the affordable-housing sector in general is contingent on access to resources (Gopalan & Venkataraman, 2015) which are land and the associated land rights, labour and capital. Unavailability of construction resources may lead to project delays, which tend to result in cost overruns (Hwang, Zhao, & Ng, 2013; Marzouk & El-Rasas, 2014) and also magnify perceived risk that is embedded in housing projects targeted at the low-income groups. For the low and moderate income households where housing affordability is a challenge (Zou, 2014), it is evident that resources are the key to successful housing provision. Local realities however impose unique barriers to access to resources (Derosssett, 2015; Gopalan & Venkataraman, 2015) through presenting development processes that impact access to resources (Du Plessis, 2002). Using the low-income housing sector, where the problem of housing shortages has been a perennial issue, the aim of this paper is to see how speculative development is resourced in a developing country context. This analysis lays bare what resources are available to developers and how they access them in an environment that is typically not conducive for private sector capital. The following section is a literature review that focuses on resourcing affordable-housing development in a developing country context, and this is followed by the methodology

for this study. The penultimate section details the research findings, and the last section is the conclusion.

LITERATURE REVIEW

Resourcing affordable-housing development

Successful private sector participation in the affordable-housing sector in general is contingent on access to resources (Gopalan & Venkataraman, 2015) which are land and the associated land rights, labour and capital. Developing country contexts present challenges which are an impediment in accessing resources as shown below, creating a need for speculative developers who are innovative and creative enough to come up with strategies that help them navigate the difficult terrain if they are to provide a product that's suitable for the low-income group

Land and the associated land rights

The most important construction resource in affordable-housing is land. Scarcity of adequately located and properly planned land has been identified as one of the leading causes for affordability problems in developing countries, as it results in an increase in land prices (Childress & Alliance, 2015; Du & Peiser, 2014; Turner, 1967). This shortage of land gives rise to land mafias, illegal encroachments and corruption (Gopalan & Venkataraman, 2015) and these issues vary with local realities. Land is usually under the purview of the government, either central government or local government, and this makes this valuable resource subject to political and ideological influences –socialism, communism, neoliberalism and other such variants (Childress & Alliance, 2015; Claussen, 2015; Derossett, 2015). Associated land rights viz. development permits and certifications that allow developers to go through the development process are another important resource (Carrillo, 2014; Marzouk & El-Rasas, 2014; Odeyinka & Yusif, 1997) which if not managed properly can significantly add on to housing costs.

Capital

It has been noted before that in developing countries, little finance is available to support the funding of housing investments (Buckley & Kalarickal, 2005) including subsidy support. Financial resources available to the target group are also an important resource as failure to meet financial obligations can result in serious client based causes of construction delays (Marzouk & El-Rasas, 2014; Odeyinka & Yusif, 1997). One of the challenges which exacerbates shortages of financial resources is that the target group usually lacks collateral as the land which is usually used for low-income housing in developing countries does not have a marketable title (Loxley, 2013; Mosha, 2013; NBRI Researchers, 1987). Studies have shown that, that the strength of the tenure option can affect perceived risk by the private sector, as financial institutions are often wary about accepting land with uncertain title as collateral instead of the usual title deed (Kamete, 1997; Mosha, 2013).

Labour

Labour, which includes technical capacity and skills, availability of financially sound contractors to choose from during construction projects, good onsite project managers and technical professional such as surveyors (Hwang et al., 2013), can also determine affordable-housing project success (Gopalan & Venkataraman, 2015; Hwang et al., 2013; Poon, Yu, Wong, & Cheung, 2004; Turner, 1967). Issues that crop up in this area in developing countries are limited access to reliable services (Altmann, 2011)

due to serious brain drain, as technically skilled people usually leave developing countries in search of better opportunities elsewhere.

RESEARCH METHODOLOGY

The study was set in Bulawayo, which is the second largest city in Zimbabwe. Bulawayo has been privy to a number of purely private sector funded affordable-housing projects that have been pursued in the period 2006 to 2016 in the city. Using five developments in three high density area of Bulawayo, a total of thirteen in-depth interviews with housing developers, financiers and the local authority were conducted spread across various respondents as follows: three interviews with the developers of the five affordable-housing projects; five interviews respectively with different banks in Bulawayo that offer mortgage finance, four local authority representatives and one interview with the housing officer in the Ministry of Local Governance, Public works and National Housing - Secondary data in the form of Local Authority minutes were also used to supplement the data collected. The findings are presented using the broad categories of construction resources under which strategies used to resource speculative affordable-housing developments and navigate the difficult operating terrain in Zimbabwe to provide a product for the low income group are detailed and the implications for agency.

RESEARCH FINDINGS

The sections that follow briefly detail the challenges that are faced in Zimbabwe with regard to access to resources that are key to the development process - land and land rights, finance, and labour. These challenges are then followed by strategies that are used to resource speculative affordable housing and the implication of these on interest and roles of the developers

Access to land

Land for affordable-housing development in Bulawayo is in short supply. One of the contributing factors that exacerbates this scarcity of land is political interference which presents itself in the form of political interests being prioritised over regulatory provisions in the demarcations between Bulawayo and the Rural district Council of Umguza. The bone of contention appears to be the political implications that would surround the official shifting of the boundary as the boundary shift would affect the number of political wards that fall under rural and urban centres, thus possibly distorting the perceived ruling party's stronghold in the rural areas. Land availability woes have been further worsened by strained relations between the Local Authority and speculative developers. Since 2009, the local authority has actively declined speculative affordable-housing proposals applications through taking an active stance to not allocate land to speculative developers. The hyper inflationary period in Zimbabwe which peaked in the period 2008 – 2009 crippled the operations of some speculative developers and the study found that those developers who were not able to carry out their developments during this hyper inflationary period as per the memorandum of agreement signed with the Local Authority soured relations between the Local Authority and private developers. Most of the projects in question were those whose execution overlapped from the Zimbabwe dollar era to the multi-currency era. As a result the Local Authority has become overly sceptical of speculative low-income housing developers, resulting in potentially good speculative low-income housing projects being rejected.

Strategies used in getting land

Speculative developers have resorted to buying land from private individuals who own vast tracts of land in the periphery of the local authority area. This land, the local authority revealed in an interview, will eventually be incorporated into the local authority purview, as it is already planned for under the local Master plan as high density residential areas, and there already are provisions for service provision for such areas under the master plan. The local authority itself is having challenges with buying land off the hands of these individuals because of lack of funds, and private developers have swiftly reacted to this opportunity in order to have access to land as was revealed by one of the developers:

Developer Respondent 1 “There is land on the periphery. Since we couldn’t get land from the local authority, we approached the owner of a large tract of land under uMguza. He was scared of the land grabs, and that was a good incentive for him to sell. He was seeing what was happening. You know that most of the land is owned by the whites? We approached him, and we offered him a good price. He gave us a portion of it, and the other portion he kept for himself. I believe the portion that he kept for himself was gazetted.”

Another strategy that is being used by the speculative developers is land speculation, which is often associated with land hoarding (Du & Peiser, 2014). Findings show that these developers amass land even before they have specific uses for the land, especially at the periphery of the city. Developer Respondent 2, who is currently working on a low income housing scheme, bought the land in question in 2005 and has been holding on it since then. This move has paid off as despite the high capital gains tax environment that exists in Zimbabwe, they have managed to cut down on this cost partly due to land valuation challenges post dollarization as shown below:

“If you bought the land pre 2009, the capital gains tax that you pay is 5%. But if you bought your land after 2009, after dollarization, the capital gains tax you are charged is 20%. It’s because our Revenue Authority doesn’t know the value of the land that they should attach to land that was bought pre 2009. A lot of people who bought the land then were pensioners. If it’s your land, and you bought it before 2009, if you now want to develop that land for onward sale, that’s when you have to pay 5%”.

All the 5 housing schemes that account for over 3000 houses targeted at the low income group had land that was acquired predollarisation, implying that this has helped to keep the price of the housing unit low. This existing tax capital gains rate is so high that it has become a barrier to some developers who want to come up with affordable-housing schemes but do not have land at the moment, as was revealed by one building society respondent, which had to fold its plans for low income housing development:

“Initially, when we opened, we wanted to buy plots off people and then develop affordable-housing and then sale. Then we noted that there is transfers tax for capital gains, and we had to rescind our plans”

Private developers can also get land through offering services that they can do at a much cheaper cost and more efficiently to the Local Authority. In a way, this is cross selling as a strategy. Analysis of the Local authority minutes revealed that over the years, due to financial constraints, the Local Authority has subcontracted out service provision related to land servicing to the private sector and paid for these with land in lieu of cash. For example in 2014, a private developer was contracted to construct a

main outfall sewer and a secondary outfall sewer that had the capacity to service more than 2000 high density residential stands. This project had been on the local authority's books since 1996 and the cost was estimated to be USD337, 750. At the developers suggestion, this cost could be payable as virgin land and the local authority accepted this proposal. A local authority responded confirmed that has been the trend with the local authority since the decision not to sell land to speculative developer:

“Council now develops land on its own, we no longer sell to private developers. But we tender out for subcontractors and these contractors are given land in lieu of their service”

The interest in land from the speculators point of view is to lock in the option to develop and to minimize production cost through capping the cost of land, as land is recognised as one of the barriers to affordable-housing production as was revealed by one of the developers:

“Land in /Zimbabwe is continuously going up. But for us, the land that we are developing for low income housing is ours, so I can't say that we have faced challenges with access to land”

Another developer also had the same sentiment as shown below

“We bought the land in the Zimbabwe dollar era. And work on the land only started after the dollarization era. So there wasn't much pressure on us [as far as keeping costs down] because the major cost drivers are the cost of the land itself, and the preliminary costs like surveying and then the servicing costs.”

The role of the developer is thus to identify and buy suitably priced pieces of land in the periphery of Bulawayo and bank them for potential future housing schemes. This in effect locks in the option to develop the land, as land is one the most critical resources in low income housing provision. In addition, developers have to scout for land servicing tenders from the local authority as this seems to be the only way to get land within the local authority area.

Associated Land rights

All the developers included in the study have had challenges with accessing their development permits, and this challenge has been worsened by the suspension of development permits in 2013 by the government though the department of physical planning. Four years later, the state still hasn't resolved the issues that resulted in the suspension of these permits and this attests to the inefficiencies that characterise public sector offices that have been a concern in the academic field (Al-Ahbabi, Singh, Gaur, & Balasubramanian, 2017; Brinkerhoff & Brinkerhoff, 2015; Klein & Price, 2015; Lewis & Fall).

The only way around this challenge according the developers is through “oiling the system” through bribes, quid pro quos and kickbacks as was admitted by one of the developers “Well corruption comes in a lot of ways, and sometimes we are forced to. Of the records, we had challenges with our permit, and we had to do something! Permits for subdivision were suspended by physical planning in 2012, but in other areas they are still developing. This office here in Bulawayo, they were saying it was very corrupt. Right now there is no one with a development permit here in Bulawayo. Even in Umguza, they were suspended, and all works were suspended. But people are

still developing. I don't know whether we can call it corruption, or it's something bigger ...but to me the major downfall is on the monitoring, it's not there."

Corruption happens at different points in the development process, and in most cases, it is the developers who would have initiated the corrupt tendencies, as a means to an end. All development processes however converge at the Local Authority, and local authority personnel are prone to abusing the system for personal gain. These findings are not unique to Zimbabwe, as corruption is a common feature of developing country economies (Altmann, 2011; Moss, 2003). In a study that was sponsored by the UN Habitat to assess regulatory framework bottlenecks for low-cost housing in Zimbabwe, Chaeruka and Munzwa (2009) noted that the way plan approval and construction supervision are organized and performed at local authorities in Zimbabwe creates undue delays which ultimately slows down the housing development process. One of the developer had this to say "The turnaround time for permits is just too long. For example, I submit for subdivision right, then I have to resubmit the same thing with drawings for sewer, water reticulation and road designs to get a development permit. Why can't I submit everything at once, with my drawing and everything, for me to say this is what I propose to do? Then I get one result at once."

This inefficiency was noted to raise observed cases of corruption and general abuse of the system as developers try to find ways around the administrative bottlenecks. "But you get developer X coming in, buying land in March for example. And in June, Developer X is done with servicing and construction and they are already selling, and everything seems to be in order. How would they have done it? If we are to manage costs, then if there is way around this process, then why not?"

Capital

Both the developers and the financiers acknowledged through interviews that low-income housing developers do not have access to loan capital. Although building societies all have different loan products including those developed for corporate clients, they all concurred that they are not extending loan finance to the developers, notwithstanding the amount of business that they get from the speculative low-income housing developers. The overwhelming reason behind this reluctance to lend to the speculative developers was the perceived risk associated with their businesses as shown from the responses of one of the financiers that was interviewed:

Building society respondent: "With these private developers....oooh nooooo...no no... we don't offer loan finance. The risk is just too much. They are not disciplined in managing their funds"

Private developers also lack acceptable collateral that can be used to secure the loans and therefore are unable to meet the requisites for commercial mortgage loans. Interviews with the Local Authority revealed that even when the developer has fully paid for land, the Local authority does not issue title deeds to the developer but will instead wait until the developer has fully serviced and subdivided the land and met all the necessary conditions set by the Local Authority. Title deeds will then be issued, but in the name of the final beneficiary who would have purchased from the developer. This leaves the speculative developers with no collateral that they can use to apply for funding from financial institutions, unless if they have other properties that have nothing to do with the project at hand.

The study findings also support observations that have been made in the literature, that the strength of the tenure option can affect perceived risk by the private sector, as financial institutions are often wary about accepting land with uncertain title as collateral instead of the usual title deed (Kamete, 1997; Mosha, 2013).

In order to work around the shortage of loan capital, all developers included in the study use “off the plan” selling of their housing developments. This strategy involves marketing and selling a proposed development, without any development having taken place at all. The deposits that the clients would have paid are then used to kick-start the project as was explained by one of the developers:

“An off the plan is a model where if you want to develop an area, you do your subdivision plans, your drawings and apply for all the permits. So with your drawing on a map, before you start working on the project, you can advertise your project for people to come and start buying, before anything has been put up. Those who have faith in you, obviously they will be given a discount. They pick up a stand from the plan, and then they pay a deposit. Keep in mind that on the ground, nothing has been done. So if the client wants a corner stand, they pick out the stand from the map. Unfortunately, this is how we finance these housing schemes. The money is coming from the people.”

That way, even if the risk associated with the target group is high, the developer does not necessarily have to put down all the capital other than the unavoidable land cost and preliminary costs to get the land development rights.

Construction materials (Carrillo, 2014; Marzouk & El-Rasas, 2014), equipment (Hwang et al., 2013; Marzouk & El-Rasas, 2014) are other important construction resources. Due to forex shortage also in the country, it has significantly become difficult for the developers to import earthmoving equipment into Zimbabwe, giving those who have been in the field for long first mover advantages. All the developers in the study affirmed that they are able to serve the low income group mainly because they have access to earthmoving equipment and have resorted to backward integration to enable cost cutting and consolidation of resources which can be made available in-house. All these are coping mechanisms in reaction to the unavailability of loan capital either through investments made before the dollarization era or through affiliations with sister companies.

“You see we have a hardware shop, we have electrical shops, plumbing and fitting, we have haulage trucks. We deploy these resources in-house and utilise all the resources that we have to bring down costs of production.

One other strategy used by developers when faced with limited capital is reducing production costs through using substandard materials. The developer said that they had experimented with using block bricks that had been made using coal ash.

“With our bricks, we are using coal ash... We don’t know if they are stronger, coz we did not do any quality testing. On the internet, we see in other countries, they use what they call coal ash, but it certainly does bring down production costs”

Instead of the traditional stones, cement and sand, they were throwing in coal into the mix when they were manufacturing their blocks in-house. However, no tests were done to check on the quality of the bricks used, and once plastered, the difference in the materials used would not be visible at all.

The target group, according to the building societies can access mortgage loans provided they have a property with title deeds that can be used to guarantee the loan, they take out mortgage life protection, and house owners insurance, and they are in formal employment on a permanent contract. If the required loan is for a building, then in lieu of title deeds, the client would be expected to produce a certification of compliance from the Local Authority, a verification survey certificate from the surveyor general, a site plan showing all the neighbouring stands, a bill of quantities and a copy of the approved plan. Developers are however unable to furnish their clientele with these documents as they do not fully meet the requirements to comply with the Local Authority when they service land for affordable-housing, and thus do not have certificates of compliance or title deeds. This implies that the target group is unable to access mortgage finance via the formal financial systems. It can thus be seen that developers have no access to finance, and in turn, the beneficiaries as an indirect result also do not have access to mortgage finance, a situation that magnifies the effect of lack of resources on agency.

Given that most of the clients do not qualify for loans as per the above discussion, what speculative developers then do is to offer their clients payment terms that mirror mortgage loans offered by financial institutions as shown in the table 1 below:

Table 1: Payment terms that are offered by Developer 1

Company name	Developer 1						
Housing scheme instalments for 15 years	200m2	225m2	250m2	300m2	350m2	400m2	450m2
Deposit	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500
2 roomed	\$130	\$145	\$160	\$195	\$220	\$240	\$260
3 roomed	\$190	\$210	\$220	\$235	\$250	\$270	\$290
4 roomed	\$205	\$225	\$255	\$270	\$280	\$305	\$320
5 roomed	\$330	\$345	\$360	\$380	\$400	\$420	\$435

Since these loans are offered in-house, the developers can waive the requirements for documentation that they cannot produce, viz. title deeds or certificates of compliance, site plans and or verification of survey certificate, bill of quantities, and copies of approved plans. This makes the application process for a house very easy for the target group, and at the same time, allows the developer to serve a target group that otherwise would remain unserved due to lack of mortgage finance. Without mortgage finance, the target group would not be able to afford the housing products offered by the speculative developers. This strategy makes it easy for the speculative developers to presell their developments, thus raising funds which would otherwise be scarce.

The interest of the developer in the face of limited capital is to ultimately bring down production costs through efficient allocation of resources and internal synergies. At the same time, the developers need to create an effective market for their product and they do this through offering affordable payment terms that are similar to rent to buy arrangements. Access to finance for the target group circumvents the problem of lack of financial resources, which is recognised as one of the biggest contributors to the low income housing challenge (El Sakka, 2016; Mukhtar et al., 2017; Sivam, 2002)

Labour

Three of the developers who have housing developments just outside of the boundary of Bulawayo were worried about the limited number of registered surveyors which has significantly pushed up the costs of surveying the land. This cost is prohibitive and there is no option to use government surveyors as they are forbidden from taking on private work. The developers have resorted to postponing having their developments title surveyed, and this in turn affects access to mortgage loans for the target group, which is another important resources in affordable-housing as explained above.

Furthermore, the building inspectorate department of the local authority is understaffed, resulting in significant delays in stage inspections. This is being exploited by some developers as they know that the local authority allows what is termed “regularisations” in cases where housing would have been built without any inspections being done. The developer is asked to pay a fine, and then the local authority carries out tests to determine if the structures built meet the minimum regulatory standards. In situations where it is found that regulations have been flouted, the inspectors would have to determine if the issues are correctable, and worst case would have to order the structures built to be demolished. However, an official at the local authority revealed that the inspectors are human, and they understand that there is a housing challenge, so they try to strike a balance between costs incurred and insisting on certain standards. That way, speculative developers can easily “persuade” the inspectors to regularise developments that ordinarily wouldn’t have been developed through ‘thanking’ the inspector and can get away with using substandard materials, thus reducing productions costs. All the speculative developers revealed that where possible, they cut out the middle man and handle developments on their own somehow through being the main contractors. For example, Developer 1 manages their projects in-house, and handle all servicing requirements from road construction, brick moulding and superstructure construction without subcontracting any work out.

Lax regulation and monitoring combined with an understaffed Local authority presents a fertile ground for the developers to sidestep high surveying costs and delays that can arise from waiting for all stage inspections by the local authority. Putting a cap on possible project delays, minimises cost overruns (Hwang et al., 2013; Marzouk & El-Rasas, 2014).

CONCLUSIONS

Developers included in the study have land, and it is this valuable resource that makes them be able to tap into the low-income housing sector through providing affordable-housing units. The ability to deliver as is evidenced by the thousands of completed units that are occupied by low income groups has created a trust relationship and a loyal customer base, enabling the developers to sell off the plan despite the lack of mortgage finance, which creates the much needed working capital to kick-start projects. It is this capital which aids them to navigate the terrain and creatively use equipment and skills that are available in-house and via backward integration, bribe officials, extend flexible payment schemes to the clientele and experiment with alternative materials which ultimately brings down the cost of the final unit. It can thus be concluded that the strategies, roles and interests of the speculative developers are all aligned towards reducing costs, and coming up with a product that is suitable for the low income group.

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ENHANCING PERFORMANCE OF CONSTRUCTION EMPLOYEES THROUGH INTERPERSONAL RELATIONSHIPS

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This study seeks to determine how interpersonal relationship among construction employees would enhance performance, thereby leading to high productivity at sites. The study used extensive review of the literature as its primary technique, for exploratory purposes, which considered peer-reviewed electronic journals, thesis and books on related themes. The study established that creation of a conflict management plan within a firm is vital if interpersonal relationships are to be enhanced. Further, the study revealed that the construction industry is mainly labour-intensive sector, it is indispensable to introduce human interpersonal relationship that would foster harmony, coherence and further improve the performance of employees. Numerous benefits characterise interpersonal relationship within a firm. Given that, it is significant for the construction industry to explore and establish the associated benefits that come with the interpersonal relationship and amongst employees for performance due to the related benefits. The complexity of individuals unique attitude within teams on site prevent conducive interpersonal relations be achieved between construction employees and all involved stakeholders. The dominating activities of labour in the construction sector makes it relevant for sound relations to be established. Employees' interpersonal relationship among themselves and management is crucial since it increases performance and productivity.

Keywords: Construction, Employees, Interpersonal relationship, Performance.

INTRODUCTION

The dynamism of constructive interpersonal relationships at work has a valuable impact on both organisational and individual variables including employees. Ashforth et al. (2008) emphasised that the individual is perceived by the cognitive energy that admits the particular influence their allocations to various work and non-work areas according to the identities that defined their roles. Work relationships can influence organisational outcomes by increasing institutional participation, instituting supportive and innovative climates, increasing corporate productivity and indirectly reducing the intent to turnover (Song and Olshfski, 2008). Job involvement affects organisational features, supervisory behaviours, and individual differences (Brown and Leigh, 1996) which can predict job performance. This is so because employees who identify strongly with their jobs have their opinions and consideration on work and understand situations as opportunities to perform their work role activities (Hillman, et al. 2008).

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The complexity of the construction activities within the industry involving unique project conditions, multiple stakeholders, varied and numerous site conditions, and various project teams can frequently cause adversarial climate that can lead to conflict (Ning & Ling, 2013). Stakeholders on all construction project sites such as owners, architects, engineers, contractors, project managers, subcontractors, and suppliers are often working together to achieve a common goal of the project. Accordingly, Gardiner and Simmon, (1998) augmented that task interdependency between these stakeholders for a project's progress is naturally high, with the consequence often developing into a conflict that escalates as the project progresses. This task interdependency between stakeholders becomes quite complicated as each party seeks to look out for their interests with the intent of producing a profit, building a quality product, and maintaining a good reputation since there is lack of thorough relations (De Dreu et al., 2001). For this reason, the interpersonal relationship of construction employees must be explored.

Although Vaux (2014) maintained that construction is the most complex process of any industry, and an interpersonal relationship is imperative. This is because of the dominance of the human capital which the sector revolves on. Appreciated interpersonal relationships positively impact individual attitudes, opinions and organisational outcomes (Dotan, 2009; Maertz et al., 2007). This is realistic for both relationships between coworkers and relationships between supervisors and subordinates. Newman (2007) supported that supervisor who adopts positive work relationships with subordinates' embrace a relational management style can improve employee retention and performance. Based on the preceding discussion that this paper seeks to explore on how the performance of construction employees would be enhanced through interpersonal relationship.

LITERATURE REVIEW

Definition underpinning the study

An interpersonal relationship is primarily defined as the relationship which includes the nature of interaction that occurs between two or more people (Dezso and Ross, 2012). Individuals (employees) in an interpersonal relationship may interact, thoughtfully, face-to-face or even secretly to impact on goals. For this reason, interpersonal relations among employees must be encouraged to be improved due to its associated benefits. Accordingly, Sias, (2008) stressed that relationships are necessary for existing systems and are the hub of organisations. It is through relationships that organisations maintain stability (Katz and Kahn, 1978). Wheatley (2001) further suggests that 'academics should give attention to how a workplace organises its relationships. This is because workplace relationships comprise those interpersonal relationships in which individuals are involved in the course of performing their jobs. Similarly, human relations also broadly infer the interactions and cooperation of people in groups which operate in different fields such as business, social clubs, homes and within governments activities (Velmurugan, 2016).

Management relationships

The study of Dezso and Ross (2012) emphasised that the behaviour and performance of employees are mostly a function of organisational leaders who determine the organisation's strategic and corporate decisions. Employees' return to a more significant extent relies on management relationship that exists or that is created. Uhl-

Bien (2006) supported that the relationship is something that in recent time have started to be associated with the leadership.

Developing employee performance

Hartog et al., (2004) maintains that organisational performance could be enhanced by aligning the performance management techniques with human resources management practices which includes establishing sound relations among employees. Saleem and Amin, (2013) similarly stressed that employee performance leads to improve overall efficiency and productivity of organisation processes. Employee performance is however defined as the activities and tasks performed by an employee efficiently and effectively (Saleem and Amin, 2013). Managers can measure this performance through different mechanisms. Various factors affect the employee performance such as monetary benefits, training programs, non-monetary benefits, organisational support for career development (OSCD), supervisory support and capacity building programs, functional relationship. Additionally, Gull et al., (2012) remarked that employee performance enhances the profitability of an organisation. Furthermore, Gull et al., (2012) emphasised that employee's performance is determined through multipurpose capacities like human, technological, organisational and institutional level. It begins with top line management, but outcomes are accomplished from bottom line (employees). High-performing companies show greater satisfaction level among their employees while sometimes corporations reporting poor financial performance also have the same instance of satisfaction among their employees Gull et al., (2012).

Enhancing interpersonal relations

In strengthening interpersonal relationships, several considerations are acknowledged. Karthikeyan and Srivastava (2012) maintained that interpersonal relations at the workplace are of much importance. Job satisfaction, as well as career progress, depends upon good interpersonal relationships. Cooperative behaviour always gets reciprocated response. Although there are problematic people at the workplace with whom everybody has a problem to get along, with some tactical approach one can still find a solution to the problem without jeopardising organisational as well as self-interest (Karthikeyan and Srivastava, 2012). Communication is a way for the managers to create and maintain the relationship and to encourage and support the employees (Cunliffe and Eriksen, 2011). According to Velmurugan (2016) to improved interpersonal relations in the work environment, schedule team-building events must be organised on a regular basis. Furthermore, an expert consultant of team-building to conduct annual seminars and workshops for employees on or off the work premises. Efficient team building should allow participants to learn how their colleagues' minds work, how to communicate thereby improving relations (Velmurugan, 2016). Velmurugan, (2016) further stressed that in enhancing the interpersonal relationships, employees have to be encouraged to communicate as clearly and concisely as likely to avoid misunderstanding. Creation of a conflict management plan within a firm is vital if interpersonal relations are to be enhanced (Yagil, et al. 2009). The plan may not prevent conflict at, but it would enable quick conflict resolution to take place which includes using self-assessment tools and teaching team employees how and when to confront or avoid confrontation, and when to force a position or when to compromise (Velmurugan, 2016). Further to their current suggestions on how interpersonal relations would be enhanced among employees, Velmurugan, (2016) informs that there must be the creation of an open-

door policy. Even if work demands and schedule availability prohibit from having communication lines the employee can still benefit from an open-door policy.

Performance in construction

To examine the effects of relationships on performance, an understanding of performance evaluations is necessary. Grant (2008) therefore defines performance as the degree to which employees behaviours achieve organisational objectives. Performance related to relationship conflict in existing management and psychology literature has been assessed as, consensus and quality of strategic team decisions (Grant, 2008). Menches and Hanna (2006) maintained there are four key performance indicators. These four signs include profit from the project, excellent communication between team members, on or ahead of schedule, and within budget, are a synthesis of all factors provided by the project managers. Pragmatic work has discovered the means by which teams actively mitigate the effects of relationship conflict to achieve higher performance. Behfar, et al. (2008) maintained that those teams performing at high levels during relationship conflict experienced equity among the members where all employees were contributing to the goals of the group.

RESEARCH METHODOLOGY

To explore how interpersonal relationship among construction employees would be enhanced to increase performance, the study adopted an exploratory approach using existing literature. The review of the literature was hinged on related themes on the study. Also, to consolidate the richness of the research, emerging trends in current analysis was used. The adopted technique enabled different dimensions of the research on interpersonal relations perspective of construction employees (peer to peer, manager and employee) to be explored. The method further allowed the goal of the study to be ascertained with ease. The exploratory technique also used eighteen (18) journals, two (2) books supported by one (1) thesis to undertake the literature review.

FINDINGS AND DISCUSSIONS

The following themes were established to enable the interpersonal relationship to be enhanced:

Conflict management plan

Conflict is inevitable in any firm that engages human activities including the construction industry. Its labour intensive activity characterises the construction industry. Construction activity is the most complex process in any industry, which includes multi-tasking activities makes an interpersonal relationship imperative (Vaux, 2014). Besides, the study of Gardiner and Simmon (1998) also brought to light in their research that task interdependency between these stakeholders for the progress of a project is naturally high, with the consequence often developing into a conflict that escalates as the project progresses. For this reason, there must be a healthy relationship among teams. Further, the study also established that maintaining teams performing at high levels during relationship conflict experienced fairness among the members where all employees were contributing to the goals of the group as stressed by (Behfar, et al. 2008). The study further established that creation of a plan to manage conflict within a firm is vital if interpersonal relations are to be enhanced as argued in the study of (Yagil, et al. 2009). The plan may not prevent conflict, but it would enable quick resolution of conflict to take place which includes using self-assessment tools and teaching team employees how and when to confront or avoid

confrontation, and when to force a position or when to compromise (Velmurugan, 2016).

Team building

Accordingly, communication is a means by which managers create and maintain the relationship and encourage and support employees as suggested by (Cunliffe and Eriksen, 2011). Velmurugan (2016), recommended that to improve interpersonal relations in the work environment, schedule of team-building events must be planned on a regular basis. Additionally, a professional team-builder would conduct annual seminars and workshops for employees on or off the work premises. Efficient team building should allow participants to learn how their colleagues' minds work, how and how to communicate thereby improving relations (Velmurugan, 2016). Effective Communication amongst peers stimulates better understanding and increases confidence, trust and high level of commitments.

Institutional policies

Further findings of the study established that interpersonal relationship activities are more prudent to be recognised in a firm. The merit of creating institutional policies would facilitate a more transparent conducive atmosphere for employees to operate and encourage productivity. Song and Olshfski (2008) emphasised that work relationships could influence organisational outcomes by increasing institutional participation, instituting supportive and innovative climates, increasing corporate productivity and indirectly reducing the turnover of the firm. Additionally, with compliance policies in place employees will operate with peace and tranquillity within their work environment as these will guide and resolve all common issues arising in a firm. More so, aligning performance management techniques with human resources management practices supported by institutional policies would also improve and encourage the interpersonal relationship.

CONCLUSIONS

The fundamental aim of the study was to establish how employees' performance would enhance the interpersonal relationship. Although the literature has failed to set a universal definition of an interpersonal relationship, the most significant variables that infer interpersonal relationship is the interaction that ensues between two or more people which could be tangible or intangible. The dynamism of constructive interpersonal relationships at work has a valuable impact on both organisational and individual variables including employees in all sectors work environment, not including the construction fraternity. The study concludes that work relationships can influence regulatory outcomes by increasing institutional participation, instituting supportive and innovative climates, increasing corporate productivity and indirectly reducing the intent to turnover. The complexity of the construction activities within the industry involving unique project conditions, multiple stakeholders, varied and numerous site conditions, and various project teams can frequently cause adversarial climate that can lead to conflict. Therefore, instituting interpersonal relations among construction employees is prudent. Performance of employees would be enhanced by aligning the performance management techniques with human resources management practices which includes establishing healthy relationships with employees.

The conclusion from the study also stressed that to improved interpersonal relations in the work environment, schedule team-building events must be organised on a regular basis. Additionally, an expert consultant of team-building to conduct annual seminars

and workshops for employees on or off the work premises. Furthermore, the creation of a conflict management plan within a firm is vital if interpersonal relations are to be enhanced. The plan may not prevent conflict at, but it would enable quick resolution of conflict if it occurs.

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CONTRACTORS' PERCEPTION OF LATE PAYMENTS

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Purpose: The purpose of this paper is to identify the effects of late payments on contractors and to implement procedures which will ultimately eliminate payment delays in future. Furthermore, the paper also highlights the importance of understanding the mechanism and workings of various contract agreements in order for the contractor to be aware of his rights and responsibilities in terms of the contract and what legal steps could be taken should a client be in default regarding payment. **Design / methodology / approach:** A quantitative research method was used. A structured questionnaire was administered to contractors who are members of the Master Builders Association (MBA), Eastern Cape Province. **Findings:** The findings revealed that contractors' cash flow is greatly affected as a result of late payments. Smaller contractors even faced bankruptcy. Contractors are also forced to suspend work on site due to late payments; this extends the contract period and as a result the contractors' expenses increase. It is also suggested that payment legislation should be introduced in order to reduce the amount of late payments made by clients to contractors. **Research limitations:** The research is limited to contractors who are registered members of the Master Builders Association (MBA), Eastern Cape Province. **Practical implications and value of the research:** An understanding of the effects of late payments will assist contractors in the smooth running of a construction project financially. Contractors will also benefit from having a good sense of knowledge in terms of contractual agreements in the event of a delay in payment from the client. Contractors would furthermore be able to identify the effects of late payments and plan accordingly.

Keywords: Cash flow, delays, effects, late payment, payment.

INTRODUCTION

Payment has been a source of grief for contractors for generations and is likely to be for generations to come if no adequate legislation is put in place, whether it is delays in payment or no payment whatsoever (Gow, 2006). The problem has two parts, firstly the client fails to pay the contractor on time or not at all and secondly, the contractor is subsequently not in a position to pay subcontractors due to a lack of cash flow. Focus will be on clients failing to pay contractor and the implications as a result, as well as the contractor's outlook on how to improve the current payment situation.

A common characteristic of construction projects is that they are dynamic and have a high level of uncertainty (Al-Kharashi and Skitmore, 2008:4). When payments are delayed, the contractor's cash flow suffers greatly and it is difficult to remain competitive in the industry.

Payment problems arise from an imbalance of commercial power between the client and a contractor (Gow, 2006). The construction industry plays a vital role in any country's development process (Fikri Hasmari, Ismail and Said, 2012:1). Efficient and timely payment is a main factor in the success of a project. The problem at hand

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affects most countries and industries, due to the long durations, large amount of money required the construction industries need for prompt payment is intensified. This research determines the effects of late payments on contractors registered at the Master Builders Association (MBA) within the Eastern Cape, especially the impact on the contractor's cash flow.

REVIEW OF THE RELATED LITERATURE

Cause and effects

The main cause of late payment in South Africa can be laid at the feet of the client according to Van der Merwe, Buys and Vosloo (2011). According to Van der Merwe et al., (2011) the effects of late payments are that it create cash flow problems, financial hardships and put a lot of unnecessary stress on the contractors.

Forms of contract for construction work

The issue of late payments were seen as a major worldwide crisis, as the impact is negative on all construction sectors and related economies. To a certain extent, it is still currently a worldwide crisis with the exception of a few countries implementing new legislation (CIDB, 2010). The CIDB endorsed forms of contract for construction and building work which provide legal remedies to enforce payment such as the Joint Building Contracts Committee Principal Building Agreement (JBCC PBA), The General Conditions of Contract for the Construction Works (GCC), New Engineering Contract: The Engineering and Construction Contract (NEC) as well as the Conditions of Contract for Construction for Building and Engineering Works designed by the Employer (FIDIC Red). The most commonly used contracts in South Africa are the JBCC PBA and the GCC. South Africa does not have construction specific legislation to address the need for prompt payment of building and civil engineering contractors and consultants (CIDB, 2014).

The contractor is entitled to default interest on late payments as all CIDB-endorsed contract documents make provision for the payment of interest. The rate is dependent on the contract used. When work is partially complete, the contractor's claim for interim payment of the partially completed work could be met with a counter claim from the client based on *exceptio non adimpleti contractus*, which is the exception of a non-performed contract, a contractor cannot abandon site if the client fails to pay for partially completed work (CIDB, 2014). All four of the CIDB-endorsed contracts contain provisions for the suspension of work and/or the cancellation of the contract when the client does not pay interim payment certificates. The contractor needs to take some aspects into consideration before leaving site or terminating the contract. In order to enforce the termination clause, the condition for its implementation need to be stringently complied with, if the contractor is required to give the client notice of his or her intention to terminate the contract, the notice must be given as an express, extra-judicial announcement and such notice cannot be implied or given by notice of motion. If there is no contractual termination clause, a contractor will not be able to terminate a contract if a client does not make an interim payment (CIDB, 2012).

Other remedies available in order to enforce payment are client provides evidence of the funds needed to pay for a specific project, a contractor's lien, a provisional sentence, a summary judgement or to make an arbitration award an order of the court. The FIDIC Red provides for evidence to be provided by the client to the contractor whereby, among other things, the client proves there are sufficient funds available to pay the contract price. "The Employer shall submit, within 28 days after receiving

any request from the Contractor, reasonable evidence that financial arrangements have been made and are being maintained which will enable the client to pay the Contract Price (as estimated at that time). If the client intends to make any material change to his financial arrangements, the client shall give notice to the Contractor with detailed particulars” (Government Gazette, 2015). The mechanism for the provision of evidence is not a remedy but it does help minimize the possible risks relating to the capability of the client to pay for work. Similar provisions are not found in the JBCC PBA, NEC3 ECC and GCC documents.

Contractor's lien

A contractor's lien entitles the holder the right to retain possession of property until the defaulter has paid the money due. The lien is designed to support the contractor's claim for payment (CIDB, 2014). A provisional sentence is an extraordinary procedure, it is available to a creditor who has liquid documentary proof of a claim against a debtor. This provides a quick provisional judgement without the expense and delay, which an ordinary trial action would involve. A summary judgement enables a creditor with a clear case to obtain the swift enforcement of his claim against a defendant who has no real defence to the claim (CIDB, 2014). A common practice within South Africa is to make an arbitration award an order of the court. An award that has been made an order of the court can be enforced in the same way as any judgement or order to the same effect. After an award has been made an order of the court, the party enforcing its rights can issue a summons of execution to be executed by the sheriff of the court. Restricted availability of funds occurs in not only the public sector but the private sector as well; again this is due to slack financial management and budgeting problems which are the cause of late payments (Munaaim, 2006). The predicted outcome is to create a process which will ensure cash flow, establish payment provisions as well as introduce adjudication as a compulsory first step for the resolution of disputes in both the public and private sectors. The proposed regulations avoid withholding of payments without going through a clear procedure. Contractors will have a statutory right to suspend works, charge interest on late payments as well as introduce a compulsory form of statutory adjudication to resolve disputes (Hattingh and Massey, 2015).

RESEARCH METHODOLOGY

Methodology

In this study, a quantitative approach was used for acquiring and analysing data. The aim of the research was to identify the effects that late payments have on contractors; the effect on the contractors' cash flow as well as the suspension of work on site.

Questionnaire Design

A questionnaire was formulated which was distributed to contractors within the Eastern Cape Province. The questionnaire was designed to be brief, concise and straightforward to encourage a high response rate from the potential respondents. The questionnaire was pre-tested by five contractors to ensure it was understandable to the respondents. The results of the pre-tested questionnaires are included in the overall analysis of the survey. The questionnaire consisted of four main sections.

Section A consisted of questions relating to the respondent's demographic background regarding organisational and personal data. Section B relates to the contractors' knowledge and views based on past experience, section C shares the contractor's outlook on cash flow problems caused by late payments while section D covers the

late payment effects on the suspension of work. A 5-point Likert scale was used in the questionnaire to determine the extent to which the respondents agreed or disagreed with the questions provided.

Sample size and response rate

The sample for the study consisted of 150 registered contractors, all members of the Master Builders Association (MBA) within the Eastern Cape Province. The online questionnaire was emailed to all contractors. Forty two completed questionnaires were returned which represents a response rate of 28%.

FINDINGS

Demographics

It is notable that 80% of the respondents have more than ten years of experience within the construction industry, while 60% of the respondents have more than fifteen years' experience which are positive indicators. All the respondents were males.

A further positive observation is that 92% of the respondents have a qualification higher than a matric certificate. This indicates the respondents are all educated and knowledgeable.

Contractors' experiences relating to late payments

Table 1 indicates the contractors' opinion relating to various late or non-payment issues.

Table 1: Contractor's opinion

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Unsure	Mean score (MS)
	1	2	3	4	5		
Litigation takes a long time and the results may often come too late to prevent financial harm to the company	0%	8.3%	0%	16.7%	75%	0%	4.58
Due to the high cost of litigation, a successful result may often be a 'paper victory' (a worthless judgement)	0%	25%	0	58.3%	16.7%	0%	3.67
Once a company has instituted litigation against a party, chances are limited that the company will get further work from that party in the future	0%	0%	8.3%	75%	16.7%	0%	4.08
Statutory prompt payment provisions will improve late payment practices in South African construction industry	0%	16.7%	8.3%	66.7%	8.3%	0%	3.67
The provision of escrow accounts, or similar trust accounts, to the benefit of the contractor and for retention money retained from the contractor is needed	0%	25%	8.33%	50%	8.33%	8.33%	3.45
Provision for a mechanism that will ensure that a client cannot withhold payment from the contractor unless he has given an effective notice of his intention to withhold such payment	0%	8.3%	0%	66.7%	25%	0%	4.08
Statutory provision for a contractors lien	0%	8.3%	0%	66.7%	25%	0%	4.08

Respondents indicate in Table 1 that the provision for a mechanism that will ensure that a client cannot withhold payment from the contractor unless effective notice has been given by the client of intention to withhold such payment is needed. Litigation is seen negatively as it is time-consuming as well as a costly exercise of which the outcome could also take some time to reach. It should be compulsory for the client to place at least two month's turnover on deposit in a joint account or account administered by principal agent, as the contractor is exposed to approximately two months further work on site due to all the legal notice periods. Respondents furthermore indicated by means of an open question that consultants, such as the

quantity surveyor should play a more permanent role in the payment process, advising client on the legal and contractual consequences of non-payment. Another open question response indicated that contractors' feel they have a right to the "pay-when-paid" clause as the risk needs to be evenly distributed.

Contractors experience cash flow problems during the construction stage

Table 2 indicates that the respondents all agreed or strongly agreed (MS=4.83) that when interim payments are paid late, this affects the contractor's cash flow. Ninety-two per cent (92%) of the respondents agree to strongly agree that cash-flow problems are experienced during the construction stage of a project. Contractors are often unable to pay their sub-contractors, labourers and suppliers, due to their restricted cash flow. The delay in payment makes sub-contractors reluctant to work with contractors known for paying late, which tends to inflate prices. Table 2 also revealed that respondents are of the opinion that the ability to tender on future projects was, consequently impacted.

Table 2: Contractor's opinion

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Unsure	Mean score (MS)
	1	2	3	4	5		
Late payments are normally a result of a default caused by the client/employer	0%	5%	0%	35%	60%	0%	4.50
Cash flow is affected by late payments	0%	0%	8%	0%	92%	0%	4.83
Cash flow problems are experienced during the construction stage	0%	5%	0%	25%	70%	0%	4.60
One interim payment paid late affects cash flow	0%	0%	0%	17%	83%	0%	4.83
Cash flow has a negative impact on the success of a company	0%	0%	8%	8%	84%	0%	4.75
Late payments by clients leads to bad working relationships	0%	0%	0%	75%	25%	25%	4.25
Late payments result in the contractor not being able to subcontractors, suppliers and labourers	0%	0%	8%	59%	33%	0%	4.25
Cash flow problems lead to bankruptcy/liquidation	0%	10%	50%	35%	5%	0%	3.35
Subcontractors, suppliers and labourers are reluctant to work with contractors known for paying late	0%	8%	0%	75%	17%	0%	4.00
Subcontractors, suppliers and labourers inflate their prices in anticipation of late payments	0%	0%	25%	67%	8%	0%	3.83
Ability to tender on future projects is impacted by cash flow problems	0%	0%	0%	75%	17%	8%	4.18

Suspension of work

Table 3 shows that majority (83%) of contractors are of the opinion that late payments results in the suspension of work onsite. Table 3 further indicates that ninety-two per cent (92%) of the respondents agree to strongly agree that the suspension of work forces the client to pay. All the respondents agree to strongly agree that the contractor's expenses and construction costs increases as a result of a delay in payment.

Table 3: Late payments' effects on the suspension of work

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Unsure	Mean score (MS)
	1	2	3	4	5		
Late payments result in the suspension of work on site	0%	17%	0%	83%	0%	0%	3.67
Late payments which cause the suspension of work are not always the fault of the client	0%	17%	8%	8%	67%	0%	3.67
The suspension of work forces the client to pay	0%	0%	8%	84%	8%	0%	4.00
Construction costs increase as a result of the delay	0%	0%	0%	83%	17%	0%	4.17
Contractors expenses increase	0%	0%	0%	67%	33%	0%	4.33

CONCLUSION

The research investigates the effects of late or non-payment on the contractor. Procedures need to be implemented which reduce payment delays within South Africa. Contractors should be knowledgeable in terms of various contractual agreements and be aware of their rights in the event of a delay in payment. The objective was to find a solution which will in turn create a better working environment by avoiding late payments. Cash flow is affected due to late payment; late payment also results in the suspension of work on site. The literature stated the importance of the various legislation which could reduce the amount of late or delayed payments within the construction industry. The results supported the literature regarding payment being a cycle effect, contractors fail to pay labourers, subcontractors and suppliers due to the negative effect late payments have on their cash flow. The suspension of works in turn results in a longer construction period which increases the contractor's expenses. Other countries such as Australia and the United Kingdom (UK) have made progress regarding late and non-payment within the construction industry which shows it is possible for South Africa to do the same. The Government Gazette released in May 2015 shows progress in the right direction for South Africa as a country.

RECOMMENDATIONS AND FURTHER RESEARCH

The following are recommendations resulting from this study:

- A commission should be established to investigate errant payments, and
- Prompt payment legislation is required in South Africa.

Further research should be conducted on the reasons why clients are delaying payments as well as the consultant's roles in the payment process. The payment systems used by government departments which also negatively effects the contractor, should also be investigated.

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ETHICS IN CONSTRUCTION INDUSTRY: A CASE STUDY OF PROJECT MANAGERS

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Business ethics and corporate governance has taken centre stage globally in the last decade due to the increasing unethical practices by private and public institutions. This unethical practice adversely impacts on the image of professionals and organisation with a resultant negative impact on competitive advantage of the organisation. This study aims to assess factors contributing to unethical behaviours of project managers. The study was conducted in five provinces of South Africa i.e. Kwazulu Natal, Eastern Cape, Cape Town, Limpopo and Gauteng. The sample frame consists of construction project managers registered with SACPCMP. Random sampling technique was employed in the selection of samples. A total number of thirty-six questionnaires were analysed for the study. Descriptive statistics was employed for the analysis of data. Findings include societal culture, personal value, perceptions are very influential factors on ethical decision of a project manager also corporate value and individual values are the factors which most influence the ethical judgement of a project manager regarding ethic. Based on the finding of the study, ways to mitigate unethical conduct would be; practising ethical conduct always will improve production, the levels of risk on projects will decrease and improvement in communication and transparency will minimise the levels of unethical conducts of the project managers in South Africa.

Keywords: Decision making, construction, ethics, unethical conducts

INTRODUCTION

The wave of corporate scandals and financial crisis globally has elicited calls from different quarters for sound corporate ethics and corporate governance in business. Enron and WorldCom are instances of global corporations that got burst due to unethical practices. The resultant effect is low trusts in corporations. Although the history of economic progress is rich with stories of fraud and dastardly dealings, the public are however, more sensitive to them today than ever. Perhaps because the ordinary citizen feels the consequences more directly (Connor, 2006).

Calls have been made for reforms to business practices to avoid such scandals. Hoo et al (2008) suggested that the rising economic crime is a growing global threat to much business. Elder, (2008) comments that the health of any economy depends on the ethical standards upheld by responsible business managers, leaders and entrepreneurs. Ultimately business depends on the conscience of business leaders and managers and they should strive to become more aware of the implications of their actions (Rob Elder, 2008).

There is therefore, a global trend towards ethical business practices. World business today shows evidence of growing acceptance that business cannot be successful

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without sound moral values. Business needs ethics and ethics needs business (Prozesky 2001). It is believed that business success will depend among other factors but on moral and ethical values. Management misconduct as have been seen from the corporate scandals in the business world has left unfavourable impression about leaders, leadership and leadership authenticity (George, 2003 cited Toor, et al, 2007).

The Construction industry is not left out of the global village, more importantly South Africa is an economy undergoing transformational and structural changes. Therefore, requires strong ethical foundation. Unethical practices have a huge impact not only on the economy but on human life. Series of unethical behaviours in the sector have been cited, such as substandard quality and specification (Liu, et al, 2004), collusive tendering, conflict of interest, unfair conduct, proprietary breach, bribery and environmental breach (Vee et al., 2003). Therefore, there is a need for high level of professional conscience and leadership with good ethical behaviour in the construction sector.

LITERATURE REVIEW

Factors influencing the ethical decision of a project manager

Personal values

Values and attitudes as factors influencing individual decision making in their contingency model of decision making. This has been corroborated by other researchers. 'Individual instrumental and terminal values as initial input for model of decision making incorporating ethical values' (Fritzsche, 2007). Moral value of the individual is linked to ethical decision making (Argandona, 2003 and Coughlan, 2005)

Perception

Hunt and Vitell, (1986), in the model of ethical decision, identified perception as an antecedent of ethical decision making. Other scholars have equally demonstrated empirically the link between perception and intentions in a scenario involving ethical situation (Singhapakdi, Vitell and Franke 1999 cited Honeycutt, et al 2001)

Individuals in organization make decisions and the quality of the final choices are largely influenced by their perception. This demonstrates that perception is linked to decision making. What the manager perceives will influence his decision (Robbins, 2007)

Culture

Culture is the matrix through which societal values are entwined. Culture constitutes a complex determining factor in ethics and affects distinct stages of the process (Srunka 2004). Different culture produces different expectations which are expressed in distinct ethical norms and this in turn influence ethical decision making. Goolsby and Hunt (1992) distinguish between individual, situational and environmental determinants of ethical decision making.

Income level

Vitell, Singhapakdi and Franke (1999) indicate that salary is not a variable in ethical decision model. Prahalad and Harmon (2002) suggest that the vast differences in ethical values, culture, poverty and corruption across levels of economic and income pyramid have significant inputs on manager's ethical decision.

Age

Age has been attributed as one factor that influences the ethical behavioural intentions of managers. Kohlberg's (1981) typology of moral development level postulates that as one moves from lower levels to higher levels, ethical decision and behaviour increases in general. This is supported by (Weber and Green, 1991). Mason and Mudrack, 1996 report a positive relationship between age and ethical sensitivity. Further exploration on whether the age or the years of experience will be made to evaluate these positions.

Education

Education results in greater sensitivity to different points of view and is linked to a person's stage of cognitive moral development. The relationship between education and ethical decision making is consistent with past empirical research on business ethics (Singhapakdi, Vitell and Franke 1999). There is a link between demographic variables of age and education with ethical decision making (Srnrka, 2004). Some other researchers have disputed the link between education and ethical decision making. They suggest that there is not necessarily a link between education and good ethical decision (Evans et al, 2006, Ritter, 2006 and weber 1990). The conflicting result requires further investigation on the part of Project Managers.

Diversity

A highly diverse workforce may be face with issues on how to manage this diversity effectively. The amalgamation of different culture within the society having different values and value systems makes management more cumbersome and difficult (Johnson 1991). The workforce diversity has important implication for management practice. It had significant impact on the decision of managers particularly to ensure that the differences are recognized when decisions are made. Diversity can lead to good ethical decision making if positively managed and can greatly increase creativity and innovation in organization as well as improved decision making.

Gender

Business practices would significantly be affected by the increasing participation of women in the work force. In a research, Singhapakdi et al (1999) found that women have more ethical intentions than men. The influx of women in the work force of South Africa and the government policy to empower women will change the dynamics of the workplace. Since Franke et al (1997) suggested an established role of women in ethical perception, this study will look at the impact of gender on ethical decision among South African Small business managers and verify the proposition that women have more ethical intentions than men.

Organizational culture (Team)

Organizational culture refers to shared beliefs by members of an organization (Coughan, 2005). Organizational ethical climate can influence individual ethical decision making (Wu, 2002). Affected by different individual, environmental, and situational variables (Bartlett, 2003).

The criteria that form the basis of ethical judgements and behavioural intentions

The linkage between judgment and behavioural intentions is defined as an individual's intention to act in a certain way that has been postulated in ethical decision-making models (Jones, 1991). Judgment is usually used as the most common indicator of an attitude and its predictive validity of subsequent behavioural intentions is a central focus of the theory of cognitive dissonance (Festinger, 1957). According to this

theory, people who are rational decision makers strive for consistency in everything they do. Therefore, a consistency between attitude and behaviour is preferred because it helps alleviate stress and anxiety resulting from the conflict of having an attitude–behaviour inconsistency (Festinger, 1957).

Individual Values

Most of an individual's ethical development occurs before entering an organization and are usually learnt very early in life. The influence of family, church, community, and school will determine individual values. McShane & Glinow (2008) states that as an individual, there are three qualities that one must possess to make effective ethical decisions. The first is the ability to recognize ethical issues as they arise and thereafter to reason through the ethical consequences of any decisions made.

Corporate Values

Davis (2003) notes that corporate values serve as the defining elements around which norms, symbols, rituals and other cultural activities revolve and that values help employees form a social identity that provides meaning and connectedness. Corporate values are shared values that develop trust and link individuals in an organization together. In order that these values are adhered to, they must be stated as both corporate objectives and individual values. These values will then also form part of the identity of the organization by which an organization is known throughout its business areas.

Moral Reasoning

Values alone do not determine one's actions. One's behaviour is also controlled by organizational and social culture, by the influence of significant other people in one's life and moral reasoning. Fredrick (2002) states that Kohlberg developed the moral development theory, which is concerned with how people judge what is morally right, out of a study covering 58 males over a 12-year period. Kohlberg found that the moral reasoning abilities of individuals develop through an invariant or fixed sequence of hierarchical stages.

Situational Influences

Crane and Matten (2003) state that there is considerable evidence to suggest that employee's ethical decision making is influenced by the systems of reward that they see operating in the workplace. Systems of reward relates to the fact that people are likely to do what they are rewarded for. An example is an organization that gives commissions to the sales team. This motivates them to increase sales but may also motivate them to act unethically to continue obtaining the commissions. In such an environment, adherence to ethical principles and standards are also less likely to be maintained unless individuals are motivated to do so by incentives.

Social Influences

In the workplace, social influence may take a variety of forms, for example, offering information, attempting to persuade, suggesting a certain course of action, requesting a favour, ordering something, or demonstrating how something should be done (Oberlechner, 2007). In this way, one can radically influence others' ethical decision making. Like situational influences, social influences are part of the significant influences affecting ethical decision making. Some of the specific forms of social influence are intimidation, manipulation, persuasion and facilitation.

Impression Management

According to Oberlechner (2007), impression management is the term used to refer to when people aim to control the impressions that others have of them. Ethical impression management is used to define actions and events for others in ways that shed an ethically favourable light on oneself. The specific methods include reputation tactics and remedy tactics.

Factors impacting the unethical behaviours of a project manager

The choice of a Project manager influences the success or failure of the project. This is because the Project Manager is the single point of responsibility, which integrates and coordinates all the contributions of the team and guides them to successful completion of the project (Burke, 2006 and Toor, et al 2007:1). Several authors have listed factors that contribute to unethical behaviours, they are, Hamzah et al., (2010), Tow and Loose more, (2009), Hamzah et al. (2010), Hassim et al. (2010) and Kennedy, (2004). The factors are: adversely affect the quality of a product cost performance, the level of risk on a project increases, time to complete the project, reduction of profit and compromising of safety.

RESEARCH METHODOLOGY

The sample frame for the study consisted of project managers in Eastern Cape, Gauteng, Kwazulu Natal, Limpopo and Western Cape Provinces, registered with SACPCMP. Research instrument was a questionnaire. Simple statistical tools, such as the mean score, percentages and frequencies were used to analyse data obtained. The quantitative research approach was employed. For selecting samples, recommendations from Leedy and Omrad (2014) were applied. The probability sampling technique was employed for sample selection. A random sampling technique was employed. The research instrument was administered to respondents by means of the email. These were received through the same means. A total of 36 responses were received. The respondents were from both public and private sector: (22%) Eastern Cape, (25%) Gauteng, (25%) Kwazulu Natal, (6%) Limpopo and (22%) Western Cape. They had an average of 40 years working experience with the majority being males (83%) and females (17%). Most (33%) of the respondents were over the age of 50, followed by 31 years to 40 years (30.5%), followed by ages between 25 to 30 years (19.4%), and 41 to 50 years age bracket (16.7%) respectively. The highest formal qualification was diplomas (33.3%), followed by master's degree (16.7%) and B. Tech (11.1%) respectively and lastly other related qualifications (5.6%). Majority (52.8%) of respondents were Candidate Project Managers registered with SACPCMP followed by Professional Project managers (47.2%). Most (27.8%) of the respondents were supervisors followed by owners of the businesses, i.e. Directors, Managing Members or Principals (19.4%), followed by senior staff (16.6%), next were managers (13.9%), and lastly were directors and other (i.e. lectures) (8.3%) respectively.

RESEARCH FINDINGS

The tables below present the results of the data analyses and interpretation thereof

Table 1: Factors influencing the ethical decision of a project manager in South African.

S/N	Determinants of manager's ethical decision making	Mean Score	Rankin

o			g
1	Societal Culture	4.3	1
2	Personal value	4.1	2
3	Perception	3.9	3
4	Age	3.8	4
5	Income level	3.8	5
6	Education	3.4	6
7	Diversity relative to work force	3.4	7
8	Organizational culture	3.4	8
9	Gender	3.03	7

Table 1 presents the factors that influence the ethical decision of a project manager. It is noted that all these factors are above the mean score of 3. This indicates that the factor has a moderately high influence in the ethical decision of a project manager in South Africa. Societal culture (MS=4.30) has the most rating. This can be recognized by the fact that culture is the background through which societal values are entwined hence the cultural values play an important role in determining the project manager's ethical decision making in the organisation. Next to societal culture is Personal value (MS=4.1). This is comparative to attitude and behaviours which will impact on personal reputation of an individual. The least rated factors are gender (MS=3.03). This is animated that gender is not necessarily the deterrent of one having to commit an unethical conduct in the organisation.

Table 2: The criteria that form the basis of ethical judgements and behavioural intentions

S/No.	Determinants of manager's ethical decision making	Mean Score	Ranking
1	Corporate value	4.02	1
2	Individual Value	3.95	2
3	Situational influence	3.85	3
4	Moral Reasoning	3.83	4
5	Social influences	3.63	5
6	Impression management	3.32	6

Table 2 presents the criteria that form ethical judgement and behavioural intentions. It is noteworthy, that all these factors are above the mean score of 3. This indicates that the factor has a moderately high influence in the ethical judgements and behavioural intentions of a project manager in South Africa because the consequences of unethical behaviours could adversely affect the reputation of the organization or individual working for the organization. Corporate value (MS=4.02) has the most rating. This can be attributed to the fact that the corporate values of an organisation are those that assist in the sustenance of the organisation. Next to corporate value is individual value (MS=3.95). This is relative to approach, people and relation cultivation, which

influence the repeat of business therefore the individual values reflect how one or a project manager fulfils the duties or responsibilities assign to him or her, for the project to be a success. The least rated factors are impression management (MS=3.32). This is relative to one trying to impress another by portraying to be good whereas he or she is engaged in unethical acts that have a possibility of a project not being completed on time.

Table 3: The impact of unethical behaviours of project managers on projects

S/No.	Factors impacting the unethical behaviour of a project manager	Mean Score	Ranking
3.1	Adversely affect the Quality of a product	3.90	1
3.2	Cost performance	3.80	2
3.3	The level of risk on a project increases	3.76	3
3.4	Time to complete the project	3.70	4
3.5	Reduction of Profit	3.68	5
3.6	Compromising of safety	3.64	6
3.7	Company image fades	3.60	7
3.8	Scope of the project changes	3.59	8
3.9	Shareholder value decreases	3.45	9

Table 3 presents the impact of unethical behaviours of Project Managers. It is notable that all these factors are above the mean score of 3. This indicates that the factor has a moderately high influence in the unethical behaviours of a project manager in South Africa. Quality that is adversely affected by the unethical behaviour of a project manager has the highest rating of (MS=3.90). This can be endorsed by the fact that quality is dependent on ethical behaviour, whereby quality and ethics have a common care premise which is to do right things right and it is a proven way to reduce costs, improve competitiveness, and create customer satisfaction. After quality is cost performance (MS=3.80). It is practical a project might have to be abandoned altogether if funds run out before completion due to unethical conducts, in which case the money and effort already invested become forfeit. Cost performance is followed by the level of risk on a project increases (MS=3.76). This is tangible that risks could arise from illegal, unethical, incorrect, and inappropriate actions by project managers the best way would be for companies to seek ways to eliminate these risks since they get no strategic benefits from taking them on. The least rated factors are the scope of the project (MS=3.59), Making changes without proper impact analysis, and without reviewing schedule and cost implications has a negative impact on a project and the shareholder value (MS=3.45), this is relative to the decline of shareholder value should the project manager engage in unethical acts.

DISCUSSION

The findings of this study corroborate with finding of other studies with respect to most factors of the study. Firstly, the most influencing factor for ethical decision is societal culture in this study, which is like the finding of Aberlechner (2001) that conclude that societal influence such as persuasion, suggestion and asking for favour

influence ethical decision making. Personal values were found to influence ethical decision making. Similarly, Fritzsche (2007) in his study found personal values linked to ethical decision making and Mason and Madrack (1996) report that there exists a positive relationship between age and ethical decision making, the was the third most influencing factor relatively. Secondly, regarding factors for ethical judgement, corporate and individual values were found to be the most influential in this study. These agree with the findings of the following: Davis (2003) says that norms, symbols, rituals and other cultural activities centred on corporate values, while Glinow and McShane (2008) three factors influences and individual's ethical judgement, namely, ability to recognise it, ability to think through it and ability to make good judgement. And thirdly, one major impact found relative to this study of unethical decision behaviour is adverse quality of product. These finding ties with one of the finding of Hamzah et al. (2010) that say human factors play an important role in quality related problems in construction projects.

CONCLUSIONS

Respondents agreed that societal culture, personal value and perception are very influential factors on ethical decision of project managers; culture of the organisation is a direct reflection of the personal value of the project manager. Project managers must be aware of the dangers of unethical conducts and be willing to do something about them including committing to personal change. Education has a direct impact on reducing unethical conduct, the more you educate project managers about ethical issues the more they engage in ethical conducts. Corporate value and individual values are also factors which most influence the ethical judgments of a project manager regarding ethics, should corporates deliberately connect values to operations the chances of project success are very high. Improving ethical practice for the professionals could improve ethical performance in construction projects and production efficiency, Quality, cost containment and risk in the construction industry in South Africa.

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REDUCING MATERIAL WASTE WITH THE APPLICATION OF BUILDING INFORMATION MODELLING (BIM)

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Construction Professionals' effort is to reduce material wastage through the principle of right-first-time. Material waste directly affects the profitability of the contractor and it is a measure of competency and competitive advantage. The study aims to identify factors that contribute to waste in the South African construction industry and develop a flow chart through the application of BIM to mitigate these wastes. A questionnaire survey was conducted among construction professionals in the industry of KwaZulu-Natal province. Random sampling techniques was employed during the sample selection. A total of sixty-one (61) questionnaires were analysed for the study. Descriptive statistics was used in the analysis of data. Findings include that order errors (too much/too less), damage to work caused by other trades, lack of material control on site and last-minute change by client therefore rework are the major causes of materials waste on sites. The use of the developed flow chart on application of BIM in the delivery of a project is hereby recommended. Further advantages of BIM usage are: it has the most potential to address the causes of waste through practices such as, collaboration, detailing, visualisation and simulation clash detection and improved communication.

Keywords: Construction, Elimination, Material waste, Prevention.

INTRODUCTION

The largest portion of global pollution and waste generation stems from the construction industry (Ibrahim et al., 2010). According Begum et al., (2009) the industry generates up to 30% of total material waste. In the construction industry waste has been identified to be problem, not only does the waste generated during a construction project have an impact on the efficiency of the construction industry but also on the overall state of the economy of the country (Polat and Ballard, 2004). Designers usually argue that the generation of waste occurs on site during construction activities (Osmani et al., 2008), although design flaws, complexities and procurement contribute to waste generation. The UK Green Building Council (2013), states that 120 million tons of waste is generated by the UK construction industry. It has further been revealed by the Environment Agency (2001) that 13 million tons of the materials delivered to sites have never been used. In addition, an ineffective planning and control of materials on sites could lead to poor performance and undesirable project outcomes (Jayamathan and Rameezdeen, 2014). Construction material is a great contribution to the cost of a construction project; therefore, material wastage has an adverse impact on construction cost, contractor's profit margin, construction duration and can be a possible source of dispute among parties involved in the project (Enshassi et al., 2009). Building Information Modelling (BIM) is an emerging new tool that is recently being implemented by the Architectural, Engineering and

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Construction (AEC) industry (Succar, 2009). The BIM tool has been developed to motivate the design, operation and construction of a project by using computer generated BIM tools (Azhar et al., 2008). Further, this aids architects, contractors and engineers to have a visual image of what is being built in a digital environment, permitting them to detect possible difficulties at any stage in the project life cycle. Eastman et al., (2008) and Al-Mohgany (2006) state that wastage generated in a construction project can range up to 20% of the total material purchased for a project. Further, wastage affects the overall cost of the project which in turn decreases overall profit margins. Waste generation can be used as a measure of the level of competence of the contractor. Manthe (2008) states that the performance of the South African construction industry about quality, cost and project parameters of time is of a very low standard. The poor performance obstructs delivery of infrastructure projects in South Africa and is generally caused by waste during the construction life cycle (Han et al., 2007). The primary concern is whether the professional team on construction sites in South Africa is acquainted on the amount of material wastage and the steps required to remedy the solution.

Based on the foregoing, this study was initiated to assess the causes of material waste in construction projects delivery in the South African construction industry.

LITERATURE REVIEW

Waste defined

According to Augustine (2011), the unnecessary depletion of natural resources, environmental damage and unnecessary costs is known as waste. This can be avoided by improved waste precautions. According to Hosseini et al. (2012) and Formoso et al. (2002), a broader definition of waste is to include not only material waste, but also waste produced in a construction project such as waiting times, transportation times, and setup time.

Causes of waste

A study of attitudes toward the causes of construction waste by contractors and architects specifies that construction waste is related to construction activities such as procurement, material handling, and design and site operation. (Osmani et al., 2006).

Past studies on construction waste (Zakar, 2008; Lu & Yuan, 2011; Tam et al., 2007; and Osmani et al., 2008) reveal the causes of construction waste can rise from all phases of the construction lifestyle of which procurement, operational, material handling, design and residual waste are the major processes.

Procurement Waste

Procurement is essential to deliver a project on time, on budget and to a high quality (CIOB, 2010). It is very close in dealing with supplier, contractor or client for purchasing and ordering the construction materials. During the construction process, many projects faced procurement problems (Lu & Yuan, 2011; Tam et al., 2007, Gamage et al., 2009) these include; Packaging materials, ordering errors, use of low quantity materials, incorrect quantity estimation (Gamage et al., 2009 and Wong et al., 2008). According to Osmani (2013), there are three main causes of procurement waste related to tender and contract arrangements. These include errors such as: Incomplete tender documents as commencement of construction: Specifications and detailing under development; incomplete information from design team; not sufficient design and detailed information; disjointed information release schedule. Limited architect

input: lack of waste minimisation recommendations in tender documentation. Not entrenched in tender documentation: No implementation and target setting guidance; lack of waste minimisation tender agreements; no financial allocation of waste in the bill of quantities.

Operational / Construction Waste

Operational waste relates to the activities occurring on site which causes accidents, the use of incorrect materials, poor site management and supervision, errors by tradesman, poor site conditions, inadequate knowledge and poor workmanship (Gavilan and Bernold, 2011; Kofoworola & Gheewala, 2009). Waste during construction stage is classified into eight categories. These are material procurement, material storage, design changes and rework, site operation and residual, transit, material handling on site management and planning (Osmani et al., 2008; Osmani, 2013 and Al-Hajj and Hamani, 2011). Although Al-Hajj and Hamani, (2011) states that cultural related issues can also be a source to waste, i.e. lack of waste prevention training, lack of awareness and lack of incentives to reduce waste. Osmani et al. (2008) states that human error is the main cause of waste during construction. Labour on site has direct contact with materials being used and wasted therefore playing a major source in waste generation.

Material Handling Waste

Material handling occurs mostly once the material is on site, this involves incorrect storage methods and damage during transportation on site (Urio and Brent, 2006; Kofoworola and Gheewala, 2009; Lu et al., 2011).

Design

Design waste generally occurs before construction. An error in the contract document, poor coordination during design stage, complexities in design, poor project coordination, design changes, unclear specification (Pollat & Ballard, 2004; Urio and Brent, 2006; and Gamage et al., 2009), therefore a substantial percentage of waste is caused by errors that occur in the design stages. According to Innes, (2004), 33% of waste maybe influenced by design concepts. WRAP (2007a) states there is a bigger opportunity to reduce and avoid waste at the design stage than later stages. This is due to the reason that vital design changes relating to material shape, size and intricate designs are likely to have a greater impact on waste. Osmani (2013) identifies incorrect work on standard dimensions and unawareness of the causes of material waste due to design changes are substantial design waste producers. The generation of construction waste during design is because of inadequate communication and coordination therefore resulting in redundant on site off cuts (WRAP, 2007a). According to Babatunde (2012) material waste off cuts are a great source of waste during construction while Al-Hajj and Hamani (2011) argued that material off cuts due to design changes is out of the contractors control but that of designers. Although Osmani (2013) states that there is limited understanding by designers on the causes of design waste.

RESEARCH METHODOLOGY

A study titles reducing material waste with the application of BIM was undertaken to identify the causes of material waste and how BIM can be used to reduce waste. The study was conducted in Durban, South Africa. The questionnaire was distributed to all members of the Association of South African Quantity Surveyors (ASAQs), Consulting Engineers South Africa (CESA) and South African Council for Project and

Construction Management Professions (SACPCMP). The sample frame for the study consisted of construction professionals aimed at quantity surveyors, architects, and engineers in the construction industry. The sample selection aimed at 9 provinces: Kwa-Zulu Natal, North West, Western Cape, Eastern Cape, Limpopo, Free State and Northern Cape (Iemon et al., 2004). The research instruments for the study was a questionnaire survey. Statistical tools such as mean score, percentages and frequencies were used to analyse the data. For selecting samples, recommendations from Leedy and Ormrod (2010), were employed, a total of 210 questionnaires were distributed, with a response of 60 questionnaires returned. The probability sampling techniques was employed for sample selection. A random sample technique was employed. The research instrument was administered to respondents through an online survey link sent out by email.

FINDINGS

Data collated from the questionnaire presents the following; the average year of respondent's experience is 8 years. Most of the respondents were aged between 31 years to 40 years. The highest formal qualification is, Bachelor's degree (34%), B. Tech degrees and Master's Degrees (21.3%) respectively and lastly other related qualifications at (6.4%). Majority of the respondents were Quantity Surveyors (54.17%). Based on these demographic findings, the data can be deemed reliable.

Table 1 presents the causes of material waste on construction sites based upon their average mean scores. From table 1, it can be concluded that there is a contribution to waste at each stage in the project.

Table 1: Causes of material waste in construction

Factor	Mean Score	STD DEV	Rank
Procurement			
Material purchased does not comply with the specification	2.97	1.17	1
Unsuitability of material supplied to site	2.85	1.16	2
Substituting a material with an expensive one	2.31	1.07	3
Escalation of material price	2.30	1.00	4
Order errors (too much/too less)	3.12	1.16	5
Operational			
Damage to work caused by other trades	3.76	1.12	1
Delays in getting information to the contractor on specification of product to be used	3.75	1.22	2
Incorrectly placed material	3.66	1.24	3
Error by tradesman	3.64	1.09	4
Incorrect material used and therefore requires replacing	3.54	1.28	5
Incorrect construction methods	3.46	1.02	6

Shortage of tools and equipment	2.98	1.22	7
Constant breakdown of equipment	2.93	1.28	8
Inclement weather	2.46	1.15	9
Material Storage and Handling			
Lack of material control on site	3.88	1.01	1
Damage of materials on site	3.84	0.94	2
Waste from cutting irregular shapes	3.77	1.13	3
Poor methods of storage on site	3.60	1.04	4
Poor handling	3.42	0.82	5
Theft	3.23	1.04	6
Wrong methods of transport	3.19	0.99	7
Insufficient handling instructions	3.05	1.03	8
Design and Documentation			
Last minute change by client therefore rework	3.97	1.03	1
Design change whilst in construction	3.92	1.05	2
Lack of communication leading to mistakes and errors	3.73	1.06	3
Unclear/lack of information on drawing	3.29	1.23	4
Incorrect specifications	3.16	1.12	5
Complex detail on drawing	3.14	1.25	6
Poor site layout	3.12	1.14	7
Poor attention to dimensional co-ordination of product	3.09	1.11	8
Choice of low quality product	3.03	1.07	9

The factors with the most rating relative to the various sections are: material purchased does not comply with the specification (MS=2.97). This agrees with the findings of Gamage et al., 2009 and Wong et al., (2008) that during the construction process, many projects faced procurement problems such as packaging materials; damage to work caused by other tradesmen (MS=3.76) arguably because of the nonchalant attitude of trades' men and incorrect planning and clashes of trades. This agrees with the findings of Wahab and Lawal (2011) and Osmani et al., 2008 state that incorrect materials, poor site management and supervision, errors by tradesman are causes of operational waste; delays in getting information to the contractor on specification of product to be used (MS=3.75) this can be traced to the consultant inactiveness; lack of material control on site (MS=3.88) an indication of lack of adequate record keeping; last minute change by client therefore rework (MS=3.97) which could be due to insufficient briefing or change in taste. This agrees with the findings of Innes (2004) that 33% of waste maybe influenced by design concepts, and

design change whilst in construction (MS=3.92) that the previous reasons of causes could be advanced.

The least factors prompting waste in the various stages include, Order errors (too much/too less) (MS=3.12), inclement weather (MS=2.46), insufficient handling instruction (MS=3.05), and choice of low quality product (MS=3.03). These are actions that a construction manager would hardly neglect. Therefore, they have no consequences.

BIM'S REDUCTION OF WASTE FLOWCHART DEVELOPMENT

Stemming from the survey conducted, it is established that there is huge materials waste on building construction sites and various reasons have been adduced for this. Therefore, the development of a flowchart was embarked on to reduce drastically waste on building construction projects.

It has been identified that BIM is implemented through each stage to create a 3D model with the ability to aid construction activities with amplified scheduling and sequencing focused in the construction phase. For this study, an approach aimed at the contractor was designed, which represents the components and description of BIM's advance tools to aid in waste minimisation. The BIM process enhances efficiency of the structural, service and architectural design for virtual waste minimisation. BIM's multi design specification, communication and coordination tools are used to aid in waste minimisation. Architectural, structural and services components of each design are created using a simple model for accurate dimensional coordination. The BIM process enhances efficiency of the structural, service and architectural design for virtual waste minimisation. BIM's multi design specification, communication and coordination tools are used to aid in waste minimisation. Architectural, structural and service components of each design are created using a simple model for accurate dimensional coordination.

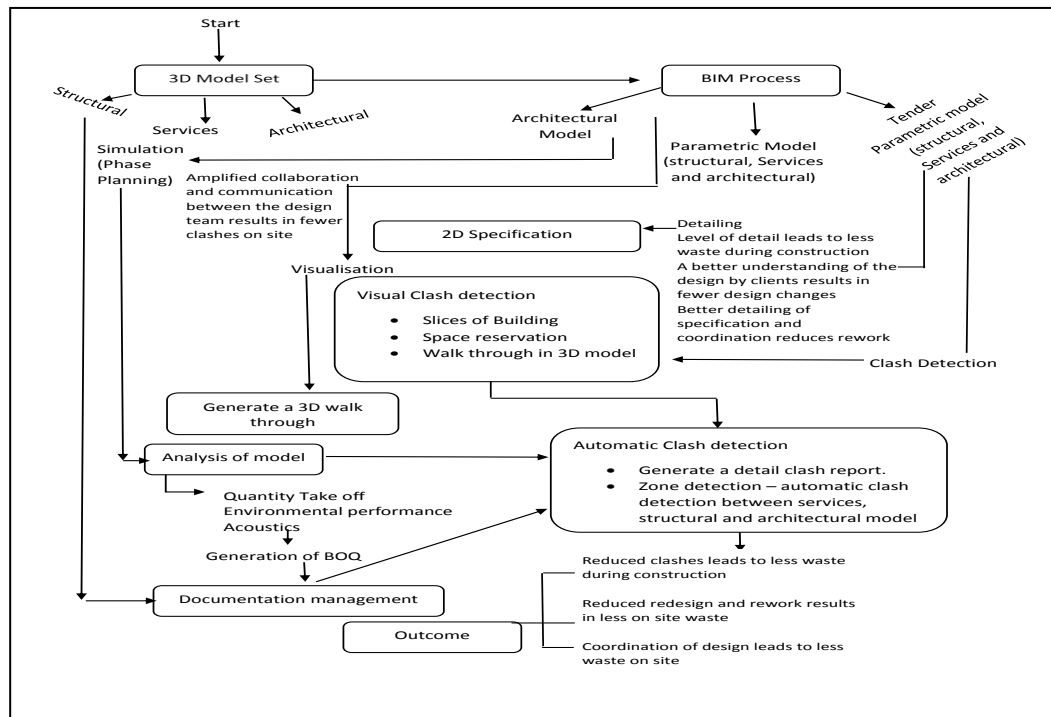


Fig 1: BIM's waste reduction flowchart

The Flowchart Process

Stage one – Information is captured into the program by the design team; Architect for layout information and design specification, Engineers for elevation detail and service detail.

Stage Two – The programme combines all information provided in the process above to create individual models. The models are combined and compared, which is known as Simulation (phase planning), based on integration of a schedule. It provides a plan indicating the construction sequence and space requirements. The BIM model allows for the planning of materials, equipment and labour to resolve workspace conflicts prior to the construction process.

Stage Three - Each member of the design team captures specifications relative to their process in detail. This includes material specifications, plant specifications and resource schedules.

Stage Four, Five and Six - The clash detection process compares 3D models of the building and eliminates any conflicts with trades involved in the project prior to construction. A detail clash report is generated that indicates task clashes, programme clashes, clashes between different trades and clash of services to name a few. A change in drawing revisions during construction will raise a flag to all members of the design team prior to the occurrence of the event.

Stage Seven – the model is rectified and created. A 3D walk through model is now accessible to members of the construction project. Documents are kept electronically and are easily accessible to any member. A BOQ is generated and updated with each revision change. Quantity take offs are provided by the programme as well as a detail list of when materials are required. Material waste during construction is generated because of poor planning and procurement procedures. BIM aids in a quantity take off as it accurately estimates the amount of raw materials required during construction.

CONCLUSIONS

It has been identified that the construction industry is a major contributor to waste generation and contributes to the depletion of raw materials in the construction industry. The main contributors to waste are: order errors, damages to work caused by other tradesmen, lack of material control on site and last-minute change by client therefore leading to rework. It is therefore recommended that the developed flowchart on the application of BIM for project delivery be used. The outcome of this study should assist the design team and construction team to reduce material waste and lower costs. Contractors in South Africa need to equip themselves with the latest tools to assist them in managing a project from design to operation in the most cost-effective way.

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EFFECTS OF CLIENT CHARACTERISTICS ON TEAM PERFORMANCE IN CONSTRUCTION PROJECT DELIVERY

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Understanding client characteristics and attributes and its impact on managerial effectiveness and team functions has become an important issue for stakeholders and practitioners in construction project management. Despite the significance of the knowledge of the effects of client characteristics on team functions and effectiveness, research focusing on delineating the contribution of client characteristics to team function is lacking. In addressing this gap, a quantitative design was set out to determine the effects of client characteristics on project team function in construction project delivery. Primary data was collected by questionnaire survey on experienced practitioners purposively sampled in construction project delivery in South Africa. Using SPSS version 22, the data was analysed using Spearman rank correlations due to its appropriateness for evaluating existence and nature of relationships between variables. The findings revealed a significant effects of client characteristics such as client type, client experience and Client approach to price competition and team function. Additionally, Client responsibility for outcomes, Client willingness to be involved in delivery and Internal technical capabilities of clients had significant influence on communication, conflict management, team cohesion and Team Consensus & Decision-Making Strategies attributes of team performance. Interesting, Client approach to risk and design input characteristics indicated no significant effect on team performance. The understanding of the significance of client characteristics on team performance is in no doubt very critical for improving project coordination, promote collaborative relationships and overall project performance. Hence it is thus considered important to team performance by understanding the behavioural and organizational cultural characteristics of clients in construction project delivery.

Keywords: Team performance, Client characteristics, Project teams.

INTRODUCTION

Plethora of literature have enumerated various factors that have significant impact on team performance, project performance and managerial effectiveness in construction project delivery. Amongst these, supply-chain relationships, team dynamics and characteristics, project complexities, client characteristics, culture and communication are ranked high as notable significant factors influencing team function and performance (see Sha'ar et al., 2017; Loosemore and Richard, 2015; Ochieng et al., 2013; Ibrahim et al., 2011; Kelly, 2011; Morwood et al., 2008; Rahman and Kumaraswamy, 2008; Ross, 2008). Even though the role clients play in construction project delivery is unquestionably very significant, there is seemingly lack of understanding of their impact on team performance. Indeed, construction project clients have become deeply involved in the construction process and responsible for several decisions and actions that have direct and indirect impact on team performance and managerial effectiveness (Ross, 2008; Kelly, 2011; Nam and Tatum, 1997;

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Loosemore and Richard, 2015). Loosemore and Richard (2015) and Nam and Tatum (1997) intimated that, the role clients play in construction project delivery is copiously different compared to the passive role by clients (customers) in other industries where an individual client has very little influence.

According to Love et al. (2010), clients exhibit various characteristics that are important in the construction industry because, these characteristics influence procurement choices, key decisions and performance outcomes. It has been suggested that, client characteristics related to client sector, client experience and client approaches significantly influence project outcomes (Gibb and Isack, 2001; Manley, 2006; Morwood et al., 2008; Ross, 2008; Love et al., 2010). Morwood et al. (2008) and Kelly (2011) likewise opined that, it is the combined effect of the client sector, client experience and client approaches characteristics that is thought to be most influential on project and performance outcomes, rather than the influence of individual factors. From literature, there is generally some notable consensus indicating that, there is some element of bi-directional relationship between client characteristics and team functions, project performance, managerial effectiveness and team effectiveness (Sha'ar et al., 2017; Ibrahim et al., 2011; Love et al., 2010; Morwood et al., 2008; Ross, 2008). However, existing research have primarily focused on exploring the effects of client characteristics on project success, project performance and risk performance (see Lahdenperä, 2012; Kelly, 2011; Morwood et al., 2008; Ross, 2008). It can be said that; little empirical evidence exists to offer an in-depth understanding of the effects of client characteristics and behaviours on team function and performance.

Gaining understanding of the characteristics and behaviours of clients and how they impact on team performance is considered as a precursor for effective management of teams and client relationships which is crucial to project success and team effectiveness in construction project delivery. Given the lack of knowledge about taxonomy of effects client characteristics have on team function, the focus of this paper is to identify the inherent effects of client characteristics on team function and performance. The understanding of the effects of client characteristics on team function is particularly significant in the wake of overwhelming recognition to engender more effective and collaborative relationship between client and project teams in construction project delivery (see Parker, 2008; Fong and Lung, 2007; Acharya et al., 2006). It can also be considered important in reducing the uncertainties associated with team functions towards meeting the goals and expectations of construction clients.

CLIENT CHARACTERISTICS

The roles, performance and functions expected of project teams by clients could be varied and influenced by the attributes and characteristics of clients. It is said that, client attributes and characteristics could fuel uncertainties in team task function and performance (Manley and Chen, 2016; Morwood et al., 2008; Rahman and Kumaraswamy, 2008). Hence, to deal with team function uncertainties, it is extremely important for project leaders and participants to gain insights into the client characteristics and how these characteristics influence their function as a project team. Plethora of existing literature emphasize the role of clients in construction project delivery as very significant not only in choosing the most appropriate procurement model but are also important in team selection (Osipova and Eriksson, 2011; Chen and Manley, 2014; Loosemore and Richard, 2015). In collaborative working models, Love

et al. (2010) argued that, client play an active role in project delivery which significantly impact on the dynamics of the delivery process. In this regard, it has sternly been opined that, the taxonomy of the attributes and characteristics of the client are important in the construction industry because these attributes and characteristics significantly impact on the team function, team integration, managerial effectiveness and performance outcomes (Love et al., 2010).

Over the past decades, understanding the key attributes and characteristics of clients has been pursued in the construction industry as an agenda towards improvement in performance, team cohesion and behavioural relationships (see Loosemore and Richard, 2015; Love et al., 2010). However, it is difficult to point to any study delineating client typologies and characteristics in construction management literature. From extant literature, it is noted that, client sector, client experience and client approach to price competition are three key client characteristics that have significant impact on project performance (Gibb and Isack, 2001; Manley, 2006; Morwood et al., 2008; Ross, 2008; Love et al., 2010). These taxonomy of client characteristics follow the four broad dimensions of organizational client typologies based on sector, experience, profile and structure by de Blois et al. (2011). Hughes et al. (2012) also intimated that, client characteristics in the form of client sector, client experience and client approach to price competition are extremely significant in collaborative processes and alliancing activities in project delivery. Drawing on the sector attributes, a client could be described as either public or private whilst in terms of experience, a client could be perceived as having adequate or inadequate experience (Ross, 2008; Kelly, 2011; Tamburro and Wood, 2014; Liu et al., 2015).

In relation to client approach to price competition, the argument is whether a client is more likely to rely on price competition in awarding contracts or other attribute perceived more relevant than the price (Tamburro and Wood, 2014). This notwithstanding, it is generally perceived that, public client is more experience in procurement of major infrastructure and are more likely to rely on price competition in awarding contracts, than private sector clients (Manley and Chen, 2016; Ross, 2008; Tamburro and Wood, 2014; Liu et al., 2015). These three client characteristics are often argued as having an intertwined and multi-causal influence on team function, task performance, decisions, managerial effectiveness and project outcomes (Ross, 2008; Tamburro and Wood, 2014; Liu et al., 2015). However, there is seemingly lack of consensus among practitioners and stakeholders in construction management genre as to which type of client better suit team function and collaborative working (Ross, 2008; Kelly, 2011; Tamburro and Wood, 2014; Liu et al., 2015). Other arguments advanced are purely based on the experience of the client in understanding the procurement environment in the project delivery as pivotal (Kelly, 2011; Tamburro and Wood, 2014). These arguments notwithstanding, there is a consensus that, the client attribute in the form of the sector, experiences and client approach to price competition are critical characteristics that must be pursued to gain understanding to engender performance, team function and delivery success (Manley and Chen, 2016; Jefferies et al., 2014; Lloyd-Walker et al., 2014; Walker et al., 2015).

Liu et al. (2015) captured responsibility for outcomes, willingness to be involved in delivery, internal technical capabilities and approach to risk and design input as five critical client characteristics. From a critical synthesis and critique of the submissions by Liu et al. (2015), it can be deduced that generally, approach to risk are embedded in approach to price competition evaluation (see Bresnen, 2010; Chan et al., 2010). In this regard notable studies tend to leave out approach to risk as a client characteristic

(see Davis and Love, 2011; Asmar et al., 2013; Fu et al., 2014; Gibb and Isack, 2001). However, in the South African Construction Industry, approach to risk are varied and detailed beyond the price competition, hence approach to risk was considered as not embedded in client approach to price competition. Morwood et al. (2008) and Lenferink et al. (2012) have clearly delivered a verdict that indicate that, public client is more stable and clear in their objectives and expectations of the project team than private client. However, private client is perceived to have more active roles in project delivery than public client (Morwood et al., 2008). In the opinion of Alharthi et al. (2014) private clients in their bid to meet deadlines and offer returns to stakeholders present undue demands on project teams than public clients. In respect of experience, there seems to be lack of consensus as some perceive clients experience as important to team function, others think this is not relevant (Manley, 2006; Hartmann et al., 2010; Love et al., 2011). This is because, the team selected are endowed with the supposed experience expected of clients (Hartmann et al., 2010; Love et al., 2011). However, Love et al. (2011) contended that public client often exhibit good knowledge and experience while private client most often rely on the experience of the team. A plausible explanation to this is that, most public client organizations in many countries including South Africa tend to have technical departments with professionals that perform the technical functions of their organizations to the project team. Morwood et al., (2008) stated that, for effective team function, clear inputs from client are vital and thus even though private clients are often actively involved in designs, their inputs are sometimes not clear enough compared to public clients.

Against the background of the client characteristics delineated in these sections, it should be noted that, this study focused on the attributes of client sector (private or public), client experience, client approach to price competition, responsibility for outcomes, willingness to be involved in delivery, internal technical capabilities, approach to risk and design input for the study.

TEAM PERFORMANCE

Team approach to task performance are thought to better provide a directed and collaborative effort to address complex task concerns justifying the significant increase in reliance and dependency on teams in project delivery (Parker, 2008; Forsyth, 2006; Levi, 2007). Understanding the tenets of team performance has gained attention in performance management literature (Parker, 2008; Gorse and Emmitt 2007). From literature team concept, team performance has been studied and conceptualized in a generalized framework that embraces input, process and outcomes (Levi, 2007; Parker, 2008; Forsyth, 2006). The input component focuses on the resources, processes entails collective efforts of the team whereas the outcome comprises of the specific performance indicators (Azmy, 2012; Kirkman et al., 2004; Bass et al., 2003). It is well acknowledged that team performance evaluation based on inputs and outcome has been extensively pursued in various domains (see Parker, 2008; Forsyth, 2006; Kirkman et al., 2004). However, Forsyth (2006) contended that theoretically and practically, the inputs and outcome in team performance evaluation are more likely to vary from team to team as well as the context of measurement. Additionally, the input and outcome in the construction project environment could be largely dynamic and very unstable due to factors such as varying behaviours, team characteristics, project typology and complexities as well as project goals. Conversely, conceptualizing team performance as process-type performance is considered ideal towards engendering team integration, team

effectiveness and cohesion in task performance (see Ibrahim et al., 2011; Chowdhury, 2005; deVries et al., 2006; Bass et al., 2003).

It can be posited that conceptualizing team performance as a process-oriented construct has traditionally been accepted and engendered (see Salas et al. 2009; Parker, 2008; Levi, 2007; Fong et al., 2007; Katzenbach and Smith 2005). The pivot of this study is to engender improvement in team work, process and cohesion in the South African Construction industry. In the opinion of Dionne et al. (2004), conceptualizing team performance as a teamwork process construct enables theoretical linkages related to interpersonally based processes that are likely present across all team typologies. Against this, the study focused on the process-oriented approach to team performance. Salas et al. (2009) established that, team process-based performance may encompass the quality of the interpersonal relationship as well as the level of collective effort expended on tasks. Other studies following this team process-based paradigm also, focus on communication, conflict management and cohesion as the linkages related to interpersonally based processes that are likely present in all teams (Salas et al., 2009; Forsyth, 2006; Bass et al., 2003).

Dionne et al. (2004) intimated that, cohesion in teams are crucial and is a single determinant that assures team performance. Shaw (1976) in a seminal study on team performance defined cohesion as the degree to which team members are motivated to stay in a team throughout their task function. Katzenbach and Smith (2005) on the other hand highlighted that, less absenteeism, active and participatory involvement in team activities and high level of coordination during team task function are the traits of highly cohesive teams. Additionally, cohesive teams are also conceived to have satisfaction, enhanced productivity and effective interactions (Parker, 2008; Salas et al., 2009). Azmy (2012) on the other hand accounted cohesion as a critical motivational factor that influence team performance. In the context of communication as process-based team performance attribute, Dionne et al. (2004) revealed that, increased listening, openness to suggestions, and giving prompt, relevant feedback are indicators of high performing team. Likewise, other researchers such as Salas et al., (2009) perceived communication one of the critical factors that address teamwork process principles.

In evaluating team performance following the process-based approach, conflict management is also accepted as a key determinant (see Parker, 2008; Salas et al., 2009; Dionne et al., 2004). Even though, conflict in teams are inevitable in groups and teams, conflicts could result in tensions which has the propensity to impede decisions in teams (Katzenbach and Smith 2005; Forsyth, 2006; Acharya et al., 2006). Gorse and Emmitt (2007) on the other hand intimated that, sometimes, conflict can be a healthy leading to awakening members to alternative points of view and stimulates creativity in problem-solving and decision-making. In this regard, effective management of conflicts actions through collaboration and competition could increase team performance in task related process (Gorse and Emmitt, 2007; Parker, 2008; Acharya et al., 2006). Team consensus and decision-making strategies has been considered as an essential factor in process-based team performance, however most studies have overlooked it (Gorse and Emmitt, 2007). Gorse and Emmitt (2007) revealed that high performing teams tend to follow laid down protocols in decision making and tend to use consensus approach whereas the reverse is common to non-performing teams.

In this study, the evaluation of the team performance will be based on the process-based approach using communication, conflict management, cohesion in team and team consensus & decision making strategies as the related indicators (Azmy, 2012; Levi, 2007; Gorse and Emmitt, 2007; Parker, 2008; Forsyth, 2006; Salas et al. 2009; Fong et al., 2007; Katzenbach and Smith 2005; Acharya et al., 2006; Bass et al., 2003).

RESEARCH METHODOLOGY

Fellows and Liu (2008) and Creswell (2009) indicated that, Quantitative research designs are most suited for testing and assessment of causal relationship and influence among variables. Drawing on this, this study mainly adopted, a quantitative research approach exploring the effects of client characteristics on team performance using a questionnaire survey. A total of 156 questionnaires were distributed to project team participants in the South Africa Construction Industry (SACI) who were selected by quota sampling from the register of active practitioners of each domain in the industry. The target project team participants consisted of Project Managers, Architects, Construction & Contracts Managers, Quantity Surveyors, Engineers (Civil, Structural & Mechanical), Main & Sub-contractors and Suppliers. The focus of these as the nucleus of the respondents is because, theoretically, they form the core participants that are directly and indirectly responsible to the client's goals and objectives of the projects and have direct or indirect contractual relationship with the clients. Quota sampling was adopted to allow for input of all team participants that are directly or indirectly affected by the client's actions, decisions and behaviour on their task functions and responsibilities to the client so that the results can reflect practical and theoretical reality (Pilot and Beck, 2004; Creswell, 2009).

The questionnaire was designed in a matrix form and the respondents were invited to respond via google form by indicating from their experience the extent the various client characteristics impacted on the performance of the project team which they were involved on a conventional five-point Likert scale. The background of the respondents focused on their professional roles and their years of experience in team work in the SACI. Following a 21-day period, 51 responses were retrieved forming a response rate of 33%. Spearman rank correlation coefficient was used to explore the extent of influence of the client characteristics on team performance. The choice of this analytical approach was due to suitability in investigating the existence of relationships between variables (Hair et al., 2010). Even though, the use of Structural Equation Modelling and Ordinary Least Square Regression would have been most appropriate analytical approach, the relatively small response of 51 does not suit them (Hair et al., 2010). However, Takim et al. (2004) recommended a response rate of 20%-30% as norm for a questionnaire survey, it can be said the yielded response rate of 33% could be considered as adequate and acceptable for the statistical analysis. The use of the Spearman's correlation analysis over other suitable forms was primarily due to its less sensitivity to skewness and outliers in rank and categorical data (Field, 2009).

The significance level was set at 95% and 90% confidence interval in accordance with conventional risk levels in construction management research (see Takim et al., 2004; Hair et al., 2010). The strength of relationship (r) between the variables was also interpreted as 0.00-0.19 'very weak', 0.20-0.39 'weak', 0.40-0.59 'moderate', 0.60-0.79 'strong' and 0.80-1.0 'very strong' with negative or positive sign showing the direction of relationship (Field, 2009).

FINDINGS AND DISCUSSIONS

Profile of Respondents' Background Information.

The cluster of respondent's profile were: Project Manager/Leader (22%), Construction/Contract Manager (14%), Architect (12%), Quantity Surveyor (37%), Engineers (Civil, Structural & Mechanical) (12%) and Contractors (4%). Their years of experienced were also as 0-5 years (47%), 6-10 years (33%), 11-15 years (16%) and above 16 years (4%). From this it can be said that, except for sub-contractors, there is a contribution from almost all the participants of the traditional project team. Likewise, the taxonomy of experience suggests that, more than 50% of the respondents have over six years of experience which is an indication that, the experience and expertise of the respondents is adequate, respectable and are more likely to offer valid and reliable responses which will reflect a credible representation of the impact of client characteristics to team performance in SACI.

Correlation Analysis: Effects of Client Characteristics on Project Team Performance

The Spearman's rank correlation coefficient analysis was used to explore the extent of influence or effect of client characteristics on the performance of project team. Preliminary test of skewness indicated that most means on the variables were greater than the median suggesting a positive skewness (Field, 2009). This made the use of Spearman's rank correlation coefficient analysis paramount due to its less sensitivity to skewness and outliers in rank and categorical data (Field, 2009). The results from the correlation analysis provide evidence of the extent of the relationship between client characteristics and project team performance. The summary of the correlation analysis is presented in Table 1.0. From Table 1.0, the results indicate that the client sector (public or private) have significant moderate positive correlation with communication ($r=0.532$, $p < 0.01$), and weak positive correlation with Team Consensus & Decision-Making Strategies ($r=0.283$, $p < 0.01$) performance attribute of the project team. In respect of conflict management ($r=0.187$, $p < 0.05$) and team cohesion ($r=0.576$, $p < 0.01$) performance attribute of the team, only private client sector attribute showed very weak and moderate correlation respectively. From the point of Client Experience (Experienced or Inexperienced clients) as a client characteristic, the results showed varied significant relationship with the team performance attributes. In this respect, client experience as a characteristic showed no significant influence on communication and Team Consensus & Decision-Making Strategies. However, experienced client exhibits significant weak correlation with team cohesion ($r=0.184$, $p < 0.05$) whereas inexperienced client significantly had positive weak correlation with conflict management ($r=0.217$, $p < 0.05$) performance of the team.

Table 1.0: Spearman rank correlation of Influence of Client Characteristics on Team Performance

	Impact of Client Characteristics on:			
	Communication	Conflict Management	Cohesion in team	Team Consensus & Decision-Making

Client Characteristics							Strategies	
	Spearman's rank correlation coefficient ρ	Statistical significance p (Sig. (2-tailed))	Spearman's rank correlation coefficient ρ	Statistical significance p (Sig. (2-tailed))	Spearman's rank correlation coefficient ρ	Statistical significance p (Sig. (2-tailed))	Spearman's rank correlation coefficient ρ	Statistical significance p (Sig. (2-tailed))
Client Sector Public Private	0.532*	0.000	0.172	0.065	0.088	0.076	0.283*	0.001
	0.361*	0.000	0.187*	0.008	0.576*	0.001	0.264*	0.003
Client Experience: Experienced Inexperienced	0.082	0.216	0.033	0.724	0.184*	0.004	0.052	0.064
	-0.019	0.084	0.217*	0.003	-0.025	0.681	0.096	0.080
Client approach to price competition	0.058	0.522	0.108	0.246	0.094	0.286	0.201*	0.002
Client responsibility for outcomes	0.356*	0.000	0.005	0.466	0.034	0.107	0.018	0.089
Client willingness to be involved in delivery	-0.246*	0.009	0.094	0.170	0.479*	0.000	-0.572**	0.000
Internal technical capabilities of clients	0.103	0.061	0.228	0.112	0.101	0.072	0.522*	0.000
Client approach to risk	0.010	0.408	0.068	0.440	0.016	0.092	0.106	0.098

and design input								

Note: *, **Significant at the 0.05 and 0.01 levels, respectively (two-tailed)

The results further showed that client approach to price competition characteristic has a weak positive significant correlation with only Team Consensus & Decision-Making Strategies ($r=0.201$, $p < 0.05$) performance of the project team. Client responsibility for outcomes as a characteristic of client also has a positive weak significant correlation with only communication ($r=0.356$, $p < 0.01$) performance of the project team. In the case of Client willingness to be involved in delivery as a characteristic of client, the evidence provided suggests a weak negative significant correlation with communication ($r=-0.246$, $p < 0.01$), moderate positive correlation with team cohesion ($r=0.479$, $p < 0.01$) as well as moderate negative correlation with Team Consensus & Decision-Making Strategies ($r=-0.572$, $p < 0.01$) performances of the team. It was also noted from the results (see Table 1.0) that Client approach to risk and design input characteristics does not have any significant relationship with any of the team performance attributes. However, there was a positive moderate relationship between the internal technical capabilities of clients and the Team Consensus & Decision-Making Strategies ($r=0.522$, $p < 0.01$) performance of the team. The results overall shows that, even though, client characteristics are deemed to make significant influence on project team performance, the findings suggest a varied correlation with the project team performance attributes in respect of communication, conflict management, team cohesion and Team Consensus & Decision-Making Strategies.

DISCUSSION OF FINDINGS AND IMPLICATION

As observed from the results, client sector characteristics had a positive relationship with communication performance of the project team in construction project delivery. This implies that, an efficient and responsible public or private client is likely to positively influence the communication performance of project team in project delivery. Fong et al. (2007) and Dionne et al. (2004) noted that, increased listening, openness to suggestions and prompt and relevant feedback from clients and project teams are crucial for effective sharing of project information that are crucial for task functions and decisions. Practically, it can be said that, open and effective inter and intra organizational communication within a team and the client is critical for attaining the project goals as well as daily team activities (Fong et al., 2007). Generally, project teams tend to rely heavily on information and feedbacks from client that are critical to the progress of the project. In this regard, in many developing countries, anecdotal evidence seems to suggest that, private clients tend to offer prompt response to requests and decisions that are critical to the progress of tasks and decisions of the project team. However, in the case of public client, there appears to be that due to bureaucratic process and need for further clarification and approval from higher authority, feedbacks and decisions that are needed by project teams tend to delay. Against the background of the significance communication play in project delivery, it is important for project teams to adapt techniques to improve communication between client sectors types that can offer prompt responses to decisions and feedbacks.

Additionally, the results further indicate that, Client responsibility for outcomes and Client willingness to be involved in delivery has a significant relationship with project

team communication performance. Tran et al. (2017) have revealed that, though acceptance of project outcomes by clients is considered critical to project success, lack of effective communication between project teams and client is partly responsible for lack of acceptance of project outcomes by client. In this regard it can be suggested that, lack of involvement of client is likely to affect the communication performance among project teams. Bresnen (2010) contended that the involvement of client in the delivery of construction project is an essential driving impetus that facilitate decisions and feedback. However, it must be noted that, in as much as this is beneficial, it must also be learnt that it comes with it antecedent communication challenges. Salas et al. (2006) revealed that, communication challenges increases when more people are involved in the communication networks hence client involvement must be managed to ensure effective communication performance.

The results further revealed that, the client experience has a positive correlation with conflict management as well as team cohesion. Hughes et al. (2012) suggested that, experienced client tend to offer stable environment for team work through their understanding and contribution to the project. They are deemed to be consistent compared to inexperienced client. From these results, it can be argued that, the stability and clarity offered by experienced client is more likely to be the explanation for the positive relationship with conflict management. This is plausibly because the more client is experienced, the more are they likely to behave in a way that is likely to reduce conflict and adversarial disagreement among project teams.

According to Dionne et al. (2004) and Katzenbach and Smith, (2005) cohesion in teams and Team Consensus & Decision-Making Strategies are the tenets of successful teams. In this study, Client willingness to be involved in delivery and Internal technical capabilities of clients as characteristics of client have been determined to have significant correlation with these two critical team performance indicators. From the perspective of Katzenbach and Smith, (2005), over indulgence of client in team activities and project delivery process tend to have adverse effect on the level of coordination during team task functions and thus could results in team break down. It must be noted that, client involvement in in team work could be beneficial when managed well. For example, Bass et al. (2003) noted that, when clients and owners are deeply involved in the decision process of activities, it enhances team integration and performance. This is because there is the incidence of prompt response and feedback as well as decisions that facilitate task function and progress. Additionally, the emergence of internal technical capabilities of clients having significant relationship with team performance is consistent with suggestions and opinions of Manley and Chen (2016). They revealed that client organizations with department who have technical capabilities offer the needed support to consultants and project teams that ordinarily the top management could not deliver. However, practically, when this is not handled well, it could lead to problems when the management is not made aware of all the assistance that required their approval.

CONCLUSIONS

Understanding client characteristics and its influence on Project Team Performance has increasingly gained attention amidst the need to improve project delivery success and client satisfaction. This study has explored the relationship between typologies of client characteristics and team performance in construction project delivery. The findings revealed that client sector type, client experience, Client approach to price competition, Client responsibility for outcomes, Client willingness to be involved in

delivery and Internal technical capabilities of clients as key attributes of construction project clients have varied significant correlations from very weak to moderate relationship with team performance based on experience and opinions of practitioners in the South African Construction Industry. It further revealed that, whereas there was evidence of predominantly positive correlation between client attributes and team performance, there were also some significant negative relationships in some cases. The assessment given by this study indicate that client characteristics had significant relationship with the communication, conflict management, team cohesion and Team Consensus & Decision-Making Strategies attributes of team performance. It is clear from the findings that the relationship between client characteristics on team performance cannot be overlooked. The findings thus have potential implications for client management and improving team cohesion in project delivery.

The knowledge and understanding of the relationship between client characteristics and team performance could be useful to practitioners and stakeholders in construction project delivery in project interface management as well as exploring decision making style, communication and team cohesion and conflict management as a predictor of team effectiveness and performance by providing evidence-based justification for devising and implementing such strategies. Such approaches could significantly contribute to improving team performance and task functions in project delivery towards mitigating potential adversarial influence of client characteristics on team performance.

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THE ROLE OF CONTRACTORS' SITE PERSONNEL IN COST CONTROLLING PROCESS

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It is the responsibility of every contractors' site personnel involved in a project to ensure that the work is executed within the allowable costs of the project and thus ensuring the effective cost controlling. Therefore, different site personnel have different responsibilities on site for effective cost controlling. The purpose for this paper is to examine the involvement of site personnel in cost controlling process during construction. The study was done through quantitative method and the data were collected through electronic questionnaire. Total of 100 contractors, registered with CIDB from three to seven general building grading, were randomly selected to participate on the study. The results show that site Quantity Surveyors are most involved in cost controlling process followed by Contracts Manager, Foremen and Site Clerks of Works respectively. Health and Safety officers are the least involved in the process. The study has identified the gap of the contractors' personnel who are involved and not in the process of cost controlling and how it can be improved.

Keywords: Cost Control, site personnel, SMMs.

INTRODUCTION

The contractor targets to optimise profits from every project to sustain the business. To meet such targets, the management needs to implement effective procedures for controlling costs for each project.

In a typical construction company, there are three tiers of management levels, namely: top management, middle management and lower management level. Personnel within top management level include Managing Directors, Contractors Directors, Commercial Directors and Chief Quantity Surveyor/Estimator. These personnel are mainly based at the head office. In middle management level we have personnel such as Contracts Manager, Site Quantity Surveyor, Site Agent, Site Clerks of Work and Health and Safety Officer. The personnel such as Foremen, Charge Hands and Supervisors are categorised under low management level. Middle and low management level personnel are site-based ensuring the project is executed effectively.

It is the responsibility of every personnel member involved in a project to ensure that the work is executed at most of the allowable costs at tender stage and thus ensuring the effective cost control. Different personnel will then have to collect information of all cost-related items on site for the management to make informed decisions. The effective cash flow management can be achieved through a proper site cost control.

According to Robert and Tichacek (2005), cost management is a process and not a discipline, requiring integration of effort and inputs from different personnel using prescribed procedures. Therefore, each personnel have an important role to play in managing cash flow

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According to Otim, Nakacwa and Kyakula (2011), cost control can be achieved by selecting the right man for the right job, the right equipment and tool for the right work and the right quality of material at right quantity, delivered at right time from the right source. According to Seeley (1997), many construction companies become insolvent through poor estimating and planning, ineffective contract control or inadequate site cost control. Malongane (2014) proves that lack of financial management skills by the small and medium contractors is one of the contributing factors towards the failure to their development.

How can involvement by all site personnel in cost controlling process be improved for the management to effectively control the costs.

PROJECT COST CONTROL

In a perfect world, everything works accordingly but in the real world of project control, the tale is often less than perfect with numerous hindrances and disappointments (Basak, 1998). Experts in project cost controlling know how to successfully manage and control project's costs. However, simply knowing what should be done without action plan is not enough.

Cost control comprises of monitoring actual costs incurred during construction phase against the cost allowed for at estimating stage and identifying the difference. Cost control in construction plays a key role during the construction stage, which determines the economic benefits of construction company (Jianbing and Jianliang; 2016). Project cost control is a key factor to ensure that project objectives are met through the collection and presentation of accurate and sufficient information to the management for taking informed decisions.

Project cost control is not a one man's show, but it requires and involvement of all parties. Therefore, management is dependent on the status of project's cost control, forecasted data and recommendations from site to make informed decision.

This activity is not performed on a computer only but requires one to be pro-active as far as collection of information is concerned.

The following are the basic steps for project cost control cycle:

1. Develop a baseline- The first step is to clarify the reference baselines of the project. The biggest challenge with projects is the lack of defined scope of work, resulting in a constant variation, budget increase and schedule adjustments.
2. Accumulate/collect data- The data must be collected as the work progress to measure the progress and performance.
3. Evaluate and analyse findings-The data collected is now critically analysed at this stage by comparing actual progress versus projected status and identify variances as well as their causes. The key will be to focus on items that are most likely to impact the project
4. Forecast- The data analysed will now be used to forecast final cost and compare to the actual reference baseline. Both hard and soft information must be consolidated to generate a realistic picture of the most probable outcome, tempered by sound judgement and experience.
5. Recommend (to support decision making) - To bring the project back on track, various alternatives such as budget shifts and adjustments to contingency allocation are considered. The project cost controller must be able to communicate findings and

recommended action steps in an understandable way to the responsible personnel to implement.

INVOLVEMENT IN COST CONTROLLING

“The major question being asked daily is ‘who controls the costs’? Cost controlling is a project team effort” Basak (1998). He further explained that the project personnel, from consultants to contractor, need to play an active role in controlling costs against the estimates. Cost controlling requires procedures that can only function with information development and knowledge hand-off and improvements. This is made possible through tasking of work, collection, assessment, analysis, and strategic decision-making process. He further explains that cost control is a management function and responsibility and must be performed by different personnel using recordable and repeatable procedures.

Effective cost control will require an effective collaboration between personnel of different roles and expertise. It demands that all personnel using management procedures cooperate in a synergistic manner. Cost management practice areas are too often sub-divided and individually tasked, allowing only minimal information exchange or knowledge improvement between silos.

Cost controlling shouldn’t be assigned as a stand-alone task to be performed by the single team member but requires participation from different levels. Cost is not managed by any software or tool. Tools can simplify or facilitate the tasks of keeping record and reporting cost, but the cost management process is dependent upon properly estimating, allocating, measuring and analysing cost performance. Therefore, management will require that information analysed, and action implemented.

Robert and Tichacek (2005) explains that cost management focuses on measuring performance, comparing against projections and actual reasons for divergence on a project. He further explains that effective cost control will require the involvement and interaction between team players of different roles and skills (Robert & Tichacek, 2005).

COMMUNICATION BETWEEN DIFFERENT PERSONNEL

Although it is perceived that the Quantity Surveyors are responsible for all financial aspects both in client and contractor’s side, there must be a communication between different personnel to achieve the main business objective of the contractor which is profit Verster (2004:3). All the aspects associated with a project have a direct impact on costing and how it is managed.

Throughout the project, everyone involved must take full responsibility to ensure that the good communication is maintained especially for the aspects which involve cost. Cost controlling cannot be performed in vacuum and therefore effective communication is essential between different personnel. The most accurate and important information is of no use if it’s not transmitted to others. According to Griffith (2006), the most accurate analysis is of little use if it is not transmitted or communicated to others.

Integrated communication strategy is necessary to ensure continuous communication which enables the personnel involved to manage their different functions effectively and achieve expected results. The only one way a company can gain access to the most valuable commodity, which is information, is through people involved. A major problem currently faced by companies today is the managing of communication.

Communication is seen as the life-blood of organisational management; therefore, all personnel must have an adequate knowledge of the nature and role of communication although it is difficult to do well or understand the influence of communication. Griffith (2006) argues that an effective communicator should have a well-founded understanding of functional transformation as a basic approach.

Griffith (2006) concluded by saying communication is an area where Quantity Surveyors may need developments, but effective communication with all different personnel will be a major part of future day-to-day activities.

METHODOLOGY

For the purpose of this study, only one type of research methodology approach was employed, namely quantitative method in the form of questionnaires. The respondents for this study include small and medium contractors graded between 3 and 7 on the CIDB database and were active in the General Building (GB) category of works only. As a result, only 100 questionnaires were sent to randomly selected SMME contractors, who were registered between 3 and 7 grading and are within Gauteng. 32% of the invited contractors responded.

RESULTS

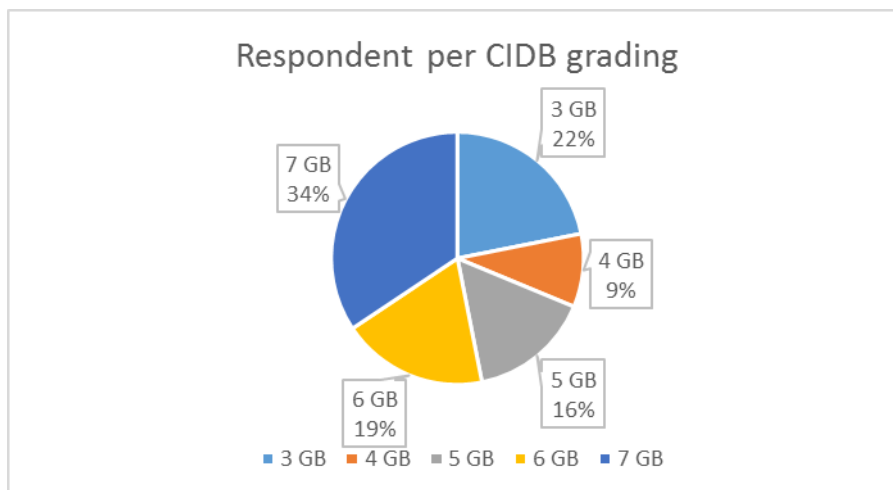


Figure 1: Respondent per CIDB grading

Majority of contractors in grade 7 GB level participated on this study while contractors in grade 4 GB participated the least. Though the researcher tried to equally include all the contractors from grade 3 to 7; the participation results shows little interest on the part of contractors in participating on the research.

The reason for positive responses from contractors in grade 7 GB level might be due to interest on the study as well as technology literacy as the questionnaires were sent through email. On the other hand, the poor responses from contractors in grade 4 might be due to disinterest on the study topic, lack of office staff and technological illiteracy.

Involvement in cost controlling from different levels

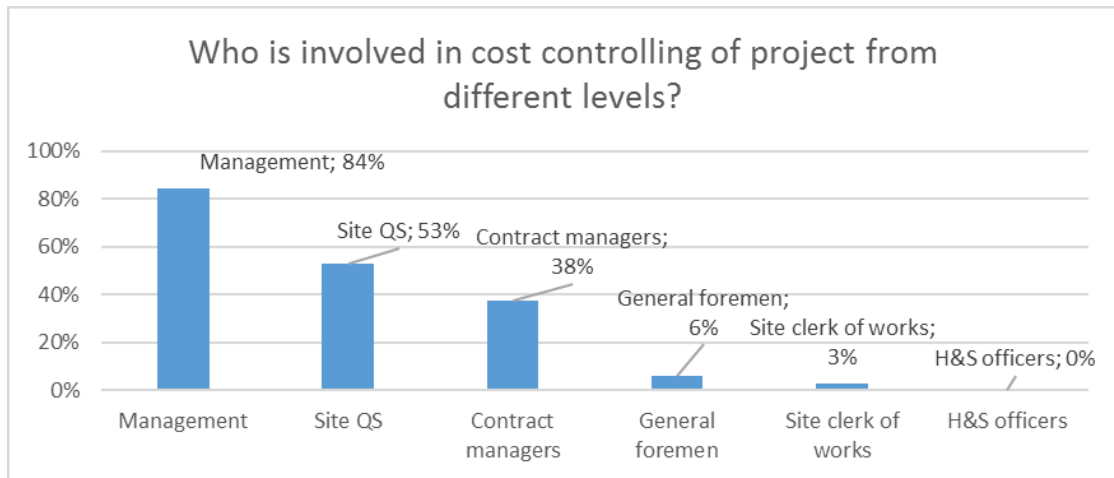


Figure 2: Involvement of different personnel in cost controlling

The above results show that majority of cost controlling involvement is by the management at 84%. Site Quantity Surveyors involvement is 53% to 38%, 6% and 3% for contracts Managers, General Foremen and Site Clerks of Works respectively of the contractors participated on the study. Many companies involve more than one category in managing cash flow. The health and safety officers' involvement are less than 1% from the above results.

Level of cost controlling literacy by different site personnel

Table 1 level of cost controlling literacy by different site personnel.

Personnel	Below Average	Average	Above Average
Site Quantity Surveyor	3%	34%	63%
Contracts Manager	13%	56%	31%
Foremen	56%	31%	6%
Clerk of Works	69%	19%	6%
Health & Safety Officer	75%	16%	3%

The results above show that 63% of the Site Quantity Surveyors' level of cost controlling literacy is above average while other personnel such as Contracts manager, Foremen, Clerk of works and Health and safety officer are 31%, 6%, 6% and 3% respectively.

Site Quantity Surveyors, as the construction financial experts, the level of expectation for the competency is higher than the results. This could be due to how involved Site Quantity Surveyors are in the process of cash flow management in different companies.

The results for Contract managers implies that they are competent enough to control costs throughout the process. This is a good sign as the Contract/Site Managers carry a huge responsibility of running the project to its success and if they have adequate knowledge of cash flow they can effectively run both production and finance.

The results for Foremen could be due to the perception that General Foremen shouldn't be involved in cost controlling process. General Foremen's activities on site are more cost involved than any other activities and therefore adequate knowledge of managing cash flow should be prerequisite to them. They are the ones who utilise the materials on site, co-ordinate labourers on site and monitor all the sub-contractors' work.

Clerk of works and Health and safety officers proved to have inadequate knowledge about cost controlling. This could be due to little or no involvement in cost controlling process.

Information required by management for cost controlling

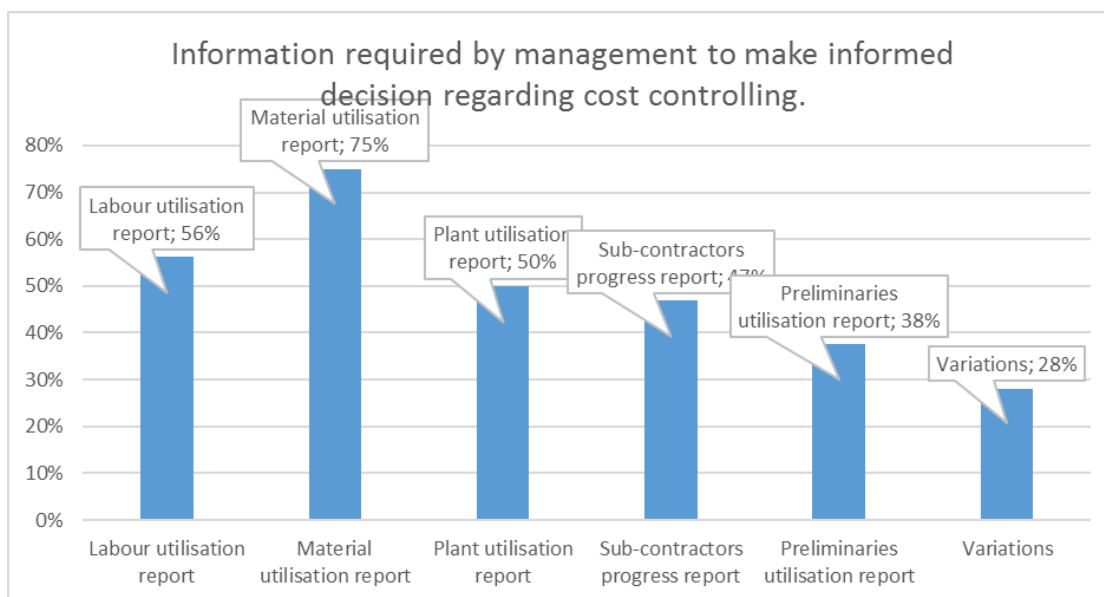


Figure 3: Information required by management for cost controlling purpose.

The results above show that 75% of the contractors requires material utilisation report more than any other report. Reason for this high percentage over other items can be mainly because of material cost as this is the most cost consuming factor on a project. Therefore, the contractors pay more attention on the material utilisation report than the rest because it can have greater positive or negative effect to the entire project.

The second report which is most required by contractors is the labour utilisation report at 56%. Labour can be the most difficult resource to control in every project. So, the findings show positively that most of the contractors do pay attention into acquiring the utilisation report. The contractor can easily compare the labour's actual cost to budgeted cost for further decision making.

The third report which is required by the management is plant utilisation report which shows that only 50% of the contractors require it in managing their cash flow. Plant utilisation report indicates the cost to date incurred for plant, either hired and/or owned, including the activities it was utilised for. The information contained on this report can help the management to monitor which activities are making a profit/loss from utilising a certain plant, and to decide on which method is viable between labour and plant utilisation. It is of great concern, from the findings, which shows that most contractors do not request such information from their personnel.

The purpose of using plant on site, amongst other thing, is to reduce labour cost which can be incurred if work is done manually. If the method of using plant is more

expensive than doing it manually, and there are no other restrictions not to use manual method, one can opt to utilise manual labour. Such decision can be reached through analysing the plant utilisation report.

The fourth report required by the management is sub-contractors progress report. The findings indicate that only 47% of the contractors require this report for cash flow management purpose. The sub-contractors progress report can include information such as work done to date, payment done to date, amount due to the sub-contractor and any variance for the original scope of work.

The sub-contractor's original amount is deemed to be fixed, subject to actual quantity re-measurement. Therefore, the sub-contractors' progress report will enable the management to monitor any difference between anticipated cost and actual cost for the sub-contractor on site. The variance can be due to justifiable change in scope of work, over claims from sub-contractors and/or claim of loss to the main contractor. Any new change pertaining to the sub-contractor's original scope of work must be recorded and taken into consideration in managing the cash flow. The results shown above indicates that majority of the contractors do not take into consideration the sub-contractors progress report in managing their cash flow.

The fifth report required by the management for cash flow purpose is preliminaries utilisation report. Only 38% contractors indicated that they required this report. The report entails the record of establishments, site running, and de-establishment of site costs. These costs cover the costs of all the necessary items and/or work, which cannot be quantified on the actual scope of work but are necessary for the execution of work, i.e. site offices, services such as electricity and water, insurances, etc.

The only way a contractor can know whether he is over the budget for preliminary items is when the actual cost data are kept regularly and monitored against the allowed cost since it cannot be properly measured. The poor response of the contractors who requires this kind of information indicates that this information is not taken too seriously, and it can have a considerable negative impact to the contractors' cash flow performance.

Lastly, a variations report is also one of the reports which is required by the management in managing cash flow. The finding proves that this information is the least required by management with the respondents of only 28% saying they require the information. The variations report helps the management in keeping record of any changes incurred during the project from the original scope of work. These changes can have direct or indirect financial implication to the project and, therefore, the management must be kept up-to-date with any variation which occurs during the execution of work.

The management relies on their initial cash flow projection in running the project and if any change occurs, which management is not aware of, such can have the bad effect to the entire cash flow management process.

The above reports help the management to make informed decisions regarding financial performance of the project during the execution phase. The accuracy of the report will influence major decisions to be taken by the management. Therefore, strong emphasis and time effort should be made to ensure great accuracy of this data information collected.

CONCLUSIONS

From the findings of the study in light with the research question, one can conclude that least involvement in cost controlling by different site personnel affects the process. All different personnel, from different levels, should be involved in cost controlling process. Their involvement can be in collecting data, analysing, presenting and recommendation. The literature has proved the importance of effective communication between role players; therefore, less involvement by other site personnel also hinders flow of information which can be used in cost controlling process.

In terms of data collected on site by different personnel, a conclusion can be drawn that most of the contractors emphasises on material utilisation, labour utilisation and plant utilisation data to be the most required or collected for cost controlling purpose. Reason being that these three components have great direct cost impact to the project and be tracked easily. It can be concluded that contractors, through experience, have developed a standard procedure to collect and monitor cost data for material, plant and labour components. Paying less emphases on items such as preliminaries also contribute in not involving other site personnel such as health and safety officers and Site Clerk.

Therefore, the study also confirmed that other site personnel do not have adequate knowledge about cost controlling process. This factor also leads to the contractors not being able to develop a standard procedure to control their costs effectively. It is evident that there is a need for the small and medium size contractors to establish a standard procedure of controlling costs. Proper training regarding cost controlling should be given to all personnel within the contractors' organisation to enhance their level of cost controlling literacy.

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EMPIRICAL REALITY ON THE CONCEPT OF ENTREPRENEURSHIP SKILLS AS A COMPETITIVE EDGE: PHENOMENOLOGICAL PERSPECTIVES OF SMME CONTRACTORS

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This paper aimed to highlight and promote the SMME contractors' phenomenological perspectives on the concept of entrepreneurship skills as a competitive edge for sustainable business development. The research study is qualitative in nature, rooted in the phenomenological paradigm and utilising an in-depth interviewing method. The research aimed for an in-depth investigation to understand the multi-dimensional perspectives held on the concept of entrepreneurship skills among Thirty-four (34) SMME contractors. The SMMEs contacted for this study are cidb grade 4 to 6 located in Port Elizabeth, who are believed to have succeeded in the construction business beyond five (5) years. The findings show that the construction business owners' ability to develop an effective and efficient business culture; ability to endure and persevere in the face of fierce competition; spirit of confidence, and self-driven are the phenomenon perspectives held by SMME contractors on the concept of entrepreneurship. In addition, contractor's intellectual development; natural talents and technical skills with respect to excellence performance; passion to learn, initiate new ideas, and innovative solutions reflected on the entrepreneurial skills. More so, the contractors' ability to market its organisation's services, products and personal talents in a profitable manner and aspirations to expand business capacity were regarded as a core concept of skills in entrepreneurship. The study would enhance the empirical understanding of entrepreneurship skills that foster business survival and growth. The findings of this study have significant insights; however, it should be adopted with caution; as it was based on a small sample frame in the context of the South African construction market. The empirical findings and knowledge of this study if creatively adopted, would enhance the readiness of the new and struggling entrepreneurs and SMME contractors to achieve sustainable enterprises and gain economic stability.

Keywords: Construction industry, Competitive edge, Entrepreneurship skills, SMME contractors.

INTRODUCTION

Entrepreneurship has evolved through the centuries and it has been viewed differently according to conditions prevailing in the world economy (CBSE, 2013). Bygrave and Zacharakis (2011) said that the 21st century could be regarded as entrepreneurial age and era, because of the high levels of entrepreneurship's participation in all sectors of the economy worldwide. Kruger (2004) claims that the term entrepreneurship has historically referred to the efforts of an individual who takes risks in creating a

successful and sustainable business enterprise. According to Khan (2015), World Economic Forum (2014), Bygrave and Zacharakis (2011), the importance of entrepreneurship cannot be overemphasized, as it is the vitality and drivers of any economic and social sustainability, and catalyst of change in any country. CBSE (2013), states that entrepreneurship spirit is vitally important in any country, as its impact on economic development; and as such the government should continue creating an enabling environment for entrepreneurs. This would boost and encourage entrepreneurs in effective service delivery in any given market and economy.

Bygrave and Zacharakis (2011), further state that any firm, big or small organisation, must have its share of entrepreneurial drives, if it is to survive and prosper in the any given market. According to Hana (2013) managers', business owners' (SMMEs) and entrepreneurs' skills and educational background contribute largely on how competitive their market positioning is perceived in the given sector (such as construction industry). In addition, Goldsby (2014) mentions that the critical issues facing entrepreneurs- such as SMMEs is how to build an effective and efficient organisation management team. Bygrave and Zacharakis, (2011) claimed that numerous research findings have revealed that an entrepreneur with effective project teams have a higher chance of survival, growth and economic success due to an increased skill set, an improved capacity for innovation, and a higher social level of support.

Problem Identification - Survival Rate and Critical Issues Facing Entrepreneurs

According to the CBSE (2013), for any organisation to deliver its work effectively, survives, and grow, it needs personnel with the necessary qualifications, skills, knowledge, work experience and aptitude for work. Thus, SMMEs as entrepreneurs must strategically understand and clearly know what kind of 'personnel should be employed as a project/organisation team based on his/her specific qualifications, skills, experience, and personality of the employees (CBSE, 2013). Bygrave and Zacharakis (2011) emphasized about the U.S. Census Bureau research reports on new business survival rate annually. This report revealed that about 81% survive for at least 1 year, 65% for 2 years, 40% for 5 years, and 25% for 10 years. Bygrave and Zacharakis, (2011), further claimed that the chances of survival increases with age and size of the firm; however, it does not necessarily denote that firm has recorded a stable success and economic sustainability. Bygrave and Zacharakis (2011), posit that survival rates of firms also varied somewhat with industry they operates, but not strongly correlates with age and size.

The Significance of Entrepreneurship Activity in Economy

According to Global Entrepreneurship Monitor (GEM) (2017), 2016/17 reports of 64 countries that were evaluated, it was revealed that the South African economic development is mainly an efficiency-driven. Thus, GEM (2017) ranked South Africa on its "total early-stage entrepreneurial activity", and "established business ownership rate" at 51 and 60 out of 64 respectively. The Established Business Ownership Rate – means the percentage of the adult population aged between 18 and 64 years who are currently an owner-manager of an established business. This has revealed that South Africa is in dire need to strategically and effectively support entrepreneurial activity among its citizenry. Khan (2015) claims that in any country whose youth lacks business aptitude, poor capacity to take calculated risks, absence of creative and critical thinking, and a sentiment to establish businesses, would never be able to develop its entrepreneurship and, nor achieve its economic sustainability. Khan (2015)

further mentions that entrepreneurship is essential in all businesses and all economies, whether big or small, developed or developing, since, the basic functions of the entrepreneurship, involves, innovation, risk bearing, and adaptation to strategic changes. Khan (2015) states that without entrepreneurship activity, there will be no growth of the economy of any country. CBSE (2013) claims that entrepreneurship is the yardstick to measure the level of development of a country.

Research Question

What is/are the impacts of entrepreneurship skills among the South African SMME Contractors on developing and growing sustainable construction organisation?

The Objective of Study

The study aimed to understand and unveil how perceptions, reflections, and experiences among the surviving SMME contractors (cidb grade 4-6 contractors) on impact of entrepreneurship skills in their businesses.

STUDY THEORETICAL BACKGROUND

Concept of Entrepreneur, Enterprise, and Entrepreneurship

According to Bygrave and Zacharakis (2011), in year 2010, about 500 million persons strived earnestly to start a new business or were owner-manager of a new business; and that about 115 000 new businesses are registered every hour of every working day in the United States. CBSE (2013), an entrepreneur is a person who starts an enterprise and this process of creation is called entrepreneurship. The entrepreneur is the actor and entrepreneurship are the act/ process actions (CBSE (2013)). According to Khan (2015), an entrepreneur is individuals who intend to add value to the economy by creating a new business venture through effective use of his knowledge, passion, dreams and desires for wealth. In addition, the CBSE (2013) states that an entrepreneur is a person responsible for setting up a business or an enterprise. He/she has the initiative, skill for innovation and high achievements. He/she is a catalytic agent of change for holistic economic growth and sustainable development.

The term enterprise, according to the CBSE (2013), is the business organisation that is formed, to provide goods and services, creates jobs, and contributes to national income, and overall economic development. The World Economic Forum (2014) indicates that, in the last decade, global interest in opportunities for early-stage entrepreneurial companies has spiked. As such, many countries continue to increase their efforts to develop hot spots to promote the starting and growing of entrepreneurial organisations in their own cities and regions.

According to The CBSE (2013) entrepreneurship as a ship on a voyage that has on board, innovative and creative men and women aiming for excellence, and to make fortunes out of business ideas. Thus, the spirit of entrepreneurship remains one of the key and cutting edges for successful small business ventures in the world today. Brooks (2015) views entrepreneurship as the development of a business idea into a profitable business. According to Brooks (2015), Goldsby (2014), CBSE (2013), Herman and Davidson (2012) and Nickels, McHugh and McHugh. (2010) entrepreneurship is the set of activities performed by an entrepreneur, through identifying opportunities, solving problems, recruiting resources required, and creating value through innovative process to gain sustainable economic and social benefits.

Meggison, Byrd and Megginson (2003) note that the principal objective of entrepreneurial organisations is solely that of making profits and growing sustainable businesses. The contemporary entrepreneurial organisations are characterised by employment of innovative and strategic management practices in their business activities. Burns (2007) posits that entrepreneurs / entrepreneurial organisations are the key business element for identifying commercial opportunities and exploiting them to create change and opportunity for making profit. Thus, Kruger (2004) posits that the value of entrepreneurship is rooted in creativity, innovation and opportunity development in a dynamic environment.

The Entrepreneurship Skills as a Source of Competitive Advantage

Entrepreneurship skills could be considered as a major competitive advantage for successful organisations, as Shakantu (2012) alluded that the lack of entrepreneurship spirit amongst the SMME contractors have limited their ability to seek and exploit business opportunities, and to successfully innovate and grow their business into sustainable organisations. According to Burns (2007), business organisations (such as SMME contractors) with entrepreneurship skills are expected to cope more effectively with the changes and economic challenges in the market. As they are more flexible and could speedily, respond to opportunities (delivering what the market wants in good time) and challenges.

Brooks (2015) observed that amongst today's most successful entrepreneurs, are history's top business leaders (those who have earned their success through entrepreneurship). These entrepreneurs include Henry Ford, Walt Disney, John Rockefeller, Richard Branson, Bill Gates and Oprah Winfrey, and other numerous people across the globe.

Generic Characteristics of Successful Entrepreneurs

Brooks (2015) indicates that the most successful entrepreneurs possess some pertinent characteristics such as the business ability to develop business strategies/ plans to meet the business goals- finance, marketing, production, services, sales, or personnel. Supporting this view, Khan (2015) added that a successful entrepreneur must have managerial, leadership skill, and technical knowledge; because if entrepreneurs is not able to mobilise, procure and manage their strategic resources (human, material, capital, and equipment) he/she would risk losing business. Khan (2015) added that, an entrepreneur who has superior technical and managerial knowledge and capability should not neglect soft skills such as attitude, intuition, perseverance, and sense of humility. More so, Bygrave and Zacharakis (2011) affirm that most successful entrepreneurs possess characteristics such as a high sense of independence; aspiration for financial success and self-realisation; longing for recognition, and business sense to innovate are the main strategic point and important reason for starting their businesses. However, Brooks (2015) states that leadership skills are the strategic ability to develop a vision for the company and to inspire employees to pursue the organisational vision and achieving success.

According to Burns (2007), innovation and technology are the prime and the success elements for entrepreneurs. Thus, SMME contractors could utilise these to create business opportunities in any given market. In addition to this, Scarborough (2014) states that the rate of entrepreneurs' willingness to adapt to change has now increased and superseded the traditional days; it is not only the strongest or the most intelligent organisations that survive; but those organisations who adapt to changes in the business environment through innovative approaches are the most likely to survive.

RESEARCH METHODOLOGY

According to Dane (2011) research is a critical process of asking and attempting to answer questions in the real world; as this can be done through questionnaire, interview, experiment and other different methods. Thus, research methodology involves three processes, namely: data collection, data analyses and interpretation, which are aimed at proffering a better understanding of the study phenomenon (Leedy and Ormrod, 2013). An extensive view of Creswell and Clark (2007) posit that the selection of research methodology and methods (qualitative and quantitative) in the discipline of management and social sciences is influenced by the researcher's assumptions about the nature of the social world and his experiences on the subject matter.

Philosophical Position of the study: Phenomenological Reality

This study adopted a qualitative research approach, rooted in the phenomenological paradigm and utilizing an in-depth interviewing method. Phenomenology is the philosophical name for the method of investigating or inquiring into the meanings of our experiences; as Miles, Huberman and Saldana (2014) state that phenomenological paradigm tends to look at data thematically, to extract essences and essentials of research respondents (SMME contractors) perceptions and its meaning. Mack (2010) claims that the phenomenologist advocates the need to consider human beings' subjective interpretations, their perceptions of the world (their life-world) as their starting point in understanding social phenomena and reality.

According to Miles et al. (2014) and Ratcliffe (2011) phenomenology is an analysis of a pure experience and in-depth perceptions of reality with unbiased narrative. Thus, phenomenology is a method of investigating human experience and reality. Ratcliffe (2011) also refers phenomenology as a philosophical position concerning the relationship between human experience and scientific accounts of the world view of reality. Thus, the study aimed to understand the phenomenological perspective and reality held by the South African SMME contractors on the concept of entrepreneurship skills as one of the competitive edge for developing and growing sustainable construction organisation.

This method is considered the most appropriate and effective to elicit authentic information and perspectives on the impact of entrepreneurship skills in South African construction industry. The respondents are the SMMEs construction business owner's and executive managers as firms' representatives; who are in a strategic position and have in-depth understanding of their firm's developmental history, management structure, and business strategies. Therefore, the phenomenological reality of this study was based on information gathered during the unstructured interview process with the 34 SMME contractors in Port Elizabeth, South Africa. According to Leedy and Ormrod (2014), the typical research sample size of the phenomenological study, utilizing unstructured interview ranges from five (5) to twenty-five (25) participants. Supporting this view, Cassim (2011), also states that in qualitative research, by the time of reaching a research sample size of 30 participants, the research would reach the theoretical saturation point, which marks the point where little or no new information can be gained. In view of these assertions, the number of the interviews (34) for this study was significant for the intended purpose. The insightful knowledge and data generated from the study were coded, and thematically discussed, interpreted and presented accordingly.

FINDINGS AND DISCUSSIONS

The Cidb Contractors' Grading System

Table 1 shows that out of 34 firms interviewed in the study, 8 (24%) were contractors with cidb grade '6GB and 6CE'- coded as E1- E8; 13 (38%) were contractors with grade '5GB and 5CE'- Coded E1-E13; and 13 (38%) with cidb grade '4GB and 4CE'- Coded as D1-D13 respectively.

Table 1. Research Interviewees (The cidb contractors' grading)

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

Source: Author's construct

Out of the seventy-four (74) construction organizations in Grades 4-6 of the CIDB register of contractors as a research population size and sampling, thirty-four (34) were purposively selected and interviewed accordingly. Thus, one of the reasons for selecting contractors in the grades 4-6, was because they are perceived to have utilized the entrepreneurship skills as a competitive edge to survive and grow their businesses beyond the first five years (The period is mostly referred to as the "red-sea crossing" for potential sustainable organization) in the construction industry.

The Interviewees' Years of Experience in Construction Industry

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

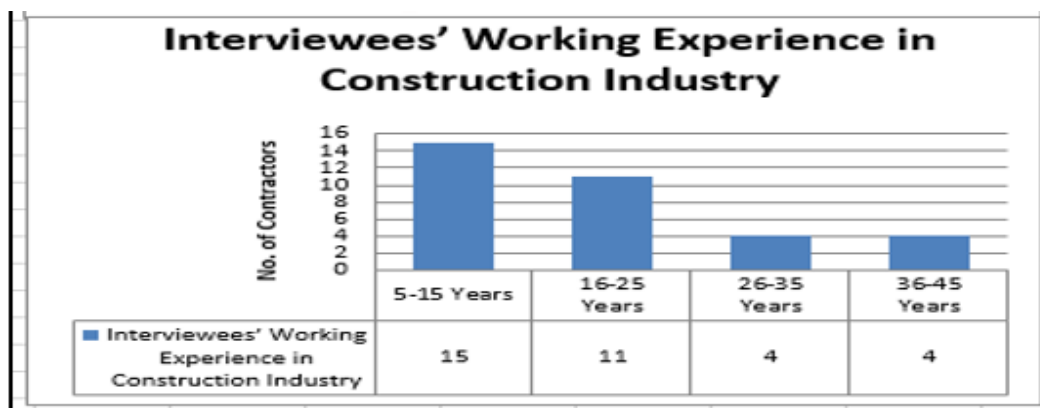


Figure 2: Interviewees' Working Years' Experience in Construction Industry

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

Interview Questions, and Finding and Analyses

Question 1: In your opinion and business experience, what does entrepreneurship mean to your organisation?

Question 2: In what ways do your organisation regards itself as entrepreneurial-driven?

Theme 1: SMME Contractors' Perspective- "Concept of Entrepreneurship"

All the respondents understood entrepreneurship as a concept of having competitive business capability, passion, desire, and drive to build and sustain firm's growth, culture and innovation.

Respondent D3 asserted that: "Entrepreneurship to us; means the business skills to sustain our growth and performance in a long-term. We continually aim to improve our services in any way possible, to sustain our business". E3 stated that: "I think every company must highlight and encourage entrepreneurship. The fact is that, both our management and owner of the business are entrepreneurs. We were able to formalise our business culture and structure, because of our entrepreneurial inclination. Moreover, we have the business passion, desire and drive to align and improve our service in line with developments in the market". E13 stated that: "From my understanding, entrepreneurship has to do with competitive business culture and innovativeness; as well as a benchmarking and best practice to achieve a competitive advantage". These findings resonate with the assertion of Goldsby (2014) and Bygrave and Zacharakis, (2011) that critical issues facing entrepreneurs is the capability to build an effective and efficient organisation management and project team, as an entrepreneur with effective project teams have a higher chance of survival, growth, improve capacity for innovation, and economic success for long-term.

The respondent D12 defined entrepreneurship as the organisation's competitive ability to develop and expand a business into a profitable organisation across and beyond the South African market. D5 viewed entrepreneurship is as a natural talent used in running a business, to be successful and to survive in the market. D5 noted that it takes a great deal to assemble individuals with different skills and experience. According to respondent D1: "To us, entrepreneurship means the competitive capability to successfully market our organisation's services and products, as well as our personal talents in a profitable manner". The findings are in accords with statement of authors such as Khan (2015) and Kruger (2004) that the sole purpose of entrepreneurship or an entrepreneur is to creatively and actively initiate business idea(s), grow it, maintain it, and develop it into a sustainable and profit oriented organisation. Thus, this would be achieved through effective use of his knowledge, passion, dreams and desires for wealth.

On the other hand, E4 views entrepreneurship as an act of supporting human development and enterprise towards growth and economic sustainability. E5 and E6 believed that it is the capability to create a sustainable organisation; this finding resonates with Hana (2013) that managers', business owners' (SMMEs) and entrepreneurs' skills and educational background (human capital development) contribute largely on how competitive an organisation's market positioning would be (such as construction industry). In addition, F2 and F8 asserted that: it is the organisation's competitive ability and capability to identify new areas or gaps in the market and innovatively deliver the services that would satisfy the identified market. F4 claimed that their entrepreneurship spirit fostered their competitive business

ability, vision and strategy to grow in the market significantly. Moreover, three (3) interviewees (D4, E8 and F1) view entrepreneurship as the competitive ability and skills to create employment and genuine wealth. Further, D8 explained that: “Entrepreneurship is all about using one’s brain and natural talents as a competitive edge towards taking business risks, and to grow a successful, self-sustaining, and self-reliant organisation”. These findings are in line with the assertion of The CBSE (2013) and Drucker (1999) that the most important function of entrepreneurs to survive long-term is the capacity and capability of harnessing strategic resource within their firms through innovation and entrepreneurship skills. They must act as a catalytic agent of change for holistic economic growth and sustainable development.

Theme 2: SMME Contractors’ Perspective – Drivers of Entrepreneurship

Almost all the respondents perceived drivers of entrepreneurship as the competitive business spirit of confidence, freedom, passion, endurance, perseverance, capability to learn new skills and utilisation of innovativeness, self-motivated, educative mind and aspiration for excellent service delivery.

Five (5) respondents (3Fs and 2Es) believed that entrepreneurship drive could be regarded as the competitive business spirit of confidence, freedom, self-drive, energetic, educated mind, and excellence in the realisation of business aims. Respondent D9 added that entrepreneurship is the ability and passion to initiate, drive and grow a successful business. These findings resonate with the assertion of Brooks (2015), and Bygrave and Zacharakis (2011) that the most successful entrepreneurs possess unique characteristics. These characteristics are a high sense of independence, aspiration for financial success and self-realization; longing for recognition, and business sense to innovate the business; ability to develop and build strategies/ plans to meet the business goals- finance, marketing, production, services, sales, and personnel ultimate needs. All these are the main competitive edge and important reasons for starting their businesses

D9 further added that the ability of organisational staff to learn new skills and make use of innovative-business opportunities, all emanates from their entrepreneurship education and business management skills. The findings are in accordance with the view of the CBSE (2013) that for entrepreneurs such as SMME contractors to deliver their work effectively, survives, and grow. The entrepreneurs (SMMEs) need personnel with the necessary qualifications, skills, knowledge, work experience and aptitude for work, and personality of their employees (CBSE, 2013).

Furthermore, D2 disclosed that entrepreneurship comes in handy in negotiations for project contracts. Meanwhile, E11 suggested that constant endurance and perseverance helped their organisation cope with difficult business challenges and fierce competition in the construction market. This perspective resonates with Khan (2015) assertions that, an entrepreneur who has superior technical and managerial knowledge and capability should not neglect soft skills such as attitude, intuition, perseverance, and sense of humility, as all these attributes contribute to the growth of an organisation.

In a nutshell, respondent F6 explained that: “A critical issue in our organisation today, is to keep alive the entrepreneurship spirit not only as the leader of the business, but also by strategically instilling the same spirit in each individual employee in the organisation”. F6 further concluded that: “Making people positive towards our business services to me is critical, as it would improve the overall performance of our organisation”. These findings resonate with the view of Brooks

(2015) that entrepreneurs' leadership skills are a competitive and strategic ability to develop a vision for the company and to inspire employees to pursue the organisation's vision towards achieving success.

Further still, E1 and E2 stated that their organisations are entrepreneurial driven, and they strategically engage in training and mentoring of local talent and community development. Respondent D4 stated that: "Our key employees are trained to acquire the technical expertise and business management skills, as part of an entrepreneurship drive of succession planning for the enterprise". The respondents D8, D9, E6 and F7 stated that education and work experience have been significant factors to their successful journey in their entrepreneurship and building sustainable organisations. E6 disclosed that: "I absolutely do not mean that people without education cannot succeed in the market as entrepreneurs, but in the case of construction business, education and technical skills have made a difference". In addition, the respondents D10, D11 and D13 describe the concept of entrepreneurship as a good management and competitive business flair to develop and own a functional and performing organisation. They consider their organisations as entrepreneurial-driven because they were able to utilise human capacity development as a strategic vehicle for wealth creation. Most of the findings are in accordance with authors such as Brooks (2015), Goldsby (2014), CBSE (2013), Herman and Davidson (2012) and Nickels et al. (2010) that for entrepreneurs, their key to success is rooted in the creation of more wealth and the constant innovation, entrepreneurship flair and aptitude from the prevailing to the next best practices. This is would be realised through identifying opportunities, solving problems, recruiting resources required, and creating value through innovative process to gain sustainable economic and social benefits.

CONCLUSIONS

This study was carried out to elicit authentic information and phenomenological reality, and perspectives of SMME contractors on the impact of entrepreneurship skills as competitive capability towards developing sustainable construction businesses in South Africa. The study primary aim is to provide and promote an in-depth understanding of empirical reality based on SMME contractor's phenomenological viewpoint on the concept of entrepreneurship skills; and as well, how it (concept) fosters their economic sustainability in the industry. Thus, the study revealed that the respondents' phenomenological reality of the concept of entrepreneurship skills as competitive capability, business culture, innovativeness, and ability to survive in the market; the ability to successfully market an organisation's services, products and talents in a profitable manner to support personal and / or organisational growth and economic sustainability. From the findings, the surviving SMME contractors also believed that entrepreneurship skills that foster economic sustainability are the contractor's competitive ability to identify new areas or gaps in the market; capability to deliver innovative services in the dynamic market; and business skills to create sustainable wealth. All these attributes, were regarded as core entrepreneurship skills that serves as a competitive edge which foster economic sustainability among the SMME contractors in South African construction industry. The study further revealed that the respondents' conceptualised ideas of reality as drivers of entrepreneurship skills and sustainability in the construction business were the ability to endure and persevere in the face of fierce competition; business spirit of confidence, freedom, being self-driven; business insight, open-mindedness, passion to learn and initiate new ideas and service; good and effective management system; educative mind; excellent attitude with respect to performance; competitive capability

to develop and expand business activities across South African market. Therefore, all these themes are the phenomenological reality and concept held by the successful SMME contractors/ entrepreneurs as competitive edge and capability in the South African construction industry. Thus, if the start-up and economically struggling SMME contractors innovatively adopts some of the perceptions and narrative it would assist to promote survival, growth and success among the SMMEs.

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AN ASSESSMENT ON ADOPTION OF BIM APPLICATION BY THE QUANTITY SURVEYING FOR EFFECTIVE COST AND WASTE MANAGEMENT

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Quantity Surveyors (QS) are key consultants in ensuring the success of a construction project. There are many links that amplify the need for QSs to make use of Building Information Modelling (BIM). This research study aims to analyse the application of BIM by QSs with reference to its ability to provide a cost-effective solution as well as mitigate construction waste during construction projects in South Africa. This research design has utilised the inductive approach to gain its qualitative data. The report comprises of the collection of data through formulated questionnaires. The data was quantitatively analysed, and findings are shown in graphic presentation. It was deduced that QSs have an idea about BIM and to a certain extent understand the benefits that technology has on project efficiency through better waste management. However, these professionals have revealed that they have not taken full advantage of BIM to help them improve their services. Some QSs have not used BIM when preparing cost estimates and only few of them that have been exposed to the use of BIM for quantification of waste management and reduction thereof. The study was limited to QS in the Gauteng region as well as restriction of respondents due to the given time frame. The significance of this research has been recognised as there is a slow adoption rate of BIM in South Africa. The idea of BIM in construction projects has created a global trend and spans the value for more professionals in South Africa to adopt this mechanism and gain a competitive advantage.

Keywords: BIM, Cost Efficiency, Quantity Surveyor, Waste Management.

INTRODUCTION

Digital technology, such as Building Information Modelling (BIM) has been incorporated into construction projects all over the world (Wooyoung Jung, Ghang Lee, 2015). International and national standards and policies have been established to ease into BIM adoption. National government as well as institutional framework could impact BIM adoption. According to McGraw Hill (2014), it was found that 75% of highly involved contractor BIM uses observed that BIM can capture the smallest of detailed information. 41% of contractors observed that the usage of BIM reduced the amount of BIM design errors using clash detection and rated this as the stand out benefit while adopting BIM. Efficiency in quantity take-off and cost estimating was seen to be the best use of BIM by 21-23% as it was seen to result in a decrease of construction costs and overruns. 19% of contractors make use of BIM to produce construction analysis and planning techniques which can be used with their regular systems (Edirisinghe and London, 2015).

The need for standardisation occurred when open standards resulted in interoperability problems between various stakeholders in stages such as design, procurement and

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operation. BIM standardisation arose with the formation of Building Smart (Edirisinghe and London, 2015). Building Smart was created to improve the exchange of information between software applications.

The estimated amount of waste in the United States for buildings in 2003 was 170 million tonnes and for China in 2014 was 1.13 billion tonnes of construction and demolition material. Landfill waste in the UK amounts to 32% (Williams, Bames and Sango, 2016). It is evident that the construction industry contributes a large percent of pollution all over the world. The use of BIM on the biggest pollutants: construction can help minimise the carbon footprint. Management of costs through BIM by quantity surveyors can minimise cost effects from the design stages through to construction.

Building Information Modelling is a system which conducts a combined effort working environment. The use of BIM has increased over the years in South Africa but is being used by single stakeholders in isolation and not among all professions in the construction environment Froise and Shakantu (2014). The fact that BIM has been followed at international and national levels, the South African industry is falling behind and can result in the economy being unable to bring the same competitiveness to other countries (Froise and Shakantu, 2014). Stakeholders in other countries have brought attention to BIM by its advantages and cost saving capabilities. The quality data that BIM provides can be used to analyse projects in the South African construction industry (Froise and Shakantu, 2014).

The South African construction industry produced 20% of construction and demolition waste in 2011 (Williams, Bames and Sango, 2016). Global warming is at an increase and where pollution can be mitigated should be a priority. BIM can minimise construction waste in South Africa. It can also be used to manage costs efficiently within the industry. These functions can be achieved through a single system and needs to be explored further. The adoption rate of BIM in South Africa can affect the study and provide constraints and limitations.

This research study is assigned to analyse the application of BIM by QSs with reference to its ability to provide a cost-effective solution as well as mitigate construction waste during construction projects in South Africa. Next sections, reviews relevant literatures to this research.

LITERATURE REVIEW

The Practices of Quantity Surveyor's (QS) in Sustainable Development Projects

QSs can consider three factors which are time, cost and quality (Dutta et al., 2016). The use of BIM is investigated into how it can bring efficiency and effectiveness on construction projects by focusing on the mentioned factors (Dutta et al., 2016). This in turn will create sustainable development projects where the three factors can be utilised by QSs to create projects which will produce low carbon footprint emissions. The uses of BIM are more focused on waste, energy, carbon, water and materials which are used to the test the efficiency brought in by BIM models and projects all to limit carbon footprints, water usage, waste production and energy used by projects (Dutta et al., 2016).

BIM detects and eradicates up to 40% of unforeseen errors and can provide the user with estimations with a threshold of 3% at a time saving factor of 80% (Cheng, Ma, 2013). BIM can provide the user with clash detections which can save up 10% of the

contract price as well as reduces the project completion time by 7% (Cheng. Ma, 2013).

Two main factors: quantity take-off (QTO) and cost estimation (CE) lead to the completion of successful construction projects. They form a precondition to other activities that take place in a project such as budgeting, bidding for a project and contracting for a design estimated at a certain value. This requires an extraction of information through knowledge acquired around the rules, processes and the lifecycle of the project. According to the study done by Eastman, Sacks and Aram (2014), three conditions must be met for QTO software products for effective performance: models of architectural and structural design suitable for quantity take-off and cost estimation purposes, all information to be of quantitative nature and designers' models to have complete information for necessary tasks (Eastman, Sacks and Aram, 2014).

Scholarly studies have discovered that the use of BIM in construction projects is the tool to achieve productivity, improved practices from the current ones, lower costs and sustainable performance as BIM models contain various information of which a QS can retrieve and use as part of decision making (Kim & Park, 2016). The sustainability of the project can be achieved as early as the design stage. Furthermore, the use of BIM can influence the whole supply chain by enforcing procurement processes that are efficient and effective in reducing construction waste throughout the life of the project. The adoption of BIM in construction projects by QSs can help achieve design optimization, efficiency improvement and sustainable enhancement (Kim & Park, 2016). The next section, reviews the QS's abilities in a BIM-enabled environment.

Quantity Surveyors' Abilities in a BIM-Enabled Environment

Some scholars view BIM to redefine the conventional ways of doing things not only for the QS but the industry at large (Kulasekara et al. 2013). In projects, many different types of software's are used to measure and manage different aspects of the project. The use of BIM can automate most of the tasks that are performed by QSs like quantity take-off, drawing up the bills of quantities and preparing estimates if linked with compatible estimating software.

BIM can replace almost all the roles of QSs with quantity take-off being replaced by "Autodesk QTO BIM measure from causeway", BOQ preparation with CostOSTM Nomitech, cost estimation with DProfiler Beck technology, cost planning with Vico Cost Planner, cost reporting with Vico Office Client, cost control with Vico cost explorer, material procurement with quantities of materials obtained from BIM tools, payments applications with Bentley, value management with BIM tools of estimating, life cycle costing by integrated environmental solutions using a virtual environment as a platform (Kulasekara et al. 2013). There are still some concerns from scholars that BIM cannot substitute the expertise of experienced QS in producing cost estimates (Kulasekara et al. 2013). Even though BIM models like 5D models provide certain benefits over the traditional methods of a QS like more efficiency, visualization and well improved services about value management. It fails to incorporate the standard method of measuring used by QSs and as such it lacks the intelligence of understanding construction processes and methods as lapping and jointing (Harrison & Thurnell, 2014).

The use of BIM during the construction stage provides individuals with the opportunity to assess, test and exploring different design alternatives and materials that may influence the energy performance of the project (Namini et al., 2015). Moreover, these studies have pointed out that there is still a long way for BIM to

perfectly match the elements of sustainable design as there is still a lack of interoperability in waste and energy analysis software packages and BIM, carbon accounting data still needs to be accounted for, loss of information between parties and the lack to quantify and test several sustainable variables (Namini et al., 2015). The current BIM tools are regarded as just a passive system of which the active one will have to bring the ideal solution to green design and sustainable construction (Namini et al., 2015). These studies propose that the new trend of active BIM will be realised through artificial intelligence (AI) parametric analysis to aid with sustainable designs (Namini et al., 2015). The next section considers BIM use for waste estimation during construction processes.

BIM Use for Waste Estimation during the Construction Phase

The rise in construction activities leads to high production of construction waste which has remained a global problem together with cost overruns which makes it difficult to complete construction projects within budget (Saidu & Shakantu, 2016). This has been shown by different studies around the world that material waste consumes a large percentage of production costs for example the study conducted in the United Kingdom (UK) reported a 15% additional cost overrun in projects due to waste generation (Saidu & Shakantu, 2016). Previous studies on the same problem area of waste production by the Hong Kong Construction Association conducted in 1993 reported 11% contribution to cost overruns and a 20 to 30 percent from a study conducted in Netherlands by Bossink & Bounwers (1996) (Saidu & Shakantu, 2016).

Waste management has been a serious issue for the industry as such the practitioners and participants of the industry have been trying different methods to mitigate the generation of material waste. This has led to the introduction of Building Information Modelling (BIM) in the sector of waste management bringing about technology that can assist in the minimization of waste when adopted by design teams (Olubenga et al., 2016). According to Olubenga et al. (2016) from a study conducted by the National BIM survey, there was an increase in the adoption rate of BIM by 26% (13-39%) from year 2010 to 2012 in the UK. The increase in adoption of BIM improved information sharing in projects, decision making and visualization and this has revolutionized the industry in the way operations are performed (Olubenga et al., 2016). Olubenga et al. (2016) argues that BIM frameworks that currently exist do not capture the domain of construction waste (Olubenga et al., 2016). There is an increasing focus on construction, demolition and evacuation waste (CDEW) combined with relevant technologies like CAD and ICT to develop various tools that industry practitioners and academia can implement as part of waste management strategies (Olubenga et al., 2016).

The BIM based design validation process can improve the design quality of a structure by decreasing the number of errors in the design phase, change orders, rework in phases ranging from planning, and design and construction as depicted in studies done. Positive effects of construction waste minimisation in other construction projects due to a decrease in design errors and reworks by BIM adoption have shown to be beneficial in final construction stages in the AEC industry (Won, et. al., 2016).

In chapter 4 of the South African Environmental Management Waste Act of 2008: Waste management measures, Part 2 of the legislation states that it is the general duty of all holders of waste to “avoid the generation of waste and where such generation cannot be avoided, to minimise the toxicity and amounts of waste that are generated” and that they should “manage the waste in such a manner that it does not endanger

health or the environment or cause a nuisance through noise, odour or visual impacts” (National Environmental Management: Waste Act, 2008). Knowing that BIM can assist in waste management the national government can formulate ways in which they provoke construction companies to make use of BIM.

Chapter 7 of the legislation makes mention that “An environmental management inspector appointed in terms of the National Environmental Management Act may, in writing, require any person to submit a waste impact report in a specified form and within a specified period to the environmental management inspector if the environmental management inspector on reasonable grounds suspects that such person has on one or more occasions contravened or failed to comply with this Act or any conditions of a waste management licence or exemption and that the contravention or failure has had or is likely to have a detrimental effect on health or the environment, including social conditions, economic conditions, ecological conditions or cultural heritage, or has contributed to the degradation of the environment” (National Environmental Management: Waste Act, 2008,pg37). With this law in place it would allow government and the appropriate officials to be stauncher on such legislations. If these legislations are implemented on the big players in the industry it will allow the industry to adapt to more efficient methods, BIM being one of these. Government can conduct more research on BIM in assist them in gaining the full potential of the technology.

The main question remains: how the adoption of BIM by QSs can bring about cost efficiency through waste management. This is what the authors of this study are to present using the methods presented in the next section.

RESEARCH METHOD

This research study adopts the positivism philosophy. According to Saunders, Lewis & Thornhill (2009) the positivism philosophy prefers to work with observable social reality to generate credible data. Thus, a typical philosophy’s product can be compared to that of natural and physical scientists as it is law-like generalization because it influences how things are done (Saunders et al., 2009). Existing theory from previous studies of the literature review is used in generating research strategy of collecting data to test or confirm hypothesis around the adoption of BIM within the context of South Africa (Saunders et al. 2009). This study uses a quantitative approach for analysis of data gathered from the questionnaires distributed. The questionnaires first went through a pilot study to pre-test and modify the survey before it was taken out as the industry wide survey (as suggested by Wong & Rahim, 2014).

A large sample of registered QSs was sourced from the Association of the South African Quantity Surveyors (ASAQS) database. The questionnaire of this study was distributed to members within the database and through The South African Council for Quantity Surveying Profession (SACQSP) to source all registered professional QS and approach them for assistance in the study.

This research is predominantly focused on QSs in the AEC industry. The QS’s population will reside in the Johannesburg area. Time constraints are a prevention mechanism from surveying the entire quantity surveying population. Therefore, a non-probability sampling technique will be used on QSs who have greater than 5 years of experience. Data collected for QSs with an experience of less than 5 years will be disregarded to provide more validity and reliability of the study. The non-probability sampling technique is a purposive technique. It allows deductions to be made even

while working with a very small sample as it is not known how many responses will be received. A homogeneous sample will allow greater focus on one group of professions, QSs, which will enable a greater depth of the study (Saunders, Lewis and Thornhill, 2007). Next section, elaborates the analyses and findings of this study.

ANALYSES AND FINDINGS:

The number of participants that have been conducted in the study are 23 individuals. 5 of these individual's questionnaires has been disregarded as they have between 0-5 years of experience using BIM, therefore a total of 18 responses were considered. The first part of questionnaire consisted of questions which asked for consent of the individual to participate in the study being conducted. The follow up questions provided an indication of the knowledge of the QSs. Figure 1 shows participants' BIM experience.

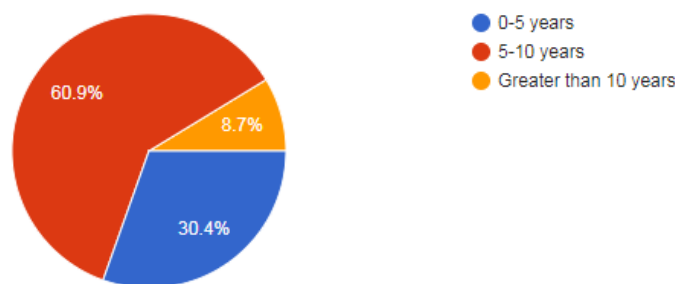


Figure 1: Participant BIM Experience

From Figure 1, it is evident that the main user experience ranges from 5-10 years. With two respondents who have experience using BIM of greater than 10 years. The respondents with more than 10 years of experience have a better knowledge of the features that BIM presents in the workplace. Next figure shows the level of BIM application within firms.

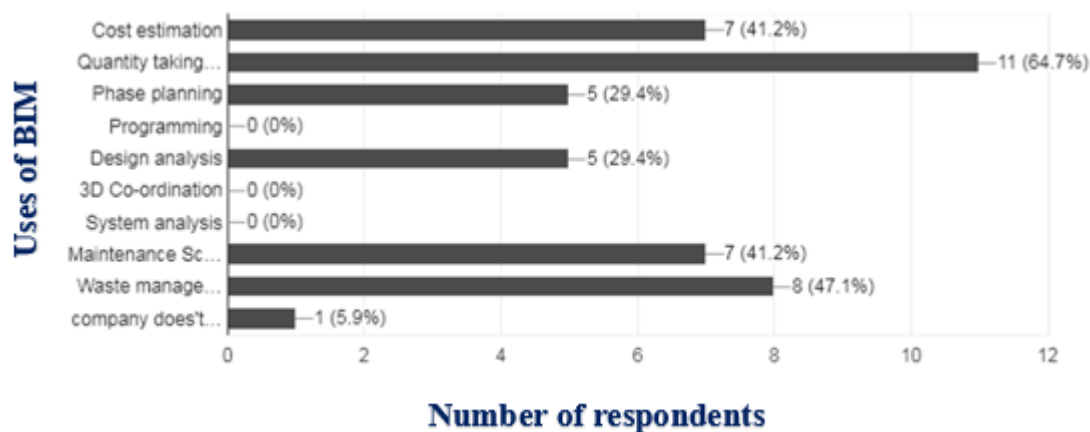


Figure 2: Level of BIM Usage Within Firms

The dominant use of BIM in companies is taking off. This is due to the profession being analysed as QSs. While there are a few people who use BIM for phase planning, design analysis, and maintenance schedules, it is evident that people are aware of the factors such as cost estimation and waste management that BIM can be used for. By identifying the objectives that BIM will be used for on a project it can be decided what

features of BIM will be used by QSs. Characteristics will be used according to the system of the facility that BIM will be used on, the point at which BIM use will be implemented in the project and the degree to which a model element is developed. Figure 3 shows systems used by QSs as follows.

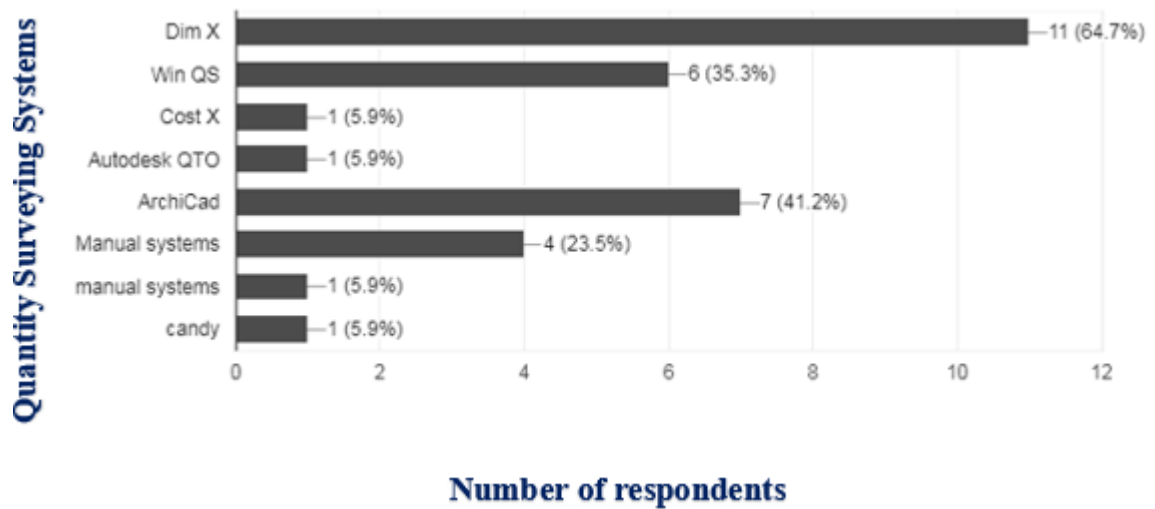


Figure 3: systems used by Quantity Surveyors

Due to the lack of independent waste management systems that are available to QSs in the industry many professionals do not make use of BIM software to assist them in this aspect. Based on the statistics received from our respondents we see that the majority of QSs make use of Dim X, ArchiCad and Win QS. These measurements are based on electronic drawings and provide users an efficient and cost beneficial way these daily tasks are operated. From the figure presented above it is obvious that about 25% of the respondents are still making use of manual systems. This brings up the topic of the adaptation of BIM by QSs. Next figure shows significance of BIM for sustainability in South Africa.

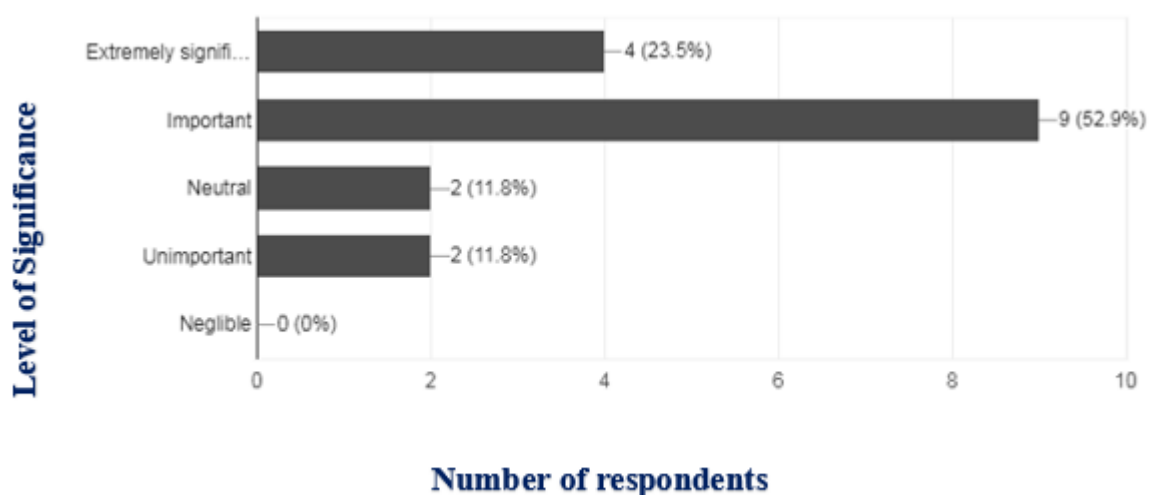


Figure 4: Significance of BIM for sustainability

Majority of respondents see BIM as important for sustainability within the construction industry. 23,5% of respondents see BIM as extremely significant. It is evident that many individuals see the importance of BIM for sustainability. Other responses can be due to lack of information about BIM and its abilities for sustainability in the construction industry. Behavioural aspects of the data received indicates that the industry vision is to move to a sustainable development. Next figure presents level of BIM use for waste quantification in South Africa.

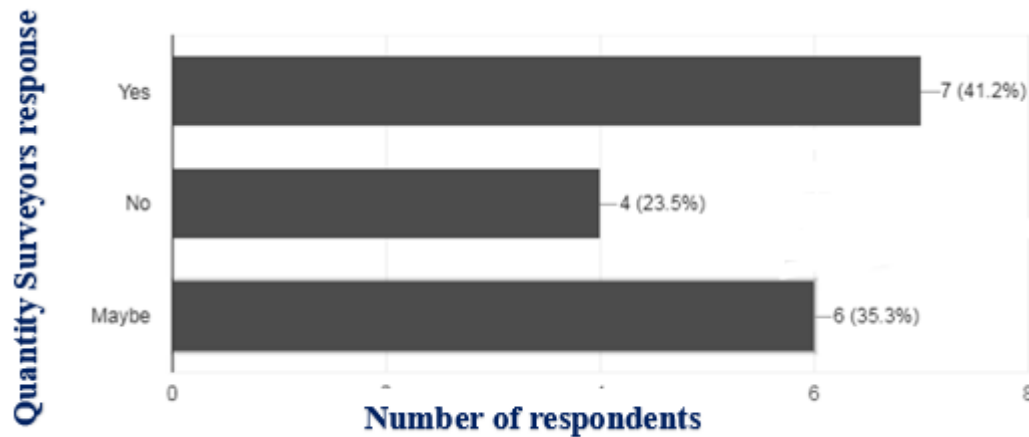


Figure 5: Level of BIM Use for Waste Quantification

The findings from this survey suggest that not so many practitioners have used BIM or exposed to BIM for estimating waste generation in construction projects. However, 7 (41.2%) of the respondents believe that the technology is useful for waste estimation purposes whereas 6 (35.3%) of the respondents are not sure of the features of BIM and 4 (23.5%) believe there is no use for BIM in quantifying the amount of waste generated. Next figure shows barriers in adoption of BIM by Qs.

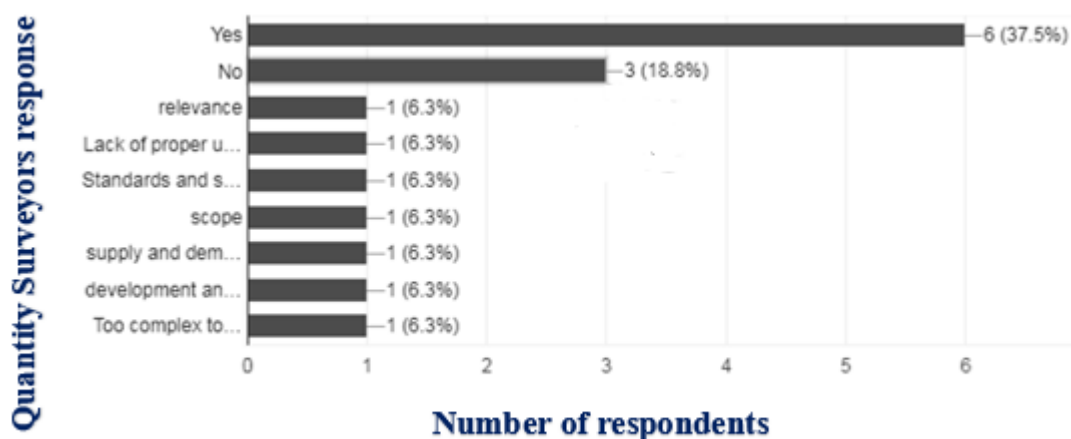


Figure 6: Barriers in adoption of BIM by Qs

The survey shows that 6 (37.5%) of the respondents feel that there are barriers that hinder most practitioners in using BIM in their practice. The study also shows that not many people believe that there are barriers for QS practitioners to use BIM 3 (18.8%), but there are concerns that contribute to less use of BIM such as lack of relevance, demand, standards etc. that makes it hard for QSs to use BIM in their practice.

Figure 7 shows the challenges QSs faced in using BIM.

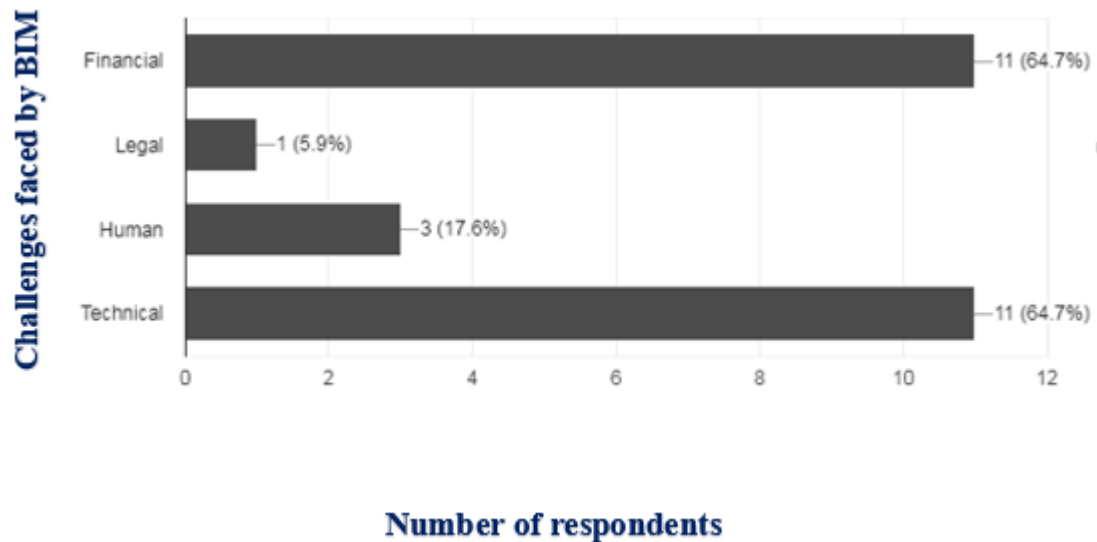


Figure 7: Challenges QSs Faced in Using BIM

BIM is a complex system and there many reasons to why the adaption rate is not as high as its benefits are. Many participants responded with there being a financial and technical challenge faced in the industry in the adaptation of BIM software. Only 1 individual believed that there were legal challenges faced by BIM which indicates that individuals believe that there are not many legality issues faced by quantity surveyors in adopting BIM. Next section highlights level of QSs satisfaction waste management processes used.

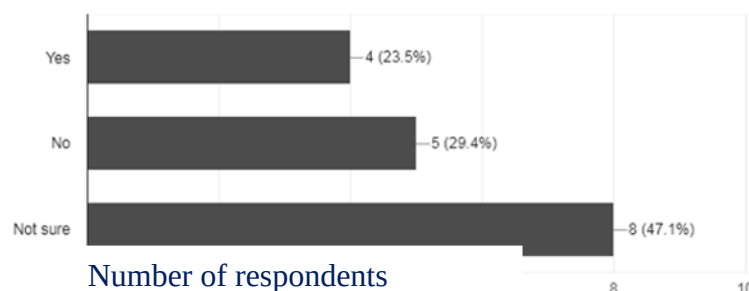


Figure 8: Level of QSs Satisfaction Waste Management Processes Used

Figure 8 shows that only 23.5% of respondents are happy with the techniques that they opted to use. This emphasizes the need for a reinvented system which meets the required agenda of QS roles in projects. 29.4% of individuals were not satisfied with the waste management systems used in projects. Many individuals were unsure 47.1%

of the waste management systems that were used within their companies. Figure 9 shows QSs influence on waste reduction.

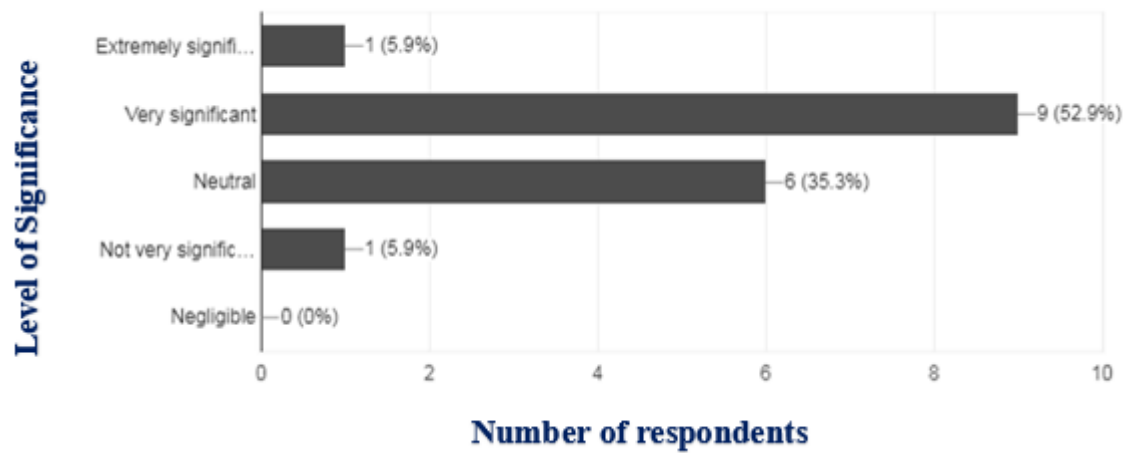


Figure 9: Quantity Surveyors Influence on Waste Reduction

The result of this survey shows that about 9 (52.9%) of the respondents agree that QSs play a critical role in the reduction of construction waste in projects. 6 (35.3%) were unbiased in their decision of whether quantity surveyors have an influence on waste reduction within the construction industry. Only 1 individual believed that quantity surveyors influence on waste reduction was not very significant.

Lastly in the next figure, causes for waste generation in construction projects are shown.

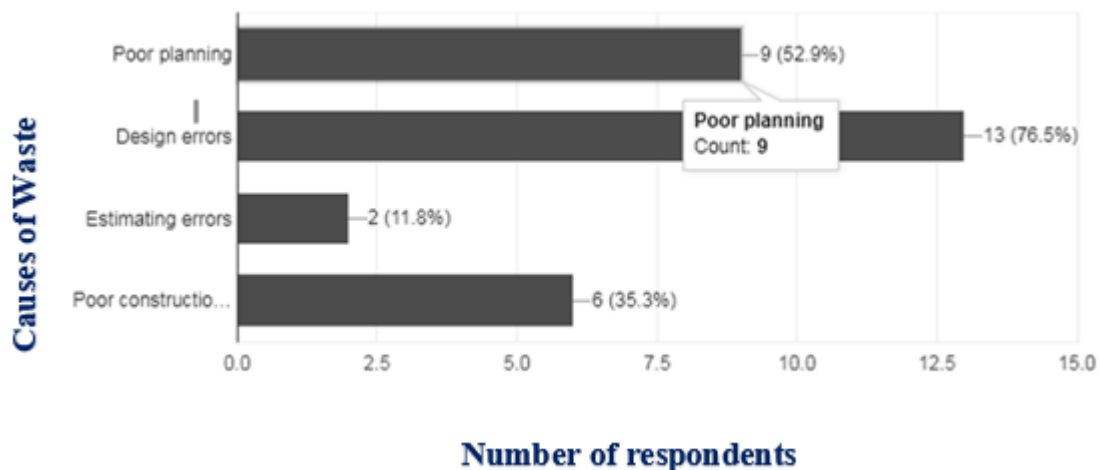


Figure 10: Causes of Waste Generation in Construction Projects

The respondents highlighted the flaw in design as the main source of construction waste in projects seating at 76.5% from respondents' views. This was followed by poor planning in construction projects seating at 52.9% from the survey responses. The results of the survey give the view that the most amount of construction waste produced on

construction projects is mostly from design errors and only 11.5% believe that this is due to estimating errors.

DISCUSSION

The study gives a view that the practising QSs have an idea about BIM and to the certain extent understand the benefits the technology has on project efficiency. However, these professionals have revealed that they have not taken full advantage of BIM to help them improve their practice and service offerings. The reason being, some QSs have not used BIM when preparing cost estimates and only few of them that have been exposed to the tools of BIM for quantification of waste management and reduction thereof.

The influence of this phenomenon is due to the barriers of adoption of BIM in South Africa and lack of experience in the use of BIM for waste reduction by these practitioners. One can further add to say the exclusion of QSs in the design stage is another reason there is waste generation as these professionals can use skill to forecast the amount of material waste that could be generation and hence provide action plans as early as design stage to reduce the amount produced at a later stage (Muleya & Kamalondo, 2017). Moreover, the dominant contributor to the impact is the lack of training programmes in waste management plans and for QSs not being involved and exposed to waste management decisions on construction projects.

According to studies conducted such as Kymmell (2008), Gerrard et al. (2010), BIM in Australia (2010), barriers which contribute to BIM can be linked to a low degree of awareness and a meagre undertaking of BIM where there is a poor relationship of trust between stakeholders in the erection of structures. There is a lack of staff training, a lack of understanding and implementation costs associated with BIM usage (Newton and Chileshe, 2012). Barriers between people seem to be the most challenging. This leads to the need of more time, resources and forming a corporate decision to allow usage of BIM by QSs in an organisation. Some needs associated with the implementation are drawn out as educational needs and standards and legality issues. Due to the nature, size and relationship between private and public sectors, challenges arise when implementation plans need to be put into place. Eastman et al. (2008), states that BIM implementation within organisations has both technological as well as social issues which arise. The exchange of information and the use of information lead to interoperability issues of allowing the system to be incorporated in existing systems (Ahmad, Demian and Price, 2017).

This study discovered that within the South African construction industry QSs are aware of the concept of BIM and some of its benefits. However, these practitioners mostly use the tools of BIM for cost estimation and quantity take-off and less for the quantification and forecasting of material waste as some of them are not familiar with. You find that the practitioners are willing to play a part in the reduction carbon footprint and environmental impact caused by construction waste, but they do not know how to go about doing this. The study pointed out that there is significance for QSs in minimising construction waste using BIM, but these professionals are not involved in waste management decision strategies for construction projects they were on.

It is evident QSs are not familiar with the waste estimation using BIM tool and the processes involved on construction sites for waste management. This corresponds to a study conducted by Oduyemi (2017) that the current tools used for waste prevention are integrated environmental solution, Autodesk ECOTECH and Autodesk Green

building studio which are not used by the South African Qs given that they use mostly DimX and WinQS in their practice. Thus, one could argue to say the lack of expertise and experience in the use of some tools of BIM cause a barrier for Qs to use the technology for the quantification of waste generation.

The study is important because it highlights the gaps and an overview of the use of BIM by Qs linking them to the quantification of waste generated on construction projects which is something that has been scantily considered within the concept of BIM (Zanni et al., 2017). This study adds knowledge to the collaboration of waste management and Qs to reduce the impact of cost overruns due to the amount of material waste generated on construction projects (Saidu & Shakantu, 2016).

Hitherto, the study answers the research question of this thesis as it discovered that there is a gap that Qs can fill by being involved in waste management strategic decisions in construction projects they are involved in. Qs using their skill and ability of costing can forecast cost overruns that are responsible for waste generation as suggested by Saidu & Shakantu (2016) to influence cost efficiency and improved waste management plans in construction projects. One can further point out that the study is consistent with the expectations of the research and reviewed literature. This was shown by the view that Qs think there are barriers that limit them from BIM adoption in South Africa which corresponds to a study by Kekana et al. (2014) which concluded that the gap and lack of information is responsible for the uncertainty in the use of BIM in South Africa. From the study of this research paper it was discovered that there is a gap of knowledge with regards to waste management using BIM among Qs as those who have been exposed to waste management processes are through recycling (58.8%), disposal (64.7%) and landfilling (29.4%) which were ranked accordingly.

Software such as WinQS, DimX and ArchiCAD were discovered to be most used cost management software by the practitioners which corresponds to the study by Windapo (2017) that pointed out that WinQS is used the most for cost estimates in the industry.

CONCLUSIONS

It has been identified that BIM has a slow adoption rate within the AEC industry in South Africa. The effects of this phenomenon on the production of construction waste was found to result in Qs being able to utilise for the overall improvement on sustainability through waste as well as cost efficiency. Qs have a strong influence over waste generation and cost efficiency but due to the barriers of the industry which has presented itself through economic, financial and social impressions makes it difficult for Qs to use digital technology such as BIM. It is evident Qs are not familiar with the waste estimation tools of BIM and the processes involved on construction sites for waste management.

During the course of the research being investigated, it was evident that quantity surveyors in the construction industry were unaware of the benefits BIM can produce in terms of waste management techniques and related cost efficiency strategies. It is critical to address the issues that prevent quantity surveyors from implementing BIM in construction project which may be essential for improved sustainable consequences for the built environment. Some recommendations for further research are proposed: Investigating how quantity surveyors can further implement BIM through government stakeholders and how this process can start becoming a standardised norm within the construction industry in South Africa which can contribute to the progression of a

sustainable future; conducting the research presented using calculations and theoretical studies; The skill level and experience of quantity surveyors in terms of green strategies and processes should be explored to gain a better understanding of how they can implement BIM for the purpose of waste management on site.

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PERCEPTIONS OF LEAN IMPLEMENTATION: A CASE STUDY OF A SOUTH AFRICAN CONSTRUCTION CLIENT

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This study presents an assessment of what constitute challenges for the implementation of integrated project delivery through the application of lean concept, with a contextual reference to the Central University of Technology, Free State (CUT) in South Africa. A critical review of literature was carried out as the theoretical foundation for the study. Thereafter, interviews were conducted with facility and management staff at CUT to identify and synthesize the implementation challenges. The main findings suggest that inadequate knowledge, lack of proactive improvement actions, and limited lean awareness across all units of the university constitute implementation barriers that must be addressed. However, outlined limitations are limited to a particular university context. The limitations form the basis for further research that would include regulatory environment and the nuances of resistance to change.

Keywords: Client, Construction, Contractor, Lean, Project delivery

INTRODUCTION

Tertiary institutions are looked upon not only for providing education and training, but also challenged to apply their research findings. This is particularly for those offering construction related programmes to ensure required pace for maintaining quality infrastructure (Buys and Nkado, 2006). This challenge underpins the motivation for this study.

Construction project delivery outcomes are influenced by construction management and the application of new tools/techniques. Despite the intervention of new tools, efficiency in construction projects delivery is still measured to be quite low (Koushki et al., 2005; Aziz and Hafez, 2013).

Earlier strategies with new technologies are targeted at design efficiency through Computer Aided Design (CAD). The strategies are not able to ensure optimization that reduce waste in the construction processes (Aziz and Hafez, 2013). As such, alternative interventions were sought to ensure that project delivery is not limited to a particular project phase and process.

In recent times, lean construction is increasingly popular among designers and contractors in developed countries in North America and Europe. A study suggested that lean approaches promises to eliminate waste by efficient management of the construction process while at the same time integrating sustainability in project delivery (Jamil and Fathi, 2016). Thus, lean project delivery is discussed in this paper as an Integrated Project Delivery (IPD).

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Project delivery according to Design-Build Institute of America (2015) is a crucial decision taken as a comprehensive strategy for a development that include planning, design and construction. IPD is most sort after by project owners who knowledgeable in its workings as shown in the quotation below.

The new focus in an IPD is the final value created for the owner, which would be the finished building. With the idea of each participant focusing exclusively on their part of construction without considering the implications on the whole process, the IPD method brings all participants together early with collaborative incentives to maximize value for the owner, (Integrated Project Delivery 2015).

From the quotation, project delivery is not only concern with the finished project but with every process leading to facility commission. The role of an integrated strategy is synonymous with lean, which has the advantage of collaborative efforts leading to value maximization. Since the lean approach has been identified as the strategy that ensures project delivery that are optimized for efficiency, elimination of waste and value creation, how then can implementation barriers be broken down for project success purposes? This study presents its findings on what would constitute challenges for the implementation of IPD for its context.

LITERATURE REVIEW

The processes of project delivery vary from a project to another because of the choices made. This is carried out through the modification of project planning system, which allows for the improvement of downstream activities (Danesh et al., 2017).

Implementing IPD entails ensuring the integration lean principles into a delivery process (Jamil and Fathi, 2016; Allu and Emuze, 2017). The integration deploys a process that that is contrary to the convention delivery method.

The conventional methods of project delivery are characterised by fragmentation, limitation in planning, delayed project appraisals and poor sequence of work (Cano et al., 2015; Deese et al., 2017). The implementation of IPD allows for the identification of processes that are either value adding or non-value adding in a given project (Abdul Rahman, et al., 2012). The concept of IPD ensures that the appropriate quality materials are supplied as scheduled and used for a specific purpose (Erikson, 2010). IPD also advances sustainability in the built environment in general (Sarhan and Fox, 2013; Allu and Elimiesiemon, 2017). However, the advancement of sustainability through IPD rely on both technology and people. Lean implementation processes are people oriented in its approach. Coffey (2000) asserts that the success of implementation in any organisation is rest with the people, who carry out the tasks required. People must be developed alongside what the implementation tasks entails. To make people think lean during project delivery activities, Pekuri et al. (2012) postulated three pillars: client, continuous improvement and respect, as key to reorienting people to think and apply lean to any project delivery.

Challenges of IPD Implementation

The advancement of IPD is supported by case studies of successes (Mossman 2009, Cheng and Johnson 2016; Zhou and Liu, 2017 and others). Although, major IPD progress has been reported in the literature, there are notable implementation barriers cited by several authors. Table 1 presents these barriers as challenges. They include inadequate education and training, knowledge limitation, low awareness, poor planning, and many more issues constitute major challenges that must be tackled. It is notable that none of the challenges presented in Table 1, were derived from a

university. This study is an attempt to examine these barriers in a university environment where projects are developed for knowledge sharing purposes.

Table 1. Challenges for Integrated Project Delivery

S/N	Challenges	Author Sources
1	Inadequate education/ training	Zhou and Liu (2017).
2	Limited knowledge and awareness	Cano et al. (2015); Zhou and Liu (2017).
3	Lack of proactive actions/ planning	Cano et al. (2015).
4	Resistance to change and interrelating tasks	Denish et al.(2017).
5	Lack of involving all stakeholders	Korbe (2012); Pekuri et al. (2012)
6	Lack of commitment and support	Sartian and Fox (2013); Hackler (2017).
7	Lack of skilled personnel	Zhou and Liu (2017).
8	IPD need to be support by management to be successful	Fisher et al., (2017).
9	Risk identification and sharing	Fisher et al., (2014)
10	Construction related complexities	Orstavik (2015).
11	Continuous communication at all levels	Jamil and Fathi (2016).

From the review conducted in this study the following challenges standout, limited conceptual education, limited knowledge, awareness, and the lack of proactive actions. This is because they are closely link to the purpose and context of this study. Lean education has been noted to be limited globally. According to Zhou and Liu (2017), lean application and implementation for project delivery can only be successful when the correct knowledge of lean is taught and understood. This barrier of limited education was also obvious during the interviews conducted and from the opinions expressed by the interviewees of this study.

Sartian and Fox (2013) opined that the implementation of lean project delivery requires the support of top management in an organisation. As such, when education is not supported to transfer knowledge and awareness on lean, its implementation would be almost impossible. Hence, to implement IPD in an organisation, education must be taken as an important factor for success. IPD implementation also requires proactive improvement actions. This is because lean approach to project delivery is aimed at promoting continuous improvement, waste elimination, value for money, and improved communications (Jamil and Fathi, 2016).

The context

Lean application to construction activities is not new to the South African construction industry (Emuze and Smallwood, 2012). Efficient construction projects delivery is below expectations (Koushki et al., 2005; Aziz and Hafez, 2013). At the Central University of Technology (CUT), there exist a blue print for sustainability and a unit for lean construction research has been established. These efforts are significant to

position this educational institute to promote research and implementation of IPD. Although, this much is known what is unknown is how these efforts have influenced infrastructural development in the university. It is unclear how those saddled with the project delivery responsibilities perceive the merit of lean construction implementation and eventual adoption in CUT.

This study attempts to ascertain the implementation of IPD within the institution with a view to provide recommendations in areas requiring improvements.

RESEARCH METHOD

This paper presents an assessment of what would constitute challenges for the implementation of IPD based on the perceptions staff of the facility unit at CUT. This was achieved using literature review, which provided the theoretical underpins for discussions. Inductive interviews provide the perceptions from lived experiences.

A convenient sampling, a sub-set of purposive sampling is adopted because the study is specific to construction project development and delivery in a specific university. Earlier research carried out in this regard acknowledged the usefulness of the method for specific research context (Higginbottom, 2004; Osei-Kyei et al., 2017).

The interview was administered to staff of CUT's facility unit. The CUT facility unit staff members were seemingly not familiar with lean and most of them avoided answering questions that particularly referred to lean but attempted answering other questions, except for the management staff who provided answers to all the questions based on his experiences and perceptions. A focus group interview became necessary when individual staff member was observed to be avoiding the one-on-one interview sessions because it seem rather more formal than the focus group, which appeared to be an informal discussion.

Consequently, out of the 16 interviews proposed only 1 with a management staff was possible and a focus group with 6 other staff in two groups with 3 interviewees in each group was conducted. This represents about 44%, which may seem low. However, Fryrear (2015) opined that thirty to forty per cent (30% - 40%) for an internal survey is acceptable. Typical of the industry (Littrell and Nkomo, 2005), only one female was a participant and all participants have a post-secondary qualification.

ANALYSIS AND DISCUSSION OF FINDINGS

The questions asked, and the summarized corresponding responses are presented in a descriptive manner. In total, there were eight questions starting with an inquiry into general knowledge on LPD at CUT and views on the implementation challenges.

Question 1: How familiar are you with lean construction principles in project delivery? Briefly explain your understanding?

This question seemed the most difficult to be answered, except for the management staff, none of the other staff seem to have any deep understanding in this regard. This is an indication that there is very little knowledge of lean construction amongst the interviewees, which is a source for concern and an indication that the participants need to be educated and train to improve their knowledge on the subject.

The impressions from this question are two-fold. Firstly, the efforts to raise awareness and knowledge relating to lean construction in CUT seem to be more of an academic exercise. As such, training of staff in the university, for the non-academic staff must be pursued. This is related and validates the assertions from earlier researches who

observed that one of the challenges for implementation IPD is lack of adequate training and reorienting people to think 'lean' in their practices (Pekuri et al., 2012; Zhou and Liu, 2017).

In addition, despite the establishment of the Lean Unit and the Sustainable Agenda of the university, there is a seeming lack of cohesion between the academic pursuits and practical application implementation, which implies weakness in the strategic planning for proactive action within the institute. Thus, constituting a managerial challenge of lack of planning postulated by Cano et al. (2015).

Therefore, there is need for harmonizing institutional research agendas and policies with that of the units saddled with carrying out implementation of project delivery. Doing this would ensure that IPD within the institution is achievable.

Question 2: What is your understanding of sustainability?

All the interviewees were observed to have some level of understanding on what sustainability is all about and a verbatim response is quoted as:

Sustainability essentially pertains to development within an environmental context, thus considering the impact of a development on the environment. In the built environment it would focus on construction and real estate and specifically on aspects such as energy usage, consumption, waste, pollution, and effect on the environment, effect of natural phenomena such as global warming, water shortages, population growth and famine.

The knowledge of sustainability in this regard is quite broad however, its futuristic advantages have not been well-thought-out by the response. This maybe an oversight, it is also necessary to ensure that the full understanding of sustainability is well understood by practitioners through refresher training by the relevant academic and planning Departments.

The responses to question 3 on relationship between lean and sustainability revealed a wide variation of knowledge and articulation.

Question 3: Do think there is a relationship between lean and sustainability principles? Briefly explain your answer please

One of the interviewee is quoted thus;

Definitely; while lean promotes efficiency in the wider context, sustainability focuses on preservation and containment of those aspects influencing the environment. Efficiency measures must consider sustainability requirements and needs, while sustainability measures need to also promote overall efficiency.

On the other hand, another respondent responded that, "No! I think these entirely two different things which I may not be able to explain but these are different."

In the theoretical review, it was clear that integrating lean into construction activities promotes sustainability. However, it was not the case in the opinion of the interviewees. The interviewees may have some unconscious knowledge on the relationship in their practices but because the knowledge and understanding of lean is limited, they are not able to express their views. The response quoted above is an indication that there is clearly a poor understanding of the concept of lean to include sustainability concepts. This is a further validation the studies conducted by Cano et al. (2015) and Zhou and Liu (2017), who both stated that, limited knowledge and understanding are part of the challenges for the implementation of IPD.

Question 4: Have you participated on any process at CUT that led to project delivery? If yes, itemise the projects please.

The respondents agreed that they have participated on several activities that are part of the process that leads to project delivery. Also, the interviewees claimed to have participated in every stage or at some stage of infrastructural projects development. This affirms that physical developments are on-going within the institute and the respondents' inputs were required. Therefore, it is necessary for these staff to have a reorientation on thinking and applying lean concept into their practices to ensure an integrated project delivery within the institution henceforth.

Question 5: Is there a guideline or checklist provided by CUT to facilitate the processes of project delivery? If YES, kindly provide a copy. If NO, how were the projects verified?

Responding to this question, the interviewees noted the absence of such a document, but they were eager to be provided with a guideline. The interviewees opined that the guidelines document would add to the success of their operations and that the document will serve as a guide to the processes leading to projects delivery.

According to the respondents, even their professional bodies subscribe to providing such a guide, but with certain amendments, involving the following:

1. Client need assessment, broad project requirement needs specified and financial budget development.
2. Selection and appointment of suitable project consultants, after project approval by management
3. Scheme design by consultants, incorporating sketch plans, broad specifications and cost budgets.
4. Detail design and tender documentation preparation
5. Contract procurement
6. Project production and construction
7. Practical completion and delivery of final completion.

Is the overall, it is necessary for the institute's management to support the formulation and provision of a checklist for the use of the Facility Unit. This would serve as support as was noted to be critical for the operations and management of IPD (Sartian and Fox, 2013).

Question 6: Is it possible to integrate the principles of lean and sustainability into project delivery at CUT? Please elaborate on your answer.

The verbatim response of an interviewee quoted below is insightful:

Yes. Most pertinent problems pertain to the planning of a project within a normally reduced and conservative budget, which requires teamwork as to seek optimal solutions. Irrespective of budget constraints, as client the CUT must ensure that value for money is received, whilst a functional project is delivered within a reasonable time. Many challenges pertain to such an aim though and applying lean principles can certainly improve the overall performance and delivery process. Sustainability measures are introduced within limited available funds.

This response shows that the interviewee is knowledgeable about the principles of lean, but he however sees sustainability as a 'stand-alone' strategy and does not

perceive the concept of lean as a channel or a means to sustainable actions. Again, this is a case of inadequate knowledge of lean in relations to IPD.

Question 7: Do you think you would require more information on the application of lean approaches to project delivery? Please explain.

This response quoted below sums up the perceptions obtained:

“Yes, it could be helpful, specifically if the various role players are identified with a clear outline of responsibilities within an integrated process and system. To have any meaning though, this would have to be driven from senior management down to operational levels.”

It is notable that the opinion express does not perceive tasks to be interrelated or even as a collaborative mechanism between management and the downstream activities. According to Danesh et al. (2017), management support and interrelationship of tasks is important to the implementation of IPD in downstream activities.

Question 8: In your opinion, what would constitute the challenges and potentials for adapting an integrated guidelines or checklist for project delivery at CUT?

Again, the opinions expressed by one of the respondent captures the opinion expressed by others as:

“Obtaining a buy-in from each functional unit; on its role, responsibilities and commitment. Furthermore, the current system is currently also deficient as top management with no technical project knowledge involve themselves directly with especially larger and strategic technical project matters without consulting the specialists within the field, who are accommodated in the Facilities Management unit.”

Communication at levels is important. The literature reviewed established the relevance of communication (Korbe, 2012; Pekuri et al., 2012), without which the managerial and operational level would be disjointed in their agendas and implementation practices.

These challenges emanating from the interviews have re-echoed those presented in Table 1. Findings also uncovered additional concern from the interviewees that, decisions that concern their service unit may not always have some input from them as unit staff as well as stakeholders.

CONCLUSIONS

The study notes that, although lean is not new to South Africa and the establishment of a Unit of Lean research at CUT, not much ground have been covered in the implementation of IPD. The paper presents IPD implementation challenges within a tertiary institute in South Africa. Findings from the study revealed that the knowledge of the interviewees was inadequate; but they as facility staff of the university are willing to learn and to be consulted on matters that involved them in any project delivery process. Other findings on the implementation challenges uncovered by the study were linked to inadequate planning and support, harmonising the linkages between academic and non-academic pursuits, provision of checklist, training and reorientation of support staff.

Policy formulation is recommended for the institution on project delivery. The inclusion of all support staff members involved in facilities in all IPD related awareness programmes is also proper for assimilation and improvement.

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BAHAVIOUR AS PROXY FOR MEASURING MARKETING RELATED CULTURAL ISSUES IN CONSTRUCTION

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Most research on marketing in construction points to culture as a barrier to adoption and implementation, however, culture by definition appears vague resulting in confusion over its composition and more importantly its measurable attributes. This paper aims at demystifying construction marketing related culture issues into surrogate's manifest constructs appropriate for defining culture to enable its measurement and to examine how they relate to factors human behaviour and marketing management in construction. The paper is descriptive. It uses literature review as the method and draws on models of culture – The Lily Pond of Culture and Behaviour, and the Hidden Dimensions of the Culture Iceberg - as the theoretical lens to achieve its objective. Findings reveal that the factors that define culture are in fact human related behaviour factors. The paper justifies the potential use of human related factors as surrogate manifest constructs for measuring culture related issues of construction marketing and other human behavioural aspects of management. Theories of behaviour can be adopted and adapted to generate constructs for measuring marketing related cultural issues in construction. Human related behaviour constructs are potential measures for marketing related culture issues in the construction industry.

Keywords: Behaviour, culture, human factor, marketing

INTRODUCTION

A critical aspect of success in a global competitive business environment is organizational culture (Sadri and Lees, 2001). However, due to the many different and sometimes conflicting ways by which culture is defined (Pepper, 1995), one of the most difficult and complex approaches to understand in the management of organisations is culture.

Culture is commonly identified as “set of mores, values, attitudes, beliefs, and meanings that are shared by the members of a group or organization” and therefore serves as a distinguishing feature of one organization from another (Williams et al., 1993; Duarte and Snyder, 2001). Culture therefore gives an organization its unique characteristics that differentiate it from all other, even in similar organizations.

Culture also has profound influence on organizational change which is inevitable due to changes that occur all the time in their business environments that necessitates adaptation of businesses to changes in the business environment to ensure survival,

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growth and profitability. For a change in an organization to occur, culture is the indispensable. Change has always remained difficult yet possible provided that the collective individuals involved are willing to change. Black and Gregersen (2002) notes that the necessary first step towards changing an organization is to change the individual beliefs, attitudes and values – culture – before the organization can relies it.

That is the case with marketing as a management function in the operations of construction business organization. Marketing is widely accepted as a source of competitive advantage in many other industries (Kotler and Keller, 2012; Dickmen et al., 2005), yet marketing as management function has not been welcomed as a necessary business management function in the operations of construction business enterprises. The change in management practices from heavy emphasis on production to marketing oriented management practices remains an uphill struggle with a little to no chance of success in the construction industry. One of the well-known reasons assigned to this is cultural barriers or cultural resistance (Symour and Rooke, 1995; Dikmen et al. 2005). The presence of cultural barriers to the adoption and implementation of marketing in construction appears to be high amongst the numerous challenges that hamper marketing as a management function in the operations of construction business enterprises.

The importance of culture stems from its ‘powerful, latent, and often unconscious set of forces that determines both our individual and collective behaviour, ways of perceiving, thought patterns, and values’ (Schein, 1999:14). Most often, decisions which are made without recourse to ‘operative cultural forces’ result in unanticipated and usually undesirable consequences (Schein, 1999). Occurrences such as these have made culture a critical subject of concern in many organizations, and particularly so in construction management functions where culture appears to be the backbone of the resistance and reluctance to the adoption and implementation of marketing in construction as a management function in the operations of construction business enterprise.

Despite this, available evidence suggests that ‘culture is an obscure construct which also possess latent characteristics (Fellows, 2011). The need therefore exists for identification of constructs and variables that can be used to measure culture. This observation highlights the need for more studies to define culture and its attributes more clearly.

This paper examines the concept of culture in relation to construction marketing and factors of behaviour to establish its latent constructs that are measurable for the purposes of future research into the potential influence of human behaviour factors on marketing in the construction industry. It further serves to justify factors of behaviour as surrogate manifest constructs for measuring marketing related cultural issues in construction, particularly, marketing of construction business. This paper therefore attempts to demystify culture into the surrogate constructs to aid researching into culture issues in construction management and enhance its measurement in relation to marketing in construction.

RESEARCH METHOD

By design the paper is descriptive. It uses literature review as method to explicate the attributes of culture to demystify its constituent components. It adopts the Lily Pond of Culture and Behaviour, and the Hidden Dimensions of the Culture Iceberg as the

theoretical lens in this explication. Appropriate theories of behaviour are drawn to define constructs and to categorize factors of behaviour for measurement purposes.

CULTURE OF CONSTRUCTION AND MARKETING MANAGEMENT

Conceptualization of culture

In the view of Fellows (2011), to define culture is highly problematic and the existence of myriad definitions of culture further exacerbates the problem of conceptualizing culture. The excerpts of definitions of culture in Table 1, further augments the assertion by Fellows (2011).

Table1: Excerpts of known definitions of culture

S/N	Source	Definition
1	Adeogun and Okafor (2013: 28)	Culture is “...the ways of thinking, behaving and believing that members of a social unit have in common.”
2	Mengolini and Debarberis (2007:520)	A pattern of shared, taken for granted basic assumptions held by the members of an organization and developed through a process of external adaptation and integration.
3	ACRCCI (in Mustapha 2017)	The behaviour, attitudes and values of members are dependent upon the sets of both conscious and unconscious beliefs that individual members possess and that these beliefs are a key element of organizational culture.
4	Cooper (in Mustapha 2017)	Culture is a characteristic set of assumptions, beliefs, values, knowledge, attitudes and symbols shared and held by all members of a group that influences behavioral patterns and perceptions. These can surface through observation and/ or description of what goes on by those that are part of the organization.
5	Martins and Terblanche (2003:65)	Organisation culture is the deeply seated (often subconscious) values and beliefs shared by personnel in an organization.
6	Fitzgerald (2005:325)	Consists shared values (what is important) and believe (how things work) that interact with an organization's structure and control systems to produce behavioral norms (the way we do things around here).

Source: Adopted and adapted from Mustapha et al. (2017)

These definitions are varied in nature, covering a wide range of issues as the assertion by Fellows (2011) indicates. This has great effect on researching culture as the definitions portray uncertain and a rather implicit constructs and vagueness of the attributes of culture. To research culture, ‘plurality of views pertains to appropriateness of paradigms, epistemologies, methodologies and methods, individually and triangulated’ (Fellows, 2011). Challenges exist in researching into culture – what it is, how it operates and with what consequences’ – remains unclear (Fellows, 2011).

Culture, according to Fellows (2011) ‘is an obscure construct due to its ‘deep seated’, latent nature and so, must be investigated through (surrogate) manifest constructs and variables’. This does not take away the challenges of researching culture; rather it opens another door of confusion. Fellows (2011) notes that efforts aimed at researching aspects of culture within the construction industry have occurred only in recent times, suggesting the need for more studies to define culture and its attributes more clearly. In times past, culture was occasionally identified as important but, more usually, as a label to try to explain differences between empirical results and expectations (Fellows, 2011).

Management practices of construction and marketing in construction

An insight into management practices of construction businesses reveals a skewed focus of attention towards production related issues far more than management issues. The reasons to this are clearly seen in the description of construction management given by Cicmil and Nicholson (1998). The authors described construction management practices as suffering from a:

“cast in concrete”, inwards-oriented management paradigm which forms a barrier to the implementation of some contemporary managerial techniques and philosophies, now widely recognized and adopted in other industrial sectors”.

Yisa et al (1996, p. 48) reports of several investigations of the UK construction industry that reveals an “indifferent attitudes” to marketing, with a heavy emphasis on “selling, business lunches, and ‘double glazing hype’”. There exist studies that showed that construction enterprises had ignored, or been slow in adopting, marketing principles; had failed to include marketing in corporate strategies; and typically regarded marketing as an extension of the responsibilities of operations managers rather than as an independent function (pp. 57-58).

Cicmil and Nicholson (1998) continue their description of construction business practices that:

Construction business practices suffer from parochial attitudes to ownership of projects, technically biased operations, and conservative, efficiency-based approach to management.

Many studies have alleged that “adversarial attitudes” towards customers exist within construction companies, resulting from a “tendering culture” that focuses on winning individual orders rather than on developing sound long-term relationships with clients (Cicmil and Nicholson, 1998, p. 97). Construction firms have also been condemned for assuming that downturns lead to fewer new entrants and consequently less competition, whereas in fact competition intensifies during a downturn and completely new critical success factors emerge (Seymour and Rooke, 1995). Cicmil and Nicholson (1998) continue their description of construction business practices that:

Novice propositions, such as the acceptance of customer-oriented policies through partnering, synergy, professional concurrence and organizational systems conducive to learning, have been a topic of major academic and professional debates on culture change in the construction industry”.

Several studies have criticized firms in the construction industry for failing to adopt modern marketing methods. This view is supported by many other researchers (Seymour and Rooke, 1995; Yisa et al., 1996; Cicmil and Nicholson, 1998; Curtis,

2001; Tay, 2001; Betts and Wood-Harper, 1994; Seymour et al., 1997) who have highlighted similar views on marketing in construction. Cicmil and Nicholson (1998) concur that construction business operational mechanisms are influenced by the culture of the industry. Because with production as the most important aspect of the business (Dickmen et al., 2005), management practices in the construction industry tends to be dominated by the engineer's paradigm (Seymour and Rooke, 1995) which leaves a rather limited scope for implementation of contemporary business theories, management processes and behavioural change, such as marketing driven strategic management or total quality management (TQM).

Explicating on the potential influence of cultural issues on marketing adoption in construction, Dikmen et al. (2005) reiterated the assertions of many other authors on the subject particularly Seymour and Rooke (1995) and Richardson (1996) and concurs that:

‘Apart from the physical nature and organizational structure of the construction industry, major bottleneck that plugs the way of marketing-oriented approach is the presence of cultural barriers. The cultural resistance is obvious in the sense that management practices in the construction industry are dominated by the engineer's paradigm which leads to a limited scope of implementation of contemporary business theories, management processes and behavioural change, such as marketing-driven strategic management. According to Richardson, if marketing is to be adopted by construction companies, the most important hurdle to be overcome is the internally generated barrier of resistance to cultural change’. (Dikmen et al. 2005, pp.258)

This observation about the potential influence of culture does not only affect marketing in construction but also the entire management of construction business. However, it is unclear what constitutes cultural barriers or cultural resistance in relation marketing management in construction industry as noted by Dikmen et al., (2005).

CONSTRUCTION INDUSTRY CULTURAL ISSUES, MARKETING AND HUMAN BEHAVIOUR FACTORS

Intricate characteristics of culture

Culture appears to be a complex subject and the mere saying of culture as a barrier is vague. This might have influenced the theme for the 2011 ARCOM doctoral Workshop. This was notable in the introductory address of ARCOM Doctoral Workshop 2011 under the theme ‘Culture in Construction’ delivered by Professor Paul Stephenson (Workshop Convenor), that: “...culture might be described as how things are done...”. This description of culture in its simplest term brings human factors into sharp focus. Things are done, but of course they are done, only by persons. All the factors involved in construction, either for production or management purposes are put together by the one factor, which is the human factor. This underscores the indispensable role of human factor in construction business management, particularly with regards to marketing management.

To explicate the human factor further, Professor Paul Stephenson notes the effects of human factors and argues that: “...there are numerous and more in-depth issues that influence outcomes related to human actions, interactions, and behaviour”.

This argument seeks to suggest that culture is an embodiment of actions that encapsulates human actions, interactions, and behaviours. This observation highlights

the potential relationship that exists between human related factors such as behaviour and culture of the construction industry. Commenting on the outcomes of the effect of culture on human actions, interactions and behaviours, Professor Paul Stephenson concurs that: "... the implications of these are not always clear, and often less certain, yet can impact greatly on both organizational performance and project success." This argument further confirms human factors as critical issues that deserve considerations.

However, there exist challenges with researching culture related issues. Fellows (2011), in his paper "Researching Culture in Construction" made startling observation about culture:

"A major problem with researching culture is that it remains a relatively obscure construct due to its 'deep seated', latent nature and so, must be investigated through (surrogate) manifest constructs and variables; indeed, just defining culture is highly problematic and myriad definitions exist. Levels of examination (national, organizational) are varied as are purposes (cultural (in-) compatibility, performance consequences, etc.) which compound the difficulties".

Demystification of culture

Demystification of culture through the 'Lily Pond' of Culture and Behaviour

This intriguing relationship of culture and human actions, interactions and behaviour is made much clearer with examination of the 'Lily Pond' of Culture and Behaviour (Williams et al., 1993), and the Hidden Dimensions of the Culture Iceberg (Duarte and Snyder, 2001) diagrams. Figure 1 and Figure 2 shows the two theoretical lenses for viewing culture, which further explain the constructs and the sub constructs and provide leads to relevant variables.

Williams et al. (1993), uses the "Lily Pond" to illustrate the characteristic patterns of group behaviour and elements of its culture. Williams et al. (1993) concurs that behaviour, attitudes, and values exhibited by persons are influenced by the set of both conscious unconscious beliefs that individuals possesses, and these beliefs determines the culture of an organization (Figure 1).

The Figure 1, further contrast beliefs, attitudes and values, and behaviour. The beliefs in an organization are unconscious in nature, attitudes and values can be reported on. Behaviour is the observable aspects of culture in an organization. This argument suggests that the behaviour that organizations exhibits are underpinned by such factor are beliefs, values and attitudes of persons that make the organization. The totality is described as culture however what is observed is the human behaviour which in other words becomes the surrogate (Fellows, 2011) for measuring organizational culture. In effect, culture by its intricate nature, can be measured through it attributes that are observable-behaviour.

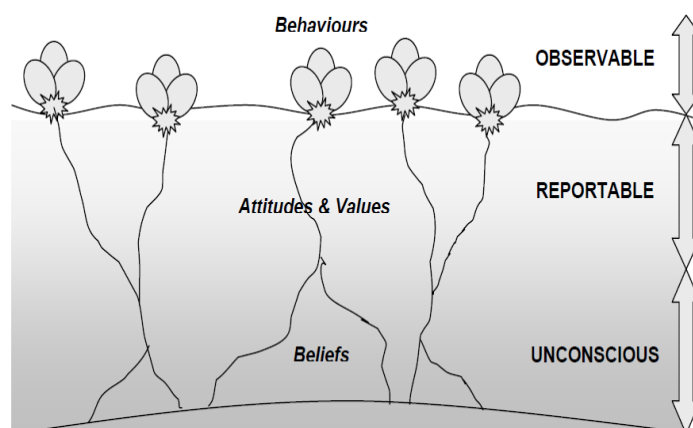


Figure 1: The 'Lily Pond' of Culture and Behaviour (Adapted from Williams et al., 1993)

Demystification of culture through the 'Hidden Dimensions of the Culture Iceberg'

Similarly, Duarte and Snyder (2001) used their diagram, the 'Hidden Dimensions of the Culture Iceberg' to explicate and demystify the intricate attributes that make up culture in an organization. The authors argue that culture is like 'hidden scrips' created by interactions repeated over time between members of a group, which serve to guide their behaviour. The authors noted that over time, the 'hidden scrips' becomes 'invisible' and 'second nature', which serve as 'shortcuts' for guiding actions and making decisions (Duarte and Snyder, 2001). This is illustrated by a diagram representing an iceberg as shown in Figure 2. Like the Lily Pond of Culture model, the hidden aspects of culture identified in Culture Iceberg are identified as beliefs, values and assumptions which are underneath what is observed as behaviour and practices. This model provides two levels of culture component: 'what is hidden' and 'what we observe' (Figure 2).

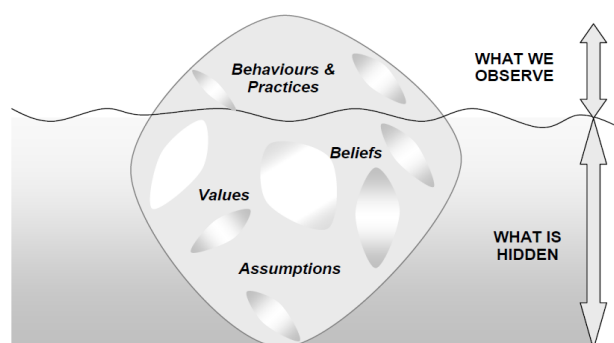


Figure 2: The Hidden Dimensions of the Culture Iceberg (Adapted from Duarte and Snyder, 2001)

It becomes clear that human factors are an integral component of culture and perhaps the most important part because it is the aspect that can be seen and therefore be measured. The extent of impact of culture in an organization is described by Williams et al. (1993) as something that:

“Pervades the decision-making and problem-solving process of the organization, influencing the goals, means, and the manner of action” and thereby “underlining much of the human activity in an organization. This assertion underscores the human

factor (Behaviour) as indispensable element of culture. Behavioral models/frameworks and theories therefore offers latent constructs for measuring culture related issues in construction marketing.

BEHAVIOURAL ASPECTS OF MARKETING IN CONSTRUCTION

The behaviour of construction manager also affects marketing of construction businesses. This is because the human (manager) needs to undertake activities (actions) that are necessary to satisfy needs and wants of customers. The motivation to undertake those activities will be influenced by usefulness of such activities and the ease with which performance of those activities are perceived by the manager. If marketing function is perceived as difficult they are likely to be avoided by such managers. This further explains why the manager's behaviour is a critical success factors or otherwise.

Human behaviour is best explained within the Theory of Planned Behaviour. A central factor in the Theory of Planned Behaviour is the individual's intention to perform a given behaviour. This theory, as outlined by Ajzen (1991), postulates three conceptually independent determinants of intention as a predictor of behaviour. The first is the attitude towards the behaviour; it refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behaviour in question (Ajzen, 1991). With regards to marketing in construction, there is likelihood of unfavorable evaluation of the behaviour (actions or activities that needs to be performed) to implement marketing in construction. This is due to construction education that places emphasis on production efficiency as the most important part of construction business to the detriment of management functions.

The second predictor is the subjective norm; it refers to the perceived social pressure to perform or not to perform the behaviour. Here again the perceived social pressure on the part of the manager not to performs activities towards marketing implementation is greater than the pressure to do so. Such social pressure can come from other management team members, other professionals and others who operate in the construction industry environment. Due to the indifferent attitude towards marketing in the construction industry, there is no such social pressure on the construction manager towards performing actions for implementing marketing in construction.

The third is the degree of perceived behavioral control; it refers to the perceived ease or difficulty of performing the behaviour and is assumed to reflect experience as well as anticipated impediments and obstacles (Ajzen, 1991). In the context of construction marketing, construction managers have perceived difficulty towards marketing management. They lack marketing skills because marketing is not an integral part of construction education. Again, resources allocated for marketing is inadequate because it is mostly considered to be less important, as compared with production related issues. Again, manpower required for effective marketing management are mostly non-existent since most businesses employ professionals to enhance their production efficiency rather than management issues.

Table 2: Theories of human behaviour

Theory	Constructs	Conceptualizations
The Theory	Attitude	degree to which a person has a favorable or

of Planned Behaviour (Ajzen, 1991)	towards the behaviour	unfavorable evaluation or appraisal of the behaviour in question
	Subjective norm	perceived social pressure to perform or not to perform the behaviour
	Perceived behavioral control	perceived ease or difficulty of performing the behaviour and is assumed to reflect experience as well as anticipated impediments and obstacles
The Health Belief Model	Perceived threat	an individual's perceived susceptibility or vulnerability to a threat and the seriousness of the expected consequences that may result from it
	Effectiveness of behaviour	effectiveness and outcomes of actions or behaviour
The three elements model cited in Chatterton, 2011	Materials	The physical objects that permit or facilitate certain activities to be performed in specific ways
	Meanings	Images, interpretations or concepts associated with activities that determine how and when they might be performed
	Procedures	Skills, know-how or competencies that permit, or lead to activities being undertaken in certain ways.

Source: Authors construct based on literature review

CONCLUSIONS

The key attributes of culture examined so far point to human behavioural factors as the surrogate manifest constructs that defines culture. This is because attributes of culture such as beliefs, attitudes, values and behaviour are basically human factor attributes. It is further evident that culture encapsulates a host of human factor attributes. Whereas the term 'culture' is vague and can therefore refer to many more other issues, human factor attributes that are known to have relationship with marketing in construction are specific and definite in defining the subject of culture succinctly. This approach overcomes the 'obscure' and 'latent' characteristics of culture. Human factors therefore become the surrogate manifest constructs for measuring culture in construction marketing related issues.

Theories of Behaviour can therefore provide basis for developing appropriate constructs for measuring culture in construction in relation with marketing as a management function.

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CONCEPTUALIZATION OF COLLABORATION AND LONG-TERM RELATIONSHIPS

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There is increasing shift from traditional contracting practices to collaboration and long-term relationships (CLR) contracts in the construction industry. The purpose of this paper is to examine dimensions of CLR practices from a construction perspective. The research methodology employed is based on desk research. This involves the collection of secondary data on CLR practices. Nvivo Pro 2011 software was used to aid analysis of the multiple articles. The result indicates that top management commitment, willingness to learn and support the parties, mutual trust, complete integration of project team members, efficient and open communication are some of the requirements for CLR. Also, the procurement strategies that internalize CLR practices in construction are reported to be framework contracts, partnership and alliance contracting. However, these approaches are shown to be appropriate for specific kind of clients, suppliers, and projects. Consequently, the selection of parties to go into these procurement strategies for CLR becomes very critical to achieve the benefits that CLR have shown to deliver. This will ensure that scarce resources are only dedicated to relationships and processes that will genuinely benefit and support CLR. The knowledge and understanding provided by the study will be useful in encouraging construction stakeholders to appreciate the need for CLR practices and to embrace CLR approaches.

Keywords: alliancing, collaboration, framework contracts, long-term relationships, and partnerships.

INTRODUCTION

The interest in collaboration and long-term relationships (CLR) arrangement has been one of the concerns of the construction industry in recent years. This may be attributed to the industry response to the failings of the traditional contracting practices as a result of its characteristics as shown in table 1. Thus, a shift away from the traditional contracting practices to CLR contracts is advocated for the construction industry. The dominant reference for this change is the Latham (1994) "constructing the team" and Egan (1998) "rethinking construction" construction industry reports. These reports suggested a change in culture and a move towards teamwork, collaboration, and supply chain management of projects. As a result, there has been growing adoption of strategies that forms a fertile opportunity for CLR in construction. Hence, several studies exist on CLR arrangements by researchers in construction and project management studies. Some of these studies used the compound word "long-term collaborative" relationships to imply CLR (Donohoe and Coggins 2016; Kumar et al. 2016; Wang et al. 2016; Chang et al. 2015; Challender et al. 2014; Meng 2013; Ylitalo et al. 2005).

CLR practices are gaining more adoption in the construction industry globally, owing to their success in manufacturing and service sectors in which the strategies are seen as a vehicle to maximize value, levels of quality and service delivery (Khalfan et al. 2014; Meng 2013; Frödell 2011; Naoum 2003; Saad et al. 2002). The approach has shown to be mutually beneficial to both clients and contractors when adopted for project delivery. However, some

clients do not see it as a promising strategy particularly during economic meltdown and recessions (Donohoe and Coggins 2016; Challender et al. 2014; Meng 2013). Also, Sanchez (2012) and Saad et al. (2002) reported that the CLR approaches requires a longer time, more effort, resources and commitment to develop. Also, due to power dynamics resulting from the dominance of some clients in the approach, some contractors do not embrace the approach in contract relationships (Rinkus et al. 2016; Chicksand 2015). Furthermore, issues around contractors becoming complacent, and the inability to prosecute rights under such contracts have been raised (Palaneeswaran et al. 2003; Black, Akintoye, and Fitzgerald 2000). These issues, suggests a limited understanding of the concept of CLR practices and a tendency to view such strategies through the lens of traditional procurement practices. Therefore, this paper will strive to create better understanding on the issue by examining the requirements and practices of CLR in construction, as well as the strategies that harness CLR in the construction industry and suggest that a reconceptualization is required to rebase the premise of these strategies.

Table 1 Characteristics of Traditional contracting practices

Authors	paper title	Source title	Characteristics
Akintan and Morledge 2013	Improving the collaboration between main contractors and subcontractors within traditional construction procurement	Journal of Construction Engineering	Main contractors and subcontractors pursue their self-interests. Mostly preferred by one-off clients. Engenders adversarial attitudes. Prone to conflicts and disputes. Lack of focus on customers' requirements, and failure to satisfy clients' needs are prevalent. Delivery processes are still mostly disconnected. Contract terms are often so strictly and litigiously applied.
Challender et al. 2013	Collaborative Procurement: An Exploration of Practice and Trust in Times of Austerity	ARCOM Conference Proceedings	Short-term contracts. The constant quest for the lowest initial bid price. Open and competitive traditional bidding.
Challender et al. 2014	Partnering in practice: an analysis of collaboration and trust	Proceedings of the Institution of Civil Engineers- Management, Procurement and Law	Competitive procurement methods based on lowest cost. Risk-averse work practices. This is limiting the scope for knowledge sharing across projects. Hampering familiarization and learning from experiences. Reducing innovation and investment within the sector.

Rowlinson and Cheung 2004	A review of the Concepts and Definitions of the Various Forms of Relational Contracting.	International Symposium of CIB	Adversarial in nature. Contractors have being selected mainly by lowest price. Superintendents see their role as gatekeepers, safeguarding the client's interest.
Khalfan et al. 2007	Building trust in construction projects	Supply Chain Management: An International Journal	Rigid flow of communication. Adversarial approach to construction projects.
Lloyd-walker et al. 2014	Enabling construction innovation: the role of a no-blame culture as a collaboration behavioral driver in project alliances	Construction Management and Economics	Tend to be risk averse. Characterized by blame and litigation. Designers have the most power and influence Require each participant to look after their own organization's interest. Involves pursuing a 'claims mentality.
Palaneeswaran et al. 2003	Curing congenital construction industry disorders through relationally integrated supply chains	Building and Environment	Transactional' contracting approach. Fragmented and disjointed transactions and processes. Short-term visions. Adversarial relationships. Unhealthy competition. Purely price-based selections. Incomplete contracts. Numerous change orders and claims. Improper risk-shedding tactics. Disputes and breaches of contract leading to litigation. Client's acts as 'watchdog' with control measures (such as warning letters and penalties).
Spekman 1998	Strategic supplier selection: understanding long-term buyer relationships	Business Horizons	Clients rely on a large number of suppliers to gain price concessions. Clients assume an arms-length posture. Use of only short-term contracts.
Suprapto et al. 2015	Sorting out the essence of	International Journal of Project	Confrontational interactions between owner and contractor.

owner-contractor collaboration in capital project delivery	Management	Too much emphasis on formal mechanisms (i.e., contracts, tools, and techniques).

RESEARCH METHODOLOGY

The research methodology employed to address the aim of the study is based on desk research of publications on CLR. First, to gather relevant publications to obtain data for the study, a bibliographic survey was conducted via Scopus using the string words "collaboration" and long-term relationship. The choice of Scopus database is because the database is the largest abstract and citation database of peer-reviewed literature, consisting of scientific journals, books, and conference proceedings across various disciplines. Searching within the title, "key-words and abstract" of Scopus database indicates a total of 749 document results on this topic from 69 countries since 1970 across several subject areas with most of the documents (up to 90%) being published after the year 2000. However, papers which are not strongly related to the field of interest of this study and construction such as publications on medical and natural sciences subjects were excluded in the search. Also, on downloading some documents, other close related articles to the topic articles were identified by the search engine and were also downloaded for the study. The final numbers of articles reviewed in the study are 96.

The collected articles were then imported into Nvivo Pro 2011 software, to quickly identify prominent words and phrases, as well as key concepts across the multiple articles. In the Nvivo software, the word frequency query was carried out using 50 most frequent display words, with stemmed words settings, and then the word cloud tab to identify the keywords from all the text. This enables exploration of trends and ideas that are prevalent in the articles and identification of what authors are frequently writing about collaboration and long-term relationships. The result indicates several themes in the research area (collaboration and long-term relationships). However, the theme of interest in this study is the requirements and practices/process of CLR. So from the several themes on the word cloud, a text search query was carried on the requirements and practice themes. This was followed by clicking the reference tab upon which list of articles with a bit of context appears respectively. Nodes were created for these themes, and significant reports from each author were coded and saved into the nodes (A Node is a bucket in which related materials are gathered into one place so that one can easily look for emerging patterns or ideas). Also, nodes were created for other relevant aspects of the study such as framework contracts, partnerships and alliance contracting that was indicated as the practices that internalize collaboration and long-term relationships in construction from the analysis. Within the nodes, other sub-nodes that were established in the study were definitions and description of key concepts, benefits, requirements, and challenges. All relevant text was coded into the nodes and sub-nodes, and aspects that are of interest and essential to the study was then integrated into the study.

COLLABORATION

Collaboration is defined as a mutually beneficial and well-defined relationship between two or more organizations working together to achieve common goals (Mattessich and Monsey 1992). Wilkinson (2005) defines collaboration as a creative process undertaken by two or more interested organizations, sharing their collective skills, expertise, understanding and knowledge in an atmosphere of openness, honesty, trust and mutual respect, to jointly deliver the best solution that meets their common goal. According to Saunders et al. (2012)

Collaboration means building a democratic approach to communication and decision making when constructing, planning, taking and evaluating each action research stage or cycle. The rationale for collaboration is for a party to find more resources, for the other to gain access to new technology domains, and for both parties to learn and enhance their business because of the relationship (Ylitalo et al. 2005). Gadde and Snehota (2000) suggested that collaboration is a function of the volume of business for the buying organization. As it is a more appropriate relationship to adopt when a supplier relationship represents a major volume of business for the buyer, and conversely, if the transaction size or volume of business is low, an arm's length relationship may be suitable (ibid).

The factors that encourage collaboration between two or more organizations when working together are indicated to include: top management commitment, mutual and shared understanding about the goals of cooperation. Others are the willingness to learn from and to support the partner, mutual trust, complete integration, effective communication, risk and reward sharing, clear definition of responsibilities (Cha and Kim 2016; Meng 2013; Anbanandam et al. 2011; Ylitalo et al. 2005). It is found to be a suitable means of nurturing relationships among contracting parties, achieving better project performance and higher end-user satisfaction (Ning and Ling 2013).

Collaboration has been indicated to have the benefit of maximising efficiency, improve profitability, reduce waste, contribute to more valuable relationships and enables benchmarking current levels of practice against the best-in-class performers (Cha and Kim 2016; Shepherd and Gunter 2006; Greenbaum 2004). It creates a free and open environment where the aim is to learn from each other and employees can air their views without hesitation and gives access to unique capabilities and resources to all involved (Soosay et al. 2008; Squire et al. 2006). These benefits may not be available in the traditional practices of arm's length relationship where parties act in self-interest without any special obligation to the other party. Mattessich and Monsey (1992) submit that with collaboration, individual expenses can be reduced in planning, research, training, and other development activities in the early stage of a new initiative. Also, they suggested that through collaboration, overhead expenses are shared, and duplication of cost and effort is avoided. Glover (2008) submits that such an arrangement is designed to encourage a certain degree of sharing of information; therefore, it is necessary for parties to be open and honest to each other in such relationships. Thus, a collaborative working arrangement is seen as a key to improved efficiency and enhanced innovation in construction (Kadefors et al. 2007). Li et al. (2012) submit that with a collaborative working arrangement, there is a higher chance of buyers achieving greater success with suppliers and it should be the right strategy for major contracts if an element of challenge, competition and value are retained in such relationship. Collaborative working arrangements are also reported to reduce project costs and secure operational efficiencies (Tennant and Fernie, 2010). This is because of the opportunity to share costs collaboratively.

However, Lawson et al. (2006) submit that although collaboration improves performance, it costs money in terms of coordination, communication, adaptation, and commitment to achieve it. This may hinder its adoption in times of austerity. Also, the pursuit of self-interest and element of power dynamics in situations where clients engage for collaboration while retaining authority and responsibility makes collaborative working impossible to achieve (Akintan and Morledge 2013; Sanchez 2012). Therefore, clients must genuinely open up a conversation and empower people to collaborate with one another while retaining the direction and greater effort is required in negotiating the interests of various stakeholders in collaboration (Sanchez 2012). Nevertheless, even though the collaborative arrangement is not without risks, the gain is argued to exceed the potential risks (Spekman 1988).

LONG-TERM RELATIONSHIPS

A long-term relationship also referred to as strategic relationship is a relationship that requires long-term commitment upon which series of projects can be delivered over a specified number of years (Filippetti and D'Ippolito 2016; Jones and Kaluarachchi 2007). Such relationships allow for firms to internalize the value of knowledge generated across organizational boundaries over time (Filippetti and D'Ippolito 2016). This contrasts with the traditional practices of short-termism and discrete contracts where new supply chain arrangements must be established for every project. Long-term relationships are suggested to be suitable for projects involving repeat clients where the continuity of work from the client stabilizes the relationship, when suppliers supply scarce or high-value products and where the complexity of the supply market is high, and where the product is of great importance to the clients (Meng 2013; Spekman et al. 1998 and Kraljic 1983).

Long-term relationships have several reported benefits from previous studies, for example, Cadden et al. (2015) submit that parties in a long-term relationship can review the credibility of one another, reward truth-telling, punish otherwise, and therefore provides the right incentive for truthful information sharing. Other studies indicate the benefits of long-term relationships to include the following: it offers stable business relationships resulting from the continuity of works, allow for aligning specific objectives between parties, it enables the development of a particular way of working that adds value to production, and creates an atmosphere of trust and commitment. Others benefits are: it ensure the provision of technological and managerial assistance and exchange of information during product development and production stages (Filippetti and D'Ippolito 2016; Meng 2013). Also, long-term relationships increase the level of cooperation in terms of coordination, participation and joint problem solving (Mohr and Spekman 1994).

Different industries have adopted the long-term relationship approach in delivering projects. Fujimoto (1999) asserted that in the automotive industry some clients prefer to deal with suppliers on a long-term basis. Khalfan et al. (2007) suggested that the approached can be used for delivering school building and maintenance, social housing stock improvement projects and the likes of local authorities in the UK. Meng (2013) reported a wider acceptance of the approach in the UK for school building projects as 33.3% of school building projects were said to have adopted the long-term relationship approach. However, they reported short-term, project-specific approach as practiced in traditional contracting are initial employed when dealing with a contractor for the first time to establish suitability for a long-term relationship. A similar practice was reported in a study on 'innovative construction procurement at Wits University (Laryea and Watermeyer 2014). This could be an expensive and high-risk selection mechanism to practice, but it indicates that a good performance from the first work by a supplier provides the foundation for going into long-term relationships. Ellram and Martha (1990) argued that paying more attention to supplier's development potential and future plans are an essential consideration for a long-term relationship. Nevertheless, trust and openness between clients and suppliers that enable mutual learning and competency development are the significant factors that have a positive effect on the long-term orientation of the relationships (Filippetti and D'Ippolito 2016; Bäck and Kohtamäki 2015; Anbanandam et al. 2011; Ylitalo et al. 2005).

Table 2 Requirements for Collaboration and Long-term Relationships

Authors	Requirements
Sanchez 2012	Having shared goals. Being involved in the process. Having open lines of communication. Directed engagement.
Saad, Jones, and James 2002	Ability to create, manage and reshape relationships. Continuous learning. Commitment from top management
Babaeian Jelodar, Yiu, and Wilkinson 2016	Attributes such as trust. Commitment. Teamwork. Open communication. Common goals between partners. Fair balance of risks and rewards. Consistent objectives. Mutually. Clear understanding of roles and responsibilities. Clear contract. Clear decision-making mechanism.
Bäck and Kohtamäki 2015	Facilitated by trust. Competence and accumulated experience.
Chang et al. 2015	Social exchange behaviour. Detail information. Respect between Parties. Flexibility. Mutuality. Solidarity.
Ylitalo et al. 2005	Openness. High level of trust.
Meng 2013	Continuity of work. Long-term program.
Mattessich and Monsey 1992	Legislation and funding to promote collaboration. Educating potential collaborators.

	Required resources of its members. Being knowledgeable. Previous experience. Participatory policy development style. Ability to take risks.
Frödell 2011	Willingness and capability for collaboration. Aligned core values. Parties to be approachable, honest and responsive. Total cost focus Knowledge along with delivery precision Trust. Long-term orientation.
Suprpto et al. 2015	Commitment. Cooperation. Connectedness of owner and contractor striving for a common goal. Team-working. Relational attitudes. Capability. Team integration.
Challender, Farrell, and Sherratt 2013	Trust. Change in mind-set. Commitment of participants. Greater coordination. Sufficient time to nurture relationship. Long-term vision.
kadefors, Björklingson, and Karlsson 2007	Trust Commitment Team working
Li, Cheng, and Love 2000	Scheduled meetings Cost control measures Litigation avoidance Satisfaction of all parties Good technical performance
Wang et al. 2016	Mutual trust

	Commitment Solidarity between the buyer and supplier

Table 3 Collaboration and Long-term Relationship Practices

Author(s) & Year	Practices
Sanchez 2012	Interactive meetings to talk about, review, and revise norms and to help each other learn to respect and abide by the norms. Practice respect, equality, direct and intentional communication and feedback, and transparency. Employees are made responsible for the good of the organization. The organization must be respectful of individual needs and diversity. Subsidiary corporations must act for the good of the entire organization in mind Empowering subsidiary corporations to make decisions in their own best interest Involving those affected by a decision or change. involving the subsidiary corporations in planning, problem-solving, and decision-making Based in part on the importance people place on belonging to part of a larger community. Each subsidiary sees itself as part of the larger organization. This sense of organization-as-community engenders a desire for shared success and unity. Sincerely soliciting feedback Participants expressed a genuine sense of pride and joy about opportunities to help one another.
Saad, Jones, and James 2002	Involves some stages including the need to innovate, knowledge awareness, evaluation of alternative innovations, planning, and implementation. Top management commitment. Agreeing on mutual objectives. Making decisions openly and resolving problems in a way that was jointly agreed at the beginning of the project. Aiming to achieve measurable improvements in performance through incentives. Promoting collaboration through leadership, facilitation, training, and incentives. Replace short-term contractually driven project-by-project adversarial relationships with long-term, multiple-project

Author(s) & Year	Practices
Black, Akintoye, and Fitzgerald 2000	relationships based on trust and co-operation.
	Restructuring and integration of project processes and supply networks with fewer strategic supplier partners.
	Frequent communication, both formally and informally.
	Co-operative attitudes.
	Trust between the parties.
	A Win-win approach to negotiation.
	Open sharing of information.
Lavikka, Smeds, and Jaatinen 2015	Multi-disciplinary involvement.
	Both the buyer and supplier are highly dependent on each other.
	Co-located working.
	Collaborative decision-making in inter-organizational meetings.
Frödell 2011	A liaison role.
	Shared project goals.
	Importance of sticking to the agreements even if the supplier's competitors are dropping their prices
	Give the service suppliers the right prerequisites when they are involved in a project because they base their pricing on them.
	For the supplier to be able to plan and forecast, the contractor needs to invite the supplier earlier in the design phase of the project and also strive to keep to the predetermined schedule since suppliers use it to plan their work.
	Core values: Personnel are approachable, honest and responsive.
Palaneeswaran et al. 2003	Treating suppliers fairly, to avoid suppliers getting tired of us and bad reputation.
	Certain approaches introduced some incentives (e.g., awards, bonuses) as motivators for good performance.
	Each alliance partner has a higher 'stake' in the project, which leads to stronger commitments and closer bonds.
	Checks are installed to avoid abuse and misuse of such relationships. This may be done through contractual safeguards that need not be dismantled in the 'binding forces'
Lloyd-walker, Mills, and Walker 2014	Inclusive decision-making
	Members jointly work to deliver project outcomes
	Joint member sharing of all project risks in a no-disputes and no-blame environment where unanimous decision-making takes place
	Provides no formal process for legal action except in the case of

Author(s) & Year	Practices
Anbanandam, Banwet, and Shankar 2011	willful default. Signatories work together in good faith, acting with integrity and making best-for-project decisions. The incentivization contract ensures that the financial reward and penalty provisions drive motivation. Pools its insurances by negotiating an alliance insurance agreement rather than separate insurance requirements, reinforcing unity of purpose. The TOC established early in the alliance selection phase of the project, represents fair and reasonable expected end costs. The details of budgets and all design and delivery assumptions are openly and transparently discussed for full understanding during initial post-alliance TOC agreement workshops. Innovation mainly achieves potential gainsharing from the incentivization contract leg, and so this arrangement encourages and facilitates innovation. Encourage a trade-off of the normal rights to sue parties that do not perform to expectation such that they may inhibit parties achieving their KPIs. Consensus behaviors turn power and communication imbalances to symmetrical input mechanisms that allow consensus about a solution to emerge, Cost control is monitored through adherence to KPIs and an open-book approach to probity and auditing. A no-blame culture develops from these features. The transparency and open-book approach lower fears that any party can 'cheat' the system. Mutual dependency binds participants closely together because the incentive contract rewards project, not individual party performance. All strive for best-for project with an understanding that this involves trying new approaches and recalibrating efforts pragmatically when better understanding of the context requires plans to be changed.
	Top management commitment. Information sharing. Trust among supply chain partners. Long-term involvement. Risk and reward sharing.
Cadden et al. 2015	Espousing characteristics of trust, cooperation, and information

Author(s) & Year	Practices
	sharing.
	Working closely together through cross-functional teams and joint away-days, both at operational level and strategic management level from the relationship creation.
	Behavioral change about how firms deal with each other in respect of pricing strategies and service level agreements are vital.
Suprapto et al. 2015	Joint working.
	Open and effective communication.
	Clear and fair risk allocation.
	Regular performance measurement.
	No-blame culture.
	Quality defects can be reduced through effective problem-solving mechanisms.
Spekman 1988	Both parties have the power to shape its nature and future direction over time.
	Mutual commitment to the future.
	Balanced power relationship is essential to the process.
	Mutual trust nurtures commitment.
	Open communication.
	Both the buyer and the seller must invest in the relationship.
	Represent a complex web of the less tangible issues of trust, openness, and commitment.

The requirements for CLR as well as the CLR practices from the desk research conducted are shown in Table 2 and Table 3 respectively. From these tables, CLR requirements and practices are indicated to focus on creating the enabling environment that optimizes the ability of project team members to work together efficiently and collaboratively. Thus, building long-term business relationships through which series of projects can be delivered successfully without litigation. This is a fundamentally different situation from what is sought in the traditional contracting practice of one-tender per project approach. In which client enters into a contractual agreement and assembles a separate supply chain for each project with short-term relationships and the subsequent concentration of knowledge within the design team only (Ruparathna and Hewage 2013; Watermeyer 2012; Sinclair 2011). Such practice is said to often result in significant opportunities for claims and inappropriate risk avoidance, and the consequence adversarial relationship and litigation processes (ibid)

The contracting strategies reported to internalize and provide opportunity for collaboration and long-term relationships in construction are partnering, alliance contracting and framework contracts (Babaeian Jelodar et al. 2016; Suprapto et al. 2015; Lloyd-walker et al. 2014; Challender et al. 2014; Mouzas and Blois 2013; Watermeyer 2013; Cheung 2011; Palaneeswaran et al. 2003;). These strategies are further discussed below.

Partnership

A partnership is one of the construction procurement strategies that harness collaboration and long-term relationship practices. Gale (2013) argues that the earliest form of collaboration is through partnering arrangements between parties and several studies described long-term relationships as the bases of partnership (Meng 2013; Ambrose et al. 2010; Naoum 2003). Never the less partnership can also be for a short-term relationship when it is based on a single project (Gadde and Dubois 2010). Lambert et al. (1996) defined partnership as a "tailored business relationship based upon mutual trust, openness, shared risk, and shared rewards that yield a competitive advantage, resulting in business performance greater than would be achieved by the firms individually" The UK National Economic Development Council defines partnership as a long-term commitment between two or more specific organizations for achieving specific business objectives by maximizing the effectiveness of each participant's resources. The Associated General Contractors of America (1991) described partnership as a way of achieving an optimum relationship between a client and a contractor. However, Cheung et al. (2003) described partnership as not a contract but an attempt to establish non-adversarial working relationships among project participants through mutual commitment and open communication.

Several benefits of partnerships are indicated in the literature. Gadde and Dubois (2010) reported the potential benefits of partnership to include increased productivity, reduced costs, reduced project times, improved quality, improved client satisfaction and greater stability. In a study examining the potential of partnering principles for subcontractor selection and improvements in overall project outcomes, by interviewing 20 successful and unsuccessful subcontractors, Kumaraswamy and Matthews (2000) revealed that partnership approach produces at least 10% cost reduction in the tender price and increase in the cost, time and quality performances in the project. Similarly, Bennet and Jayes (1998) examined the financial benefits of partnership and submits that partnership approach can achieve savings up to about 10% of total costs. Other benefits of partnership approach include improved relationships among contracting parties, cost effectiveness, work efficiency, opportunities for innovation, equitable risk sharing, and less confrontation (Cheung et al. 2003; Naoum 2003 Black et al. 1999). However, the RICS (2005) argues that most study on partnership focus on success rather than failure is said to pose an unbalanced view and bias impression in terms of the contribution that partnering and collaborative procurement has had within the construction industry, and therefore raised questions around reliability. Also, Morgan (2009) reported that partnering projects are often open to abuse owing to the scale of the commercial interests involved, such that clients may be paying far too much for their products. Cheung et al. (2003) indicate that the non-compromising tendering process, poor perceptions of the partnering process, lack of knowledge and skill to adopt partnering and non-commitment of partnership parties in construction undermines the benefits partnership as shown to deliver.

The reported requirements essential for successful partnerships in the literature are commitment, trust, preparation, understanding, equity, development of mutual goals, inclusion of appropriate parties, continuous joint evaluation, use of project partnering tools and procedures, empowerment of stakeholders, evaluation methodology and willingness to accept mistakes (Ng et al. 2002). Other requirements are mutual objectives, effective communication, continuous improvement, equality, win-win profit-sharing, management commitment, a clear understanding of roles, consistency of objectives, and flexibility to change (Babaeian Jelodar et al. 2016; Chicksand, 2015; Black et al. 1999).

Alliancing

Alliancing together with partnership and framework contracts are the procurement strategies that incorporate collaboration and long-term relationships in construction. Although alliancing is often used interchangeably with the partnership (Ingirige and Sexton 2006), it refers to any arrangement in which the contractual arrangements are designed to stimulate trust by aligning commercial objectives (Broome 2002). In the business literature, alliancing is used to refer to an arrangement between two or more suppliers (not involving buyers or clients) join together to market, manufacture, distribute and sell their product (Ibid). The important difference between alliancing and partnership is that parties shared gains and lost in alliancing while in partnerships, parties may individually gain and suffer lost gains and lost (Challender et al. 2014). Thus, alliancing reflects joint rather than a shared commitment between partners with partner selection based on performance rather than only price (Raisbeck et al. 2010).

Alliancing is argued to have the potentials benefit of providing an environment that maximises collaboration through joint decision making by employing best-for-project and no-blame philosophy (Lloyd-walker et al. 2014).

Although factors that contribute to collaborative working such as trust, mutual understanding, respect, communication, problem solution mechanisms, sharing of the risks and benefits and having a win/win philosophy are attributed to promoting alliancing among parties, a 'no-blame culture' is indicated to be the key requirement for the success of alliance contracting (Lloyd-walker et al. 2014).

Framework Contracts

A framework contract which may also be referred to as "framework agreement" or "umbrella agreement" (Mouzas and Furmston 2008) is an agreement which is reached between two parties to cover a long-term collaborative arrangement, particularly where clients have a long-term program of work in mind and are looking to set up a process to govern the individual construction or supply packages that may be necessary during the term of the framework (Glover 2008). Mouzas and Blois (2013) describes a framework contract as a manifestation of agreements that defines the fundamental principles upon which companies wish to work together. Framework contracts provide an "umbrella" contract upon which projects are procured at call-off bases contrary to traditional discrete contract practice (Lam and Gale 2014). Watermeyer (2012) remarked that it enables infrastructure clients to procure goods, services and construction works on an instructed basis (call off) over a term without any commitment to the quantum of work instructed and in the absence of a detailed scope of work.

Long-term relationships are submitted as the theoretical basis for the adoption of framework contracts by clients as against the arrangements in discrete contracts (Gale 2013). This is due to the tenure period in framework contracts which provides the opportunity for parties to the project to work together for the period of the framework agreement. Tennant and Fernie, (2010) indicated the period of framework contracts to be for four years with an additional two years' subject to exceptional circumstances. While the ISO 10845-1 (2010) specified a tenure period of three years for a framework agreement after which unsuccessful contractors must wait for the next opportunity to present themselves for selection. It was also indicated that this long-term period of relationship in framework contracts makes the selection of right contractor vital to ensure continuous improvement is achieved within the period.

In describing a framework contract, some authors associated the approach to other construction procurement strategies, for example, Gale (2013) opined that framework

contract approach might have evolved from partnering arrangements. Tennant and Fernie (2010) noted that the approach is analogous to partnering in many ways. However, Tennant and Fernie (2012) describe it as a descendant of the design and build procurement route. This may stem from the characteristics of the approach in providing the opportunity for integration of design and construction through early contractor involvement at the pre-construction stage of projects which has been one of the advantages of the design and build system.

Framework contracts provide the advantage of suppliers reserving capacities for their clients making supplies cheaper and quicker as markup is fixed for the period of the contract (Balcik and Ak, 2014). The approach is also indicated as a tool for improving performance, quality, and long-term relationships (Lam and Gale 2014; MLacoste 2014; Mouzas and Blois 2013). In other words, the framework contract is used to describe an arrangement in which streams of projects can be obtained without the need for a new tendering procedure, under certain agreed conditions. The JCT and Glover (2008) described it to be suitable when clients have a long-term programme of work in mind and are looking to set up a process to govern the individual construction or supply packages. Therefore, Process then must be central to the system as opposed to an ad hoc approach.

Framework contracts are apparently not intended for individual projects. The approach is best suited for repeat clients and may involve several contractors being selected for contracts over an extended period. However, to allow for price competition within a framework agreement, the minimum number of contractors to contract with when it involves more than one contractor is suggested to be three, and there are no maximum number contractors to contract with (Mills and Reeve 2015). However, in practice, it will be difficult to deal with a large number of contractors due to the need to approach each of the contractors for a call-off (ibid). Nevertheless, if framework contracts are not properly implemented, it can be a source of corruption, increases in cost and exclusions (Supply Chain Management 2016).

CONCLUSIONS

This paper creates a better understanding on CLR by examining the requirements and practices of CLR in construction, as well as the strategies that internalize CLR practices in the construction industry based on desk research. CLR was indicated from this review to deliver several benefits to all parties involved. These benefits may not be achievable in the traditional practices of short-termism and arm's length relationships. From the review, the requirements for collaboration are top management commitment, team working spirit, flexibility, solidarity, continuity of work, litigation avoidance, shared understanding about the goals of collaboration, clear definition of responsibilities, willingness to learn from and to support the parties, mutual trust, complete integration of project team members, efficient and open communication, fair risk and reward sharing. While the practices that promote CLR are good performance from the first engagement, potentials for development by parties, future plans of parties to guarantee continuity, interactive and scheduled meetings, respect for one another, a no-blame culture, mutual trust and all parties taking responsibility for the good of the organization. Other practices that promote CLR includes balanced power relationship, parties are approachable, honest and responsive; inclusive decision making and involvement, having a sense of belonging to the larger organization, a win-win approach to negotiation, replacing short-term contractually driven project-by-project adversarial relationships with long-term, multiple-project relationships, and openness between parties.

These requirements are different from what is obtainable in the traditional contracting practices, as traditional approach requires more directive functions, separation of design

activities from construction and the subsequent concentration of knowledge within the design team only, with arms-length relationships. With one-off project practices, relationships are short-term in traditional approaches thereby not accessing the values of long-term relationships. Also from the study, the procurement strategies adopted in the construction industry that internalizes collaboration and long-term relationship practices are framework contracts, partnerships and alliance contracting.

Consequently, the selection of parties to go into these procurement strategies for CLR becomes very critical to achieve the benefits which collaboration and long-term relationships have shown to deliver. Especially as most practitioners on both the contractor and the client sides have been trained and accustomed to the traditional contracting practices. Parties will need to assimilate the requirements and practices that support and promote CLR to ensure that scarce resources are only dedicated to relationships and processes that will genuinely benefit and support CLR.

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RENTAL HOUSING MARKET FAILURE: A NEW INSTITUTIONAL ECONOMICS PERSPECTIVE

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Rental housing remains an essential component of a vibrant housing market, but, due to market failure, the sector has been unable to deliver sufficient housing units to match the demand in most developing countries. Much of market failure analysis has been based on the neoclassical economic theory. However, housing, unlike other goods exhibits peculiar attributes. Therefore, a comprehensive theory for analysing rental housing market failure should not only be able to effectively accommodate the idiosyncratic features of housing as good but should also recognize that housing market comprises several institutions that affect the behaviour of the market participants. This is a theoretical research examining the supply-side of, and analyses market failure in the rental housing sector using the principles of the new institutional economics (NIE) theory. The approach to this study involved a critical review of literature exploring how the rental housing market failure can be understood in the perspective of the new institutional economics theory. The findings reveal that rental housing markets can, and often do fail (to work) due to unfavourable institutional environment resulting from policy failures, which make transaction costs in the rental housing segment high, hence the sector becomes unattractive to the investors due to perceived low returns. The knowledge is vital for appropriate policy re-evaluation towards stimulating rental housing development activity, which consequently promotes the construction industry and its stakeholders. The dearth of existing literature relating to rental housing analysis through NIE is considered a limitation. This research will therefore advance the general knowledge of market failure and extend the theory of NIE into the rental housing market analysis.

Keywords: Housing Markets, Market Failure, New Institutional Economics, Rental Housing

INTRODUCTION

Rental sector remains a significant housing option and an essential component of a vibrant housing market and construction industry as a whole (Tandel et al 2015; JCHS 2013; Pomeroy and Godbout 2011). However, rental housing markets in most developing countries have been characterized by market failure because of the inability to provide adequate rental units commensurate with the urban population's demand (Peppercorn and Taffin, 2013; Gilbert, 2009; Cadstedt, 2010).

One of the major reasons for the inefficiency is attributed to the little attention by the private developers/landlords towards the rental housing development, yet they are perceived to be the major players on the supply side. It is therefore pertinent to understand why the supply side of the rental housing market has been unresponsive to the demand. This research therefore focuses on the rental housing market and the underlying causes of its failure. Using the principles of new institutional economic theory, the study explores the concept of market failure in the rental housing market;

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with an aim of providing an understanding on how the rental housing sector relates with institutions, transaction costs as well as property rights.

Rental housing basically comprises a property whose occupant is not the owner, but instead pays a periodic rent to the landlord (Peppercorn and Taffin 2013). A landlord therefore has the proprietorship rights over the property, but, relates to the tenant through a contractual agreement and a regular payment (UN-Habitat 2003). In an absolute rental system, the owner is not obliged to sell, nor the tenant to purchase the occupied units, but, the contract between the two parties can either be 'formal or informal', for a specific period at a scheduled rent (Peppercorn and Taffin *ibid*). The landlord hence remains the 'residual claimant' to the housing unit. The contracts are either short-term or long-term, whereby the former can be discontinued within a short notice and be reviewed severally during the tenure period, while the latter may be for a fixed term or an indeterminate period and guarantees the tenant tenure security and pre-determined rental payments (Hubert 2006).

Indeed, the rental sector is diverse in nature and serves a wide spectrum of the population. It accommodates a sizable proportion of households, who prefer renting to owning (Haffner et al 2009). However, as noted by Gilbert (2016), rental housing is fundamentally an urban phenomenon which has grown due to urbanization. For instance, it is estimated that as at 2015, nearly 1.2 billion urban dwellers were renters globally (*ibid*). Further, it has been observed that rental housing forms a significant proportion of the urban housing market in most developing countries (Mwangi 1997; Cadstedt 2010; Watson and McCarthy 1998). Examples from Kenya indicate that over 80% of the Kenyan urban dwellers are renters (UN, 2014). In Johannesburg about 42% of the population live in rental housing.

Basically, rental sector remains appropriate for meeting housing demand in rapidly urbanizing cities which are usually characterized with considerable adjustments in employment structure, hence necessitating housing tenure that enhances flexibility and mobility of labourers, and transitional workers who only require temporary shelter to minimize their transaction and fixed costs (Hammam 2014). For instance, Gilbert (2004) explains that rental housing is suitable for low-income households who are unable to afford home-ownership, the young population with preference for mobility, new urban settlers, households with small size and those who simply prioritize renting to owning due to personal reasons.

Given the large size of rental sector in most developing countries, its role in the overall housing market and the construction industry cannot be overlooked (Apgar 2004). There is need to transform the private rental housing sector through appropriate policy re-evaluation focused on stimulating rental housing development activity, and consequently promote the construction industry and its stakeholders (Field 2014).

This research involves review of existing relevant literature on rental housing market, market failure and new institutional economics. Part one provides the introduction and explores the nature of rental housing market and its significance to construction industry. The literature review in part two is classified in three sections, where section one explains the concept of market failure in the rental housing market; section two examines the concept of the new institutional economics; while section three explores the rental housing market through NIE perspective. The conclusion section identifies the key areas of action to stimulate rental housing development.

LITERATURE REVIEW

The Concept of Market Failure in the Rental Housing Market

Market plays a pivotal role in driving economic activities, and in an ideal situation, it is expected to ensure optimal allocation of resources through price mechanism (Hammond 1993). Simply put, in a well-functioning market, supply should match demand. However, when the mechanism fails to distribute the resources efficiently or when the market processes hurt social benefits, then the market is deemed to have failed (Bator 1958).

Therefore, market failure is considered to arise when the price mechanism that regulates supply and demand fails (Pearce 2007). Various authors concur with Bator (1958) on the meaning and sources of market failure (Borooah 2003; Cunningham 2012; McKenzie and Rowley 2013; Bhalla 2001). Generally, market failure is viewed as a result of sub-optimal allocation of resources, leading to inefficient and inequitable market outcomes which are socially undesirable (Cunningham 2012). It is important to note that as much as housing market varies from the market for ordinary goods in many ways, it however operates under the principles of conventional markets and therefore, the standard analysis used in the market theory remains a valuable reference point for rental housing market analysis (Fallis 1985).

Clearly, housing as a commodity is peculiar just as the functioning of housing markets (Fallis 1985). Conventionally, a market attains equilibrium when supply matches demand *ceteris paribus* (Borooah 2003). Similarly, the rental housing market is deemed to attain equilibrium when the supply for rental housing units sufficiently meets the demand, and contrary outcome leads to rental housing market failure.

On the other hand, occasionally, the definition of market failure may not follow the strict economic rubric of efficient allocation of resources. There are various features of rental housing market failure. For instance, as explained by Gore (1994), the housing market failure can be because of the inability of market system to attain the goals as set by the government. However, of much relevance to this study is the rental housing market failure resulting from inadequate supply of private rental housing units.

While it is true that an efficiently operating market should self-correct the disparity of supply and demand, however, the intrinsic features of the rental housing complicates the operation of market mechanisms. The rental housing market therefore remains imperfect and prone to failure. Rojack (2007) argues that the rental housing market failures exist when unsuitable outcome is realized because of the interaction between the peculiar housing characteristics with both demand and supply factors

Coase (1937) attributes the imperfection in the private rental housing sector to transaction costs and argues that markets in the real world always have positive transaction costs as opposed to the neoclassical viewpoint which considers zero transaction costs. In concurrence, Berner (2009) notes that the underlying features of rental housing market results to high transaction costs which distort the market hence leads to market failure. The transaction costs in rental housing market emanates from interaction of the market with the institutional environment. High transaction costs increased risk yet, the producers are risk averse and would only invest in ventures that guarantee returns. High transaction costs therefore minimize their expectations in terms of returns and in effect, deter them from delivering rental housing.

However, as argued by Cunningham (2012), market failure does not connote that a market is completely non-functional, but rather inefficient in producing the desired goods and services. For instance, there can be demand for a commodity without a corresponding supply of the same. Therefore, in the case of rental housing, there may be few private developers/landlords who are willing to invest in rental housing, but the number of units they deliver is not able to satisfy the growing demand.

Nevertheless, as much as markets are anticipated to play the role of allocator of resources through price mechanism (Borooah 2003), their efficiency in achieving fair results towards this goal remains debatable. As Culli and Jones (1998) postulate, the contention arises from theoretic conceptualization of a market as operating in a perfect environment devoid of any interferences. But as stated by McMillan (2002:5); ‘careful analysis of even a simple market such as a bazaar will reveal that there is more at play than just supply and demand. There are rules and customs, and there are negotiations, search costs, price comparisons, transaction costs and competition between suppliers. Therefore, it is imperative to state that market operations are hinged within certain social systems and the performance of the market is greatly influenced by various non-market institutions (Cunningham 2011). And since market failure is a consequence of inadequacies in the institutions that aid the market, the rental housing market failure is therefore because of failure in the institutional arrangements that influence the housing sector, among other reasons.

The Concept of the New Institutional Economics

Much of the market failure analysis has been based on the neoclassical economic theory (MacKenzie 2002). Neoclassical economics assumes a market based competitive economic system with the cardinal principles being equilibrium, utility maximization, and market certainty. Therefore, through the neoclassical lenses, an equilibrium is achieved through optimal outcome as established on Paretian rubic (Borooah 2003). In other words, market efficiency is measured by attainment of an equilibrium compliant with Pareto Efficiency. But, several factors hinder achievement of the equilibrium (Bator 1958).

A comprehensive theory for analysing housing market failure should not only be able to effectively accommodate the idiosyncratic features of housing as good but should also recognize that housing market comprises many institutions that affect the behaviour of both the producers and consumers of housing (Dubel et al 2006). It is therefore posited that neoclassical thinking is not the best tool to understand housing market failure since it ignores the institutional arrangement operating within the market (Smith 1978).

The emergence of New Institutional Economics (NIE) theory provided a framework to cover the weak links identified in the neoclassical economics (Williamson 2000). The concept of institution is important in understanding how market works, since markets operate within certain institutional framework. Indeed, to understand why market fail, knowledge of the relevant institutions and how they facilitate economic activity remains significant. NIE has three main theories that are relevant in analysing market failure, namely; institutions, transaction costs, property rights (Eggertsson, 2013).

Institutions are viewed as humanly devised constraints which structure human interactions (North 1990). These consist of both formal rules (laws and regulations) and informal institutions (norms culture and codes) (Eggertsson 2013). For a clear understanding of institutions, David and North (1971) clarify the difference between the ‘institutional environment’ and ‘institutional arrangements’. While the former

represents the ‘rules of the game’ that influence human behaviour, conversely, the latter are detailed rules usually referred to as the ‘governance structures’ formulated by transacting parties to facilitate specific economic interactions (Williamson 1996).

The institutional environment can also be defined as the collection of essential socio-political and lawful rules that create the foundation economic interactions (Williamson 1993). This implies that the institutional arrangement is usually a subset of institutional environment. Institutions have certain ‘rules of the game’ and it is important for instance to understand how the game is played and the relevance of the institutions in the rental housing market. NIE recognizes the power of these institutions and regards them as ‘legitimate objects of economic analysis’ (Furubotn and Richter 1983:2).

Transaction costs concept has been widely studied and discussed since its inception by Coase (1937). NIE recognition of transaction cost is a great departure from the neoclassical approach which assumes an equilibrium devoid of the cost. The significance of transaction costs emanates from their nature of distorting the market, hence they become a major factor in market failure (Van Ommeren, 2008). Generally, transaction costs are incurred in an operational economic structure (Arrow 1969). This implies that transaction costs comprise expenses incurred directly, along with any incidental market ineffectiveness and the resultant misallocations. For better comprehension, Marinscu (2012) expounds that transaction costs include the entire ‘costs and efforts’ made by the investors and the market players generally, to adhere to the rules that institutions impose on a society.

Property rights are also a key element to institutional frameworks. A property is a stack of accredited relations (rights, obligations, privileges or claims) between individuals in relation to some commodity, services or anything that possesses economic value (Pryor 1972). Property rights therefore have a major influence in the housing market as different types of tenure have different economic implications. Property rights deal with rules of ownerships, and housing market is generally characterized by differentiated tenures. Therefore, in terms of home-ownership, the developers’ rights are terminated on the completion of the sale process, while for rental housing, the rights of the developer/landlord continue during tenants’ occupation.

By and large, the NIE, recognizes the principles of neoclassical economics but emphasizes on advancing the scope of the mainstream theory considering the features that were hitherto ignored in the system (Furubotn and Richter 1983). Therefore, cognizance of the complexities inherent in the housing market and the diverse nature of stakeholders, it is pertinent to understand both written and unwritten norms and laws that influence behaviour of the actors and incorporate such in the analysis model. In this context, the New Institutional Economic theory provides an appropriate framework for the analysis and understanding of market failure.

The Rental Housing Market through NIE Perspective

The housing market, just as the wider property market, has its foundation on institutions. The institutions not only enable the formation of housing markets, but, as well, facilitates the utilization, transactions and development of housing (Kamarudin 2006). Application of the institutional viewpoint in the housing market provides an understanding of the intricate manner under which it operates. This is because the institutional model appreciates the complex processes involved in the housing market operations and acknowledges that changes in spatial and economic environment have

an influence in the housing market (Han and Wang 2003). Both Ball (1996) and North (1990) agree that institutions provide a system for interaction under which the housing market functions.

Understanding the institutional concept of the rental housing market borrows from Keogh and D'Arcy (1999) analysis of the property market using a three-level institutional hierarchy (Figure 2.1). They demonstrate that the levels interact with each other to determine the outcome of the property market. In their model, the highest level comprises the 'institutional environment' under which the society is structured; then the next level comprises the property market as an institution itself and lastly, the property market organizations. This means that the institutional framework of the property market signifies the organizational arrangements and agents' rules on the market, and the relationship amongst the market players (Han and Wang 2003). The rental housing market exhibits similar attributes and therefore, the below concept can be extended to its analysis.



Figure 2.1: The institutional hierarchy of property markets (Adapted from Keogh and D'Arcy, 1999)

Level 1: The Institutional Environment and Rental Housing Market

Evidently, the housing market activity is dependent on the intricate institutional setting in which it operates (Allen 2008; North 1990). The external factors include socio-economic, political and legal system which influence the housing market. The general institutional environment (rules of the game) comprising of both formal and informal rules together with their execution instruments generate 'constraints and incentives' that define the opinions and beliefs of the housing market players (Eggertsson 2013). Market actors have no influence on the external environments and therefore take the rules as given (Williamson 1998).

As observed by Kamarudin (2006), political system as well as the economic development policy of a country may not directly influence the housing market, but, they shape the broader structure of the market. For instance, government policy may

influence housing market by determining what houses are developed, for whom they are produced, how they are delivered and in what quantity (Gilbert 2009). This explains why the dominant home-ownership policies have stifled private rental housing development (Melzer and Moothilal 2008; Rugg and Rhodes 2008; Malpezi 2011; Peppercorn and Taffin 2013). Stable social and political structure provides foundation for stronger housing markets with recognized property rights. The political system influences the housing market through formulation of various legislations that regulate the housing sector, while the legal structure outlines the broad legal context of the country and describes the instruments for understanding property rights through different statutes. The level of these rights is then revealed in the housing market structure (Kamarudin 2006).

Ostensibly, home-ownership tenure has dominated most housing policy debates in the developing countries. Actually, it has been observed that the entire housing market institutional structure encourages home-ownership. For example, right from perceptions to financing and fiscal incentives, more inclination is towards home-ownership as opposed to renting (Mayo et al 1986; Schwartz 2010; Stephens 2017; CAHF 2010). The notion derives from the traditional significance that most countries place on home-ownership (Ronald, 2004). For instance, the promotion of home-ownership has been premised on the assumption of accrual of other incidental benefits such as asset accumulation, social and behavioural changes and general neighbourhood enhancement.

The preference for home-ownership is therefore epitomized as the norm that results from inherent aspiration for private property by people because of the socio-economic environment under which they live. “The desire for private property springs not from the individuals but from the socio-economic system.” (Boddy 1980:25). Therefore, from this viewpoint, it could be true that the society can influence the people in such a way that what they consider they want is different from what they actually need. For instance, the ideology promoting home-ownership has been infused in the society such that rental housing is viewed with contempt (Marcuse 1987). This illustrates how the housing market can be influenced by the socio-political environment within which it is bounded. Indeed, to a greater extent, the policy plays a major role in determining what kind of houses are supplied and under which tenures they are supplied. Therefore, if policy does not promote rental housing, the supply is diminished (Williamson 1998; Kamarudin 2006).

Level 2: Regulatory and Legal Frameworks and the Rental Housing Market

As an institution, the housing market usually comprises of institutions of governance and is concerned with ‘the play of the game’. The housing market therefore represents a cluster of ‘formal and informal rules and conventions’, and whose capacity and design are determined by the prevailing societal preferences (Keogh and D’arcy 1999). The institutional authorities play a key role in determining market outcomes. For example, the manner in which the market is regulated, and functions can ultimately determine the quantity of housing supplied to different population segments, i.e., it is the regulatory framework that defines the amount of land allotted for development purposes and how it is developed. (Bolt et al 2010).

The impact of land-use regulations on the housing market has been widely studied (Malpezzi 1990; Schuetz 2007; Wilson 2017; Malpezzi and Ball 1991; Arnott 2008). One common observation from the studies is that formal housing markets in developing countries are overregulated. Peppercorn and Taffin (2013) similarly

concur that rental sector in most development countries are exposed to excess regulatory and legal processes. Malpezzi (2011) explains that the essence of these regulations is usually to rationalize land use and help in achieving organized urban development, by protecting the neighbourhood against externalities that may result from incompatible land uses. However, they sometimes turn out to be the major constraints that hinder developers' involvement in delivery of private rental housing.

Still, it is worth noting that regulatory frameworks have influence over the overall housing market (Malpezzi 2011). But of great concern for this study is how rental housing supply is specifically impacted by these regulations. Evidence from the literature reveal that only a few studies dichotomize the impacts of regulations on rental and owner-occupied housing. One such study is Malpezzi (1990) who investigated the issues and constraints in rental housing sector in developing countries and observed that even though regulations affect both home-ownership and rental markets alike, it is however conjectured that regulatory rules by nature set high building standards and control densities, hence, tend to affect the rental sector more.

A subsequent study by Malpezzi and Ball (1991) further confirms that regulations such as building codes, zoning and other land use standards often discriminate against low-cost rental housing. Actually, most zoning regulations restrict construction of multi-family dwelling units by reducing acceptable densities in many prime areas, yet, these are the most suited categories for rental housing. For instance, a considerable number of empirical studies have analysed the relationship between land use regulation and the rental housing market and concluded that, land use restrictions constrain the supply of new rental housing and increase rents (Malpezzi and Green 1996; Somerville and Mayer 2002; Schuetz 2007).

Similarly, recent study by Melzer and Moothilal (2008) also confirms that regulations limit supply of suitable land for affordable rental housing. Earlier, Green et al (1999) also examined the impact of regulations on supply elasticity and concluded that areas which are less regulated experience more levels of new constructions than heavily controlled regions. Besides, bureaucratic barriers to development may delay construction and consequently delay the expected rents (Schuetz 2007).

While the regulations cut across both rental and owner-occupied housing, the transaction costs associated with navigating the bureaucracies, especially in the developing countries is usually considered higher for the rental housing developers and given other considerations such as longer payback period and rental uncertainty in the rental sector has made the investments become riskier, hence unattractive (Malpezzi 2011). Therefore, as reiterated by Malpezzi (1990), regulations are necessary to set the 'rules of the game' but should aim at levelling the playing ground such that housing investments are beneficial to the developers, whether owner-occupied or rental units.

Furthermore, legal framework also forms a critical component of housing policy in regulating rental sector (Malpezzi and Ball 1991). The significance is based on the belief that a successful private rental housing market requires a competent and stable tenure regulations to control its transactions (Hubert 1998). In fact, Peppercorn and Taffin (2013) explain that the laws are created to protect gullible tenants from being victimized by the landlords.

The legal framework ordinarily comprises two main elements, with the first one aimed at controlling the prevailing circumstances for private rental market operation, and specifically, the freedom of the landlords to increase rentals to maintain affordability

and prevent economic exclusion that could arise if rental levels exceed the tenants' capacity to pay (O'Sullivan and De Decker 2007). Many authors have identified rent control as the common tool used to regulate the rents in the rental sector (Gilbert 2016; Malpezzi and Ball 1991; Peppercorn and Taffin 2013; Komu 2013). However, despite rent control being widely used to protect the tenants against manipulation by the landlords (Haffner et al 2009), there is a near consensus among the scholars that they are detrimental. The negative impact of rent control is best captured by Lindbeck (1972:39) as 'the most efficient technique presently known to destroy a city other than bombing'. Accordingly, there have been concerns that rental controls do not only discourage supply of new rental housing units, but also leads to qualitative deterioration of the existing rental stock (Gilbert, *ibid*; Peppercorn and Taffin *ibid*). Rent control is also considered to retard new investments and hence limit rental housing supply (Malpass and Murie 1994; Whitehead et al 2012). According to Peppercorn and Taffin (*ibid*) rent control can be viewed as a state-guaranteed subsidy to the renters but paid by the landlords. In this regard, Hughes and Lowe (2007) opine that while the intent of such regulations is to safeguard the tenants, they prevent the landlords from receiving the suitable returns on their investment. The potential investors therefore tend to worry that their investments might be subjected to stringent state-imposed rental ceilings and hence divert their capital to alternative ventures.

Secondly, the legal framework seeks to create tenancy security and build certainty about occupancy period, and concurrently reduce chances of arbitrary eviction of tenants by landlord, except for prescribed reasons (Pomeroy and Godbout 2011). Malpezzi (2011) observes that the rental housing sector is governed by private contracts which are mainly controlled by state. Legal framework therefore defines the landlord-tenant relationship. Ordinarily, these laws usually outline the nature of property rights to be enjoyed by the landlords and tenants as specified in the contract. Generally, a viable rental housing sector requires legal framework that aims at achieving secure tenure for the tenants, while at the same time ensuring adequate returns for the investors (Peppercorn and Taffin 2013). Therefore, when the benefits of tenancy regulations are heavily skewed toward the tenants, the landlords become apprehensive, and the supply of rental housing is constricted (Cadstedt 2010; Dubel et al 2006). As explained by Hughes and Lowe (2007), the landlord-tenant relationship is basically founded upon the extent of power exercised by the landlord, yet, a viable rental sector requires significant contractual neutrality between the landlords and tenants.

Level 3: Rental Housing Actors and the Risk-Return Equation

Rental housing market is characterized with various actors and institutions, with different roles and interests, and are guided by both the formal and informal rules in terms of norms and beliefs (Han and Wang 2003). These market players are deemed to be rational decision-makers whose main intention is to optimize profitability and minimize transaction costs through adjustment of price and output in a dynamic market environment (Williamson 1998).

Hence the general principles of investment apply to rental housing. A rational investor in rental housing will therefore be guided by three principles namely; total returns, risks, and liquidity (Peppercorn and Taffin 2013). This is evident since much of the consideration when evaluating the impacts of institutional, legal and fiscal policies on rental housing, the ultimate judgement is based on their overall influence on the returns and risks levels in the rental sector (Hughes and Lowe 2007).

Consequently, assessment of financial viability of the potential rental housing investment comprises quantifying the risk-adjusted rate of return, which should be higher than that of the alternative investment to offset the extra risks associated with the subject investment (Peppercorn and Taffin 2013). Lawson et al (2014) however argue that when rental yields fail to meet the risk-adjusted conditions of the investor, then this hinders delivery of rental housing, and further explain that this failure could be due to lower rentals associated with units. Chiquier and Lea (2009) observe that the failure could result from risks and uncertainties associated with rental housing and explain that rent collection uncertainties and other risks (such as vacancy, eviction risks, disposal risks) are determined by the regulatory framework that control the landlords and tenants' relationship. For example, in most countries, legal and regulatory framework are more inclined on safeguarding the tenants, hence end up shrinking rental returns through increase in operation costs and consequently increase risks associated with rental housing (Lawson et al 2014).

Moreover, the influence of financial and fiscal framework on risk-return equation is well captured. As noted by Peppercorn and Taffin (2013), the nature of financial framework is critical for development of rental housing. When the financial instrument is fashioned in such a way that it ultimately leads to favourable rate of return for rental housing, then, more investment is attracted towards rental units. For instance, lower interest rates and longer amortization terms results to lower monthly repayment amounts, hence lowering the expenses and enhancing net income. This in effect results to positive rate of return (Chiquier and Lea 2009; Lawson et al, 2014).

There is however evidence that rental housing has been faced with lack of interest on funding by financial institutions (Chiquier and Lea, 2009; Peppercorn and Taffin, 2013). This is because in most countries, rental housing sector is viewed less profitable and riskier than commercial properties sector. As expounded by Malpezzi (1990), the risk results due to low and uncertain rental income which may hamper loan repayment. Further, the formal rental housing particularly in the developing countries is not yet well developed, and as such, there is limited information. Hence, the dearth of rental housing data also imply that the financial institutions lack the relevant information upon which to make investment. Besides, rental housing development is predominated with small-scale landlords with sporadic investments, hence present more risk as compared to owner-occupier (Peppercorn and Taffin, *ibid*).

Moreover, a number of studies have also recorded the significance of fiscal policy in influencing supply of rental of rental housing (Gilbert 2016; Peppercorn and Taffin 2013; Dubel et al 2006; Oxley et al 2011). Dubel et al (*ibid*) for instance observes that the manner in which fiscal policy treats rental housing forms a critical policy guideline which influences comparative housing rents and prices, and consequently the viability of investment and rental levels. Therefore, high tax burdens lower the rate of return and discourage investment in rental housing (Melzer and Moothilal 2008). Pomeroy and Godbout (2011) also observe that favourable tax provisions enhance net yields and consequently encourage rental housing investment.

CONCLUSIONS

Of relevance to this research is how to understand rental housing market failure from the perspective of NIE theory. It is evident that the manner in which institutions and property rights treat rental housing market increases transaction costs, hence become a disincentive to the private landlords/developers towards supplying rental units. Within the context of housing market, it is postulated that the structure of the institutional

framework in terms of its constraints and incentives promotes home-ownership relative to the rental housing, hence leads to market failure of the latter (Schwartz, 2010). These comprise informal rules, which include beliefs or culture, for instance, when it is believed that owning a house is more prestigious than renting. Similarly, formal rules such as regulations have also been identified to either act as incentive or constraints to rental housing supply. Again, institutional frameworks that lead to unbalanced property rights constrains the developers' motivation to supply rental housing hence the market failure. That is, a highly regulated rental market limits supply and vice versa.

Additionally, in terms of rental housing market, returns constitute the incentive package for the developers and landlords. Developers in rental housing usually face higher transaction costs and lower returns relative to home-ownership developers (Peppercorn and Taffin 2013). This evidence underscores the significance of property rights to the rental housing delivery. Recalling Pomeroy and Godbout (2011), it is evident that the nature of property rights enjoyed by the landlords/developers determine whether they will be willing to supply rental housing or not. This is because property rights have an impact on transaction costs, and consequently the returns. Developers will therefore be willing to supply rental housing if the resultant transaction costs are minimized to allow them to realize desired returns. Therefore, when property rights are formulated in such a way that they increase transaction costs to the developers/landlords, they act as disincentive towards supply of rental housing hence results to market failure.

To conclude, it is evident that rental housing markets can, and often do fail (to work) due to policy failures (though the two are not mutually exclusive). Rental market failure therefore arises due to unfavourable institutional environment, which make transaction costs in the rental housing segment high, hence the sector becomes unattractive to the investors due to perceived low returns. But still, the crucial question is how can policy unravel the inherent market failure in the rental housing sector to enhance delivery of private rental housing? Opinions point at adoption of a more integrated approach based on a diversified means of housing provision. More emphasis should therefore be laid on the need to formulate policies that are aimed towards building and regulating a functional rental housing system (Chiquier and Lea 2009). Therefore, there is need for policy-makers to find the nexus between policy provisions and market conditions, through balancing public goals against private expectation. This implies that for appropriate rental housing program, the policy provisions should be intertwined with the housing market system. Efforts to expand rental housing supply should therefore focus on the institutional frameworks that cause rental housing market to fail (Peppercorn and Taffin 2013).

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TOWARDS ADAPTING HAUSA TRADITIONAL ARCHITECTURE IN A CHANGING CLIMATE: MEETING THE NEEDS FOR SUSTAINABLE HOUSING IN NIGERIA

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Sustainable housing discourse has been on-going particularly for countries like Nigeria where the housing demand has been enormous in addition to the challenges posed by climate change. Yet not much has been done to adopt the traditional sustainable architecture into the present needs. Therefore, this study presents the potentials of Hausa traditional architecture, in terms of how the architecture still adopts to the negative impacts of climatic changes passively. A literature-based discourse is pursued for this study. The main keywords are expanded to argue for the adaption of traditional architectural styles into the present need for sustainable housing. Findings suggest traditional housing styles adapts better to the present climatic changes and the local materials used are less expensive, durable and cost effective. In the overall, the potentials of traditional architecture are promises to sustainable housing delivery. Additionally, the findings are expected to spur housing developers and the different government housing agencies, particularly within the Hausa States of Northern Nigeria to develop housing models and housing estates. This study's discourse is intended to redirect housing provisions toward a more indigenous sustainable approach within the Hausa States and for the other Nigerian traditional architecture to be adopted for housing provisions in their different locations to face the challenges of climate change.

Keywords: Climate change, Hausa Architecture, Housing, Sustainability

INTRODUCTION

The demand for housing in Nigeria has been on the increase due to the continuous population growth. It is also no longer news that climate change impacts has affected many sectors and the built environment is worst hit (De Wilde and Coley, 2012; Allu and Ebohon, 2014). Furthermore, the twin options for this housing demand must be sustainable and affordable (Milligan and Gilmour, 2012). To support this argument (Martinez et al., 2017), suggest that sustainable options and affordability are possible within the housing sector.

Looking inward, in Nigeria traditional housing is evolved from what the environment offers; climate, building materials and the cultural beliefs of the people. Hence, the motivation of this paper. The focus of the paper is therefore, to link climate change and buildings and to presents highlights on how the concepts of traditional buildings can be adopted for a sustainable and affordable housing for the Nigerian people.

LITERATURE REVIEW

Climate has been defined by scientists long ago as referring to the average weather condition of a region over a long period of time, normally spanning a period of a few

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decades or even centuries. It is defined by elements, which include Temperature, Rainfall, Wind, solar radiation and humidity among others. Weather itself has been defined as “the daily and hourly change of atmospheric condition” (Brain, 2012, p.2)

Climate change on the other hand is a change in the statistical distribution of weather patterns when that change lasts for an extended period. The most general definition of climate change is a change in the statistical properties (principally its mean and spread) of the climate system when considered over long periods, regardless of cause (Solomon 2007). This is also synonymous with the concept of climatic change proposed in 1966 by the World Meteorological Organization (WMO) to encompass all forms of climatic variability on time-scales longer than 10 years, regardless of cause. (UNFCCC, 1994)

Nigeria is located in the tropical region of the world. In the south, it is bound by the Atlantic Ocean and in the north by the Sahara desert. It enjoys a wide climatic spread running from North to the south and patches of relief-induced microclimates. Located between latitude 4° N to 14° N; and longitude 3° E to 15° E., it has a land extent of about 923,769 km²; a north-south length of about 1,450-km and a west east breadth of about 800 km. It is a country with diverse biophysical characteristics ethnic nationalities, agro-ecological zones and socio-economy (NIMET 2015) It is a multi-cultural, multi religious and multi ethnic country with diverse economic and natural resources.

Hausas occupy a large part of northern Nigeria, between Latitude 3.50 east and Latitude 11.00 east from Longitude 10.50 to longitude 14.0 north. The Hausas are also found in some West African countries in large numbers. According to Britannica (2011), the Hausas grew in numbers in seven centralized city-states like Daura, Katsina, Kano, Zaria, Gobir, Rano, Biram (Hadejia) in feudal fenced city-states, collectively known as the seven Hausa states. Islam, as a religion, came to the Hausas in the 14th Century and strengthened the existing Hausa monarchies and traditions. Late 18th century comes the British colonial masters with a new system of government and their architectural style. At first, they identified with monarchies but later edged them out of authority.

The Hausa Architecture hence developed from a mixture of culture, climate, environment, Islam and colonization. Hausa traditional architecture like other traditional architecture across Nigeria has evolved through response from its environment and particularly the climate (Agboola and Zango, 2014). Katsina State was created in 1987 and since then, has been providing houses to its citizens who are mostly the Hausas. Katsina State Housing Authority 2015 Report indicate that provision of housing is not without challenges which emanate from land acquisition and location, design, cost, materials, mortgage, method of delivery, recovery of loans and sustainability.

Climate change affects buildings; the way architects adjust to this change is a matter of design based on understanding of the climate (Agboola and Zango, 2014). Traditional Hausa architecture has some passive, cost effective solutions to some these issues (Isa et al, 2017). Furthermore, it can provide the much-needed comfort required in dwellings in Katsina State, which is the context of this study.

Figure 1 is the map of Nigeria, showing its 36 states with the location of Katsina in Northern Nigeria highlighted with black borders lines.



Figure. 1 Map of Nigeria showing the 36 States including the Federal Capital Territory

Source: nigerianmuse.com (Assessed 1/11/2017)

CLIMATE CHANGE

The ongoing climate change, often referred by scientists to as global warming is a fact that, it is primarily caused by certain human activities (IIPC, 2007). This is in addition to traditional factors which include biotic processes, variations in incident solar radiation received by Earth, plate tectonics, and volcanic eruptions which are generally considered as part of the earth's natural processes (IIPC, 2007).

The scientific consensus on climate change is that climate is changing and that these changes are caused by human related activities that are irreversible (IIPC, 2007; Solomon, 2009).

Climate change is a global phenomenon. The effects however vary among regions and continents; largely due to variations in local conditions and the nature of a region's economic development. Daily and average temperature variability have continued to widen, changes in the pattern of rainfall particularly intensity and annual onset and cessation have resulted into serious consequences in particularly tropical parts of the world causing flooding and in some regions encouraging draught and desertification (IIPC, 2007; Welch, 2010).

Vegetation has continued to change in density, nature, distribution and diversity; winds, their intensity, direction and timing have continued to portray drastic seasonal variations across the world and Nigeria in particular (Odjubo, 2010; Sayne, 2011). Atmospheric humidity and particularly humidity of micro climatic regions and the rates of evaporation has been altered and will continue to change (NASA, 2011). Thus, the observation that there is a general shift in the existing year-to-year climatic records globally and Nigeria is not an exception.

The impacts of these changes have been unfavorable in most instances. For instance, rising diurnal and mean temperatures increases evaporation and increased cost air-conditioning. Increased rainfall variability encourages dry spells and desertification and in some areas adverse flooding. Winds in particularly the northern part of the country encourage desertification, health and economic challenges. According to Nigeria Meteorological Agency (NIMET), Climate Report, 2015), extreme weather and climate events are responsible for about 90% of natural disaster (NIMET, 2015). The report also noted that the vegetation of the country is the worst affected as such, the Forest resources continue to dwindle and the hydrological systems continue to change for the worst.

Climate change and the housing sector have a strong link. The link between climate change and buildings are twofold. Firstly, whilst buildings contribute significantly to climate change (Cole, 2011; Laustsen et al., 2011; Allu and Ebohon, 2014), through its continuous carbon emissions and the huge reliance of its raw materials from the natural environment. On the other hand, buildings have been acknowledged to be the most vulnerable components of the environment to the negative impact of climate change (UN Habitat, 2009; William et al., 2012; De Wilde and Coley, 2012; Allu and Ebohon, 2014). In general, these changes continued to have negative impact on the economic and social development of the people particularly in Africa (Onyekuru and Marchant, 2011).

In Nigeria, climate change has resulted in the destruction of bridges, roads, houses, infrastructures and farmlands especially in some Northern and Western States of Nigeria (Etuonovbe, 2011). Climate change impact in Nigeria has affected more people than any other disaster and also caused more damage to the housing sector (Ebohon et al, 2013; Allu, 2014). Additionally, Northern Nigeria has also had its share of the negative impact of climate change (Paehler, 2007; Allu, 2014). Katsina State is no exception being one of the Northern States. Hence, the reason for choosing Katsina State as the context for this paper. According to NIMET (2015), Kastina State has experienced and is still experiencing the negative impact of climate change.

The focus of this study is to identify some of the specific effects of this phenomenon on traditional Hausa buildings of Northern Nigeria and the strategies employed by the people of Katsina region to mitigate the effects traditionally.

CONTEXTUAL EVIDENCE OF CLIMATE CHANGE IMPACTS

Katsina is a typical example of areas with dominant Hausa architecture. One of the characteristics of Hausa city neighborhoods are ponds, known as ‘kuddudufi’ which are mainly man-made. Intense rain makes these ponds to exceed their known banks and thereby become threats to the surrounding buildings.

These evidence are presented in Figures 1 and 2. The ponds clearly constitute health and safety risk.



Fig 1 The effects of rainfall on exposed wall
Source: Author's field photo archive. Nov 2017.



Fig 2. Erosion, ponds and health situation
Source: Author's field photo archive. Nov 2017

Brain (2012) summarized the Potential Impact and Risks on Buildings as follows:

1. Increasing health and safety risks for occupants caused by a reduction in the quality of the indoor environment.
2. Premature or accelerated deterioration.
3. Reduction of design safety factors.
4. Reduced service life and functionality of components and systems.
5. Increased risk for catastrophic failure.
6. Increased repair, maintenance, reserve fund contingencies and energy costs.
7. Increases in service disruptions and emergencies.
8. Increased liability as a result of premature aging or deterioration.

These risk factors enumerated by Brain (2012) suggest that curbing the negative impacts of climate change to buildings would mean minimizing other human related effects of climate change. Thus, housing solutions and strategies would promote the people and the environment.

HOUSING IN KATSINA STATE

According to the World Bank Report (2010), Nigeria requires 17 million housing units, to meet up with the current housing deficit. This has been translated to monetary terms by the then authorities of the Federal Mortgage Bank of Nigeria (FMBN) to the tune of about 56 trillion Naira to be able to adequately meet the housing needs of Nigerians (FMBN, 2015 Report). That was in 2015 when the exchange rate of Naira to Dollars was about N200/USD.

By implication Katsina State needs to contribute about 90,000 units of houses to compensate for this deficit, going by its current population of eight million citizens. To achieve this, various steps have been taken by all tiers of government in the State to provide affordable, user friendly and environmentally appropriate housing for their citizens.

The National Housing Policy provides the policy framework and legislations for efficient and effective delivery of housing schemes. Successive governments, since the State was created in 1987 tried to deliver different housing schemes in Katsina

State with varied degrees of successes. Although there were some challenges which included; project financing, land acquisition, design, construction, allocation and mortgage (Katsina State Housing Authority Report, 2015). Table 1 show that less than 4,000 of housing units were constructed in the State since 1987.

Table1: Showing Mass Housing Units built by MDAs in Katsina State from 1987-2015

S/N	ESTATES	NO. OF HOUSES	FEDERAL STAFF	STATE GOV. STAFF	INDIVIDUAL	LOCAL GOV. STAFF
1	Kofar Marusa Katsina	152	18	94	28	12
2	Batagarawa Katsina	266	26	203	29	8
3	Ahmadu Commassie	350	80	251	19	
4	Kankia	32	5	22	1	4
5	Mani	27	4	16	2	5
6	Malumfashi	29	3	7	8	11
7	Funtua	99	3	63	25	8
8.	Dutsin- ma	48	8	24	10	6
9.	Daura	53	9	29	9	6
10	Barhim Housing Estate	500				
11	34 Local Governments	1020				
12	Makera Village	252				
13	Fatima Shema	250				
14	Ahmadu Sardauna	510				
15	Kafe, Abuja	117				
16	Ministerial Pilot	150				
17	Mubassir PPP	97				
	GRAND	3962				

TOTAL

Source: Katsina State Housing Authority Report 2015.

This represents less than 1% of the required units. There are factors militating against the ability of the State government to provide adequate housing. Some selected factors are:

1. Finance
2. Cost
3. Mortgage
4. Income of beneficiaries cum affordability
5. Architectural Designs and location

In the last five years the average budgetary allocation has been about 4 Billion Naira annually for the housing sector in Katsina State. This gave the sector the wherewithal to record more than 50% of the housing stock increase since the State was created. This is still inadequate, however, the State government subsidizes the cost of the estate, sometimes by more than 50% but, still, the average civil servant cannot meet up with the mortgages as was observed. This is because the government still charges for the land, provision of infrastructure and the buildings. There are many instances where the government wrote letters to housing allottees threatening eviction due to the inability of the occupants to make payments.

The bottom line is therefore, affordability. Realistic budget, style of design and choice of materials, environment, due consideration of occupier's income and culture are ways to achieve sustainable housing in Katsina State and beyond. This background further motivates this paper to document the potentials of how traditional Hausa architecture could be adopted to solve the housing needs in Katsina and Nigeria in general.

HAUSA TRADITIONAL ARCHITECTURE

Traditional or vernacular Architecture is the design and construction techniques using locally available resources based on the environmental, cultural and historical background of the people (Isa, 2017). The study of Ulusoy and Kuyrukru (2012) offers the most suitable explanations as to what traditional architecture is to this paper as quoted to mean:

“It is widely accepted that there are still many things contemporary architecture can ‘learn’ from traditional buildings. Traditional buildings display features which are ‘proper’ in many aspects, which may be taken as an example by all actors in the field of education, and from which certain deductions may be made throughout the design process, from the whole to the details or from the details to the whole.” Ulusoy and Kuyrukru (2012, p. 2121)

From the quotation above, it is therefore not out of place to adopt Hausa traditional architecture as the reference for this paper, more it is the only known architecture within the context of this theoretical discourse. Thereby, providing an avenue to learn what potentials can be adopted into the contemporary needs of the Katsina State housing needs

COMMON BUILDING MATERIALS IN HAUSA ARCHITECTURE

Distinct attributes of Hausa Architecture can be seen in the use of naturally occurring materials that do not require extensive energy input like earth, stone, timber, thatch; to construct virtually all building elements like foundations, walls, roof and openings. Ornamentation and engravings are also distinct features. The different components are highlighted in the subsequent section

Earth as building Material: Earth is a building material in abundant supply in Katsina and is the basic traditional material used in making blocks and finishes. Its thermal properties are good for housing as it slowly absorbs and releases heat thereby cooling building occupants in daytime and warming them at night (Haruna, 2016). Walls constructed with earth have low heat conductivity, perform better than sancrete block wall and a lot cheaper (Oluwagbemiga, 2014). Earth as building material has been used to build houses and monument since the 12th century (Pacheco et el, 2012). The form of Hausa building with high level relatively small windows allow hot air to escape to the atmosphere creating a Mexican hat effect that further cool interior spaces passively (Haruna, 2016).

Over the years many attempts have been made to stabilize earth with additives and compression for longer service use to contemporary houses. Only recently, Jigawa State which is a neighbouring State to Katsina ordered a number of Compressed Earth Bricks (CEB) machines from South Africa and has commenced the production of some housing estates with the CEB technology. Figure 3 shows a typical example of the house built from the CEB technology and Figure 4 shows the simple machine and some stabilized compressed earth bricks. This is an indication that the traditional materials can be modified to suit the present challenges of climate change and pursue sustainability as well.



Fig.3: House constructed using CEB technology in Katsina.
Source: Author's Archive. Nov 2017.



Fig. 4: CEB machine and products
Source: Author Archive. Nov 2017

Stone as Building material: Stone is primarily used in foundation for structural support and as moisture barrier to protect the superstructure earth walls in Hausa architecture (Isa, 2016). In some parts of Kastina State, stone is used in walling to represent authority. Most Native authority buildings are observed to have their walls built in stone in this regard as shown in Figures 5 and 6. Stone foundations provide a cheaper alternative to the conventional over-site concrete floors. Stone finished wall require

less maintenance and protect isolated walls from the elements. All these contribute to lowering the cost of housing.



Fig. 5: House constructed in stone walls
Source: Author's field photos. Nov 2017.



Fig. 6: Stone wall finishing
Source: Author's field photos. Nov 2017

Engravings and wall décor: Hausa traditional buildings are well known for their decorative art works in beautiful colours and engravings mostly on their building facades. The motifs express status of the building owner. It is widely believed that there is a connection between the embroidery in Hausa clothing and the engravings in their buildings. This connection is clearly seen in Figure 7. The Hausa people are connected to their buildings by the similarity in culture, colours and in their dressing. The finishes used for their buildings are naturally sourced without any non-natural additives to even the colourful finishes. The materials are affordable and can withstand the weather to a reasonable degree; this is because these houses have been existing even before the colonial era. Whilst, many of the modern buildings have fall apart due to the impacts of climate change.

Katsina by its climate condition has a hot arid climate and therefore, requires is that the interior temperature is made naturally cool. This has been achieved by the traditional architecture. In the traditional Hausa architecture, the colours are not heat absorbing unlike the black roofs being used by architects in Katsina these days, which absorb rather than deflect heat away from building and creating discomfort to occupants.



Fig. 7: Wall Motifs in Hausa Traditional Architecture at Katsina emirate palace. Source Author's Field photos, Oct 2017.

Timber: Izara (Hyphaene Thebaica) is the traditional timber use in Hausa architecture. With desertification caused by climate change, this building material resource is fast

becoming extinct. The timber logs (Azara or Izara) are cut into sizes to generally provide roof truss members, ceiling joists and girders as shown in Figures 8 and 9. Izara logs are naturally insect-attack resistant, strong, rigid and recyclable. A mixture of ash and mud into paste is used to provide the flat roof covering, typical with Hausa architecture. The timber truss design creates a dome and relatively large volume of air is held within. This invariably passively creates a cooler interior mitigating the need for mechanical cooling for comfort to the occupants. Figure 10 depicts a typical Hausa architecture built in 1954 and still undisturbed by the climatic changes.



Fig. 8: Roof truss. Source, Author's archive. November 2017



Fig. 9: Roof beams supported by corbels in walls Source, Author's archive. November 2017

The dependence on modern design techniques and materials has resulted to high cost of construction in recent years. Contrary to this, traditional building materials enable cost effectiveness in terms of materials and simple innovative expertise of the local builders (Opoko, 2011; Oluwagbemiga, 2014).

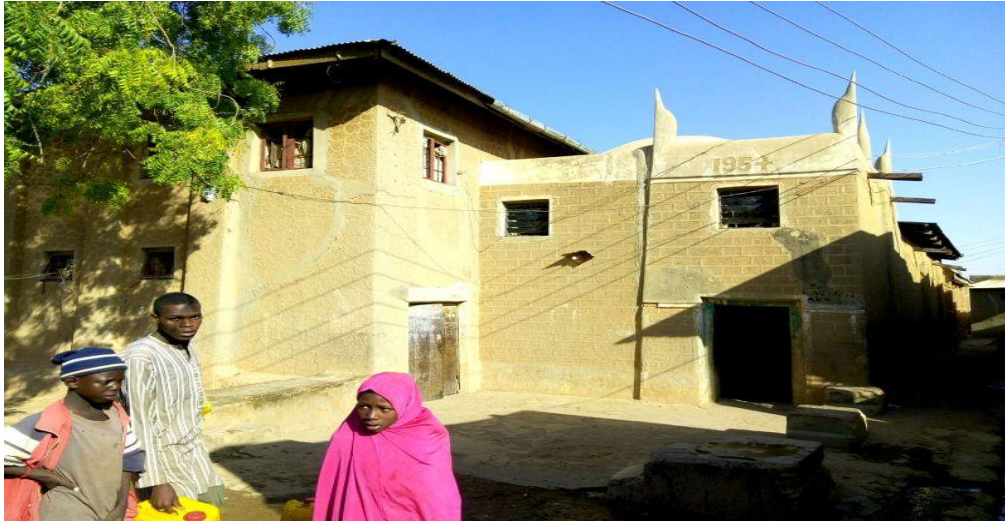


Fig. 10: A 1954 storey building in Katsina State showing elements of Traditional Architecture.

Source, Author's archive. November 2017

SUMMARY AND CONCLUSION

The paper showed evidence that climate change is real even in its context. The environment, buildings and occupiers are all vulnerable to the impacts of climate change. Traditional architectural materials as demonstrated with stabilized earth in Hausa architecture can be improved upon sustainable applications as strategies curbing the impacts of climate change and for the promotion of environmental.

Building materials in Hausa architecture are; natural, durable, readily available, colourful, and economical and are well able to withstand the current challenges of climate change. Thus, the paper suggests that these potentials can be further developed by policies, research and guided applications strategies for the good of people, the environment and the future. Adopting these would promote the development of traditional architecture as a means of achieving sustainable housing in Katsina State and for other traditional architecture in Nigeria.

This paper is also an attempt to spur Government agencies like the; Nigerian Building and Road Research Institute (NABBRI), Nigerian National Monuments and MOTNA's research units are encouraged to carry out more research in this subject. Furthermore, the paper also recommends that the curricula in tertiary institutions in Nigeria should incorporate the study of traditional architecture in relation to environmental issues as live projects.

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EXPLORING STAKEHOLDERS' PERCEPTIONS ON THE GREEN CAMPUS INITIATIVE IN SOUTH AFRICAN HIGHER EDUCATION INSTITUTIONS

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Although mixed performances have been documented in the attempt by South African higher education institutions (HEIs) to mainstream sustainable development (SD) ethos into their core activities, the neglect of such integration into the management of built assets and spaces on their campuses has been observed. Among other factors, this has prompted the introduction of green campus initiative (GCI) in South Africa in 2012. However, GCI's implementation performance seems underreported, hence the need for this study. This study explored the level of awareness as well as the perspectives of stakeholders on the success or otherwise of the GCI in their respective institutions. Adopting a case study research design, this study relied semi-structured interviews. Interviewees were recruited through purposive snowballing at a selected HEI serving as a case study. Consequently, data accruing from these sources was analysed using the thematic analysis technique. The preliminary findings revealed considerable level of awareness among the interviewed stakeholders. Also, interviewees acquiesced to the potential of the concept to make significant contribution to the resolution of the environmental challenges bedevilling the South African context. Impediments hindering the successful implementation of the initiative were also identified. Findings from this study will contribute to a wider research project seeking to optimize GCI implementation performance in South African HEIs.

Keywords: Campus, Green Campus initiative, Higher Education Institutions, Sustainable Development, Thematic Analysis

INTRODUCTION

Sustainability and sustainable development (SD) remain pivotal concepts which need to be addressed. Abubakar, Al-Shihri and Ahmed (2016) have stated that over the past two decades, South African higher education institutions (HEIs) and other HEIs across the globe have joined counterparts in promoting the concept of sustainability initiatives, also known as the green campus initiative (GCI).

It must be taken into consideration that HEIs are known to be microcosm of societies or "small cities" (Alshuwaikhat & Abubakar 2008). This means that HEIs are not only responsible for offering qualifications and conducting research, they are the key stakeholders in promoting and sustaining transformation within societies (David, Karodia, Shaikh & Soni 2015). Thus, it behoves HEIs to serve as champions for society's sustainable development aspirations. Accordingly, they are expected to provide exemplary leadership in this endeavour through the adoption and implementation of various facets of sustainable development in their core and non-

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core activities. The GCI happens to be one of the initiatives launched to achieve this objective.

The GCI is a broad concept which comprises of education, research, administration and campus operations (Aleixo, Leal & Azeiteiro 2016). A green campus consists of features such as, energy management, water management, landscape management, biodiversity management, waste management, building management, purchasing and food services. The focus of the study is limited to the implementation of GCI during the development and management of built assets in South African HEIs.

Although there have been many studies conducted on the status of the implementation of GCI globally, no studies are known to the authors concerning the status of GCI implementation within South African HEIs since it was launched in 2012. This lack of studies on the phenomenon calls for concern among scholars, administrators and policy makers working in the HEI space in South Africa. This study emanates from this observation and seeks to explore the level of awareness as well as the stakeholders' perception on GCI in South African HEIs.

This paper is structured according to the following sections namely; a review of the literature, a justification of research methodology, presentation and discussion of findings, before the conclusion.

LITERATURE REVIEW

Sustainability and sustainable development in higher education institutions

According to Aleixo, Leal and Azeiteiro (2016) sustainability is now a well-known concept. However, the terms "sustainability" and SD remain equivocal, as it will have different meanings to different people (Owens & Legere 2015). Despite the existence of diverse views concerning what sustainability means, the definition provided by WCED appears to be widely accepted. According to WCED (1987: 46), sustainability connotes "the ability to meet the needs of the present while living within the carrying capacity of supporting ecosystems and without compromising the ability of the future generations to meet their own needs."

In a recent study conducted by Aleixo et al. (2016), most respondents (35%), associate sustainability with the "preservation and conservation of resources for future generations", whereas 30% of the respondents associate the concept with the three pillars of sustainability -social, environmental and economic pillars respectively. Other respondents associate the concept of sustainability with either one or two dimensions of sustainability. This goes to show that there is no generally accepted connotation of the concept.

Research has shown that HEIs are key stakeholders in driving society's quest for sustainable development (Baker-Shelley, Zeijl-Rozema & Martens 2017). This can be achieved through proper education, research and involvement of all stakeholders (Dumitriu 2017). Educating HEIs stakeholders about SD is important, as it will assist in developing their skills and broadening their knowledge regarding SD (Sanusi & Khelghat-doost 2008). This has led to the evolution of the sustainable university concept.

A sustainable university, according to Velazquez, Munguia, Platt and Taddei (2006: 812) is defined as "a higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of

their resources in order to fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles.” A sustainable campus or green campus must be able to reflect these features across four main components as shown in Figure 1.

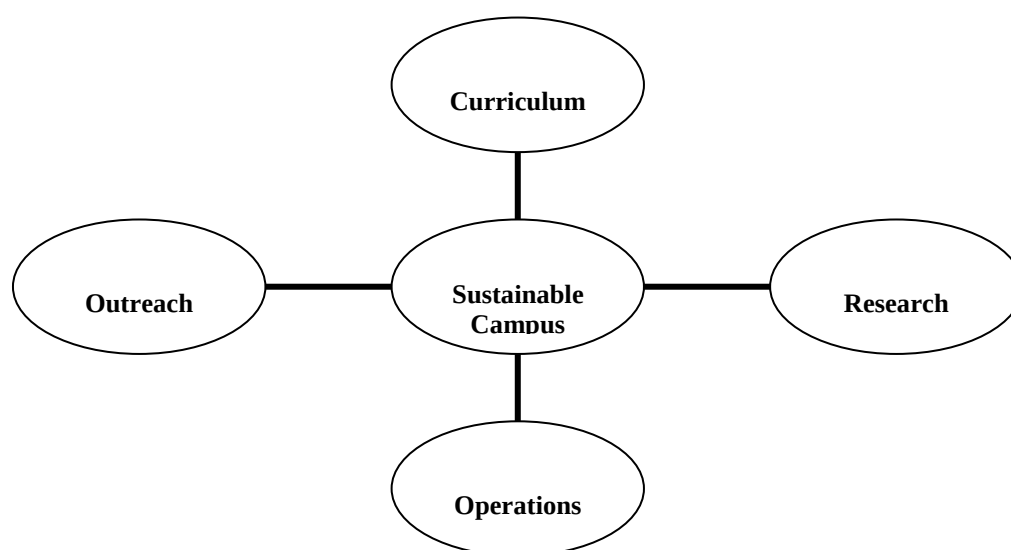


Figure 1: Main components of a sustainable campus (Adapted from Arroyo, 2017)

Green campus initiative

Humblet, Owens and Roy (2010: 4) define a green campus as “a higher education community that is improving energy efficiency, conserving resources and enhancing environmental quality by educating for sustainability and creating healthy living and learning environments”. The definition of a sustainable university (Velazquez et al. 2006) and the definition of a green campus (Humblet et al. 2010) have similar meanings, as they both have a connection to what sustainability connotes. It should be noted that the main aims for the GCI in HEI is to reduce the negative impacts that the bio-physical environment is encountering due to the high levels of energy and water consumptions and the utilization of treacherous materials, through the design and construction of energy efficient buildings (Alshuwaikhat & Abubakar 2008).

According to Filho (2011) the aims of a GCI can only be achieved once the perception of the stakeholders is understood. In addition, Katiliūtė, Stankevičiūtė and Daunorienė (2017) stated that GCI cannot be achieved without the participation of stakeholders. Arroyo (2017) observed that the HEIs consist of several stakeholders and can be categorised along the following lines (see Table 1). Each of the stakeholders listed in Table 1 has a fundamental role to play in the achievement of a green campus.

Table 1: Green campus stakeholders

External stakeholders	Internal stakeholders
Community/donors	Sustainability officer
NGOs	Faculty
University bodies	Staff
Companies	Research centres
Other universities	Administration

Association HE	Students
Alumni	
Government	

Source: Arroyo (2017)

Implementation of GCI in South African HEIs

The GCI was launched in South Africa in 2012 by the Minister of Higher Education and Training, Mr. Blade Nzimande. The purpose behind the launch was to make HEIs aware of the negative environmental impacts that are caused by their daily operations. In addition, the initiative sought to provide students with the necessary skills and knowledge to address and overcome sustainability issues, not only on their campuses, but also in their communities. However, five years after the launch of the initiative in South Africa, the achievement of campus sustainability remains a critical subject that seems to be overlooked.

Many HEIs are struggling to fully implement the GCI due to impediments that they are experiencing (Rwelamila & Purushottam 2015). According to research that has been conducted, a common impediment that is experienced is the lack of financial resources (Arroyo 2017). Katiliūtė et al. (2017) report that having a limited budget may result to the HEIs not being able to fully commit to GCI projects, as some of these projects require a lot of money for them to be successful. Lack of awareness and knowledge regarding the GCI is also one of the impediments that led to the unwillingness of HEI stakeholders to support the sustainable transformation of their institutions (Katiliūtė et al. 2017).

Besides these, Velazquez, Munguia and Sanchez (2005) identified eighteen (18) impediments to GCI implementation, whereas, Sharp (2002) identified mechanisms that can lead to the achievement of successful GCI (see Table 2).

Table 2: Impediments to GCI implementation Vs Mechanisms for successful GCI implementation

Impediments to GCI implementation	Mechanisms for successful GCI implementation
Lack of awareness, interest and involvement	Securing support from the HEIs' management
Not having a functional organizational structure	Having effective coordination
Lack of funding	Maximizing face to face communication
Lack of support from the HEI administrators	Building formal and informal support
Lack of time	Seeking partnership from students and external stakeholders (through also involving the communities)
Lack of data access	Launching initiatives that attract most of the attention and support from stakeholders
Lack of training	Removing risk and generating organisational support for the
Lack of opportune communication and information	
Resistance to change	

Profit mentality	running projects
Lack of rigorous regulations	Having a continuity of the launched initiatives
Lack of interdisciplinary research	Having the right management framework
Lack of performance indicators	Willingness to support low risk innovation and to mentor the staff
Lack of policies to promote sustainability on campuses	Continuously improving the learning curriculum regarding the GCI
Lack of standard definitions of concepts	Sharing its learning experiences
Technical problems	
Designated workplace	
The "Machismo"	

Source: Velazquez et al., (2005), Sharp (2002)

The absence of any study that has comprehensively sought to identify these factors within the South African HEIs, through an elicitation of stakeholders' perception has led to this study.

RESEARCH METHODOLOGY

Research method and design

This research study adopted a case study research design. The adopted research design is chosen as it allows the phenomenon to be viewed in more detail, such as exploring the perceptions of the stakeholders in the South African HEIs (Denscombe 2007). The research study utilised multiple data collection methods within the selected case study. Interviews were deployed to elicit data.

Case study selection

HEIs in South Africa were selected as probable case studies within which the viewpoints of relevant stakeholders will be elicited. The selection of the HEIs was centred on their publicly available deposition towards their adoption of the GCI as part of their developmental programmes as well as their intention to achieve the status of a sustainable university.

Sampling technique

A non-probability sampling technique was used, namely the purposive snowballing technique. This technique was chosen to give the researcher the opportunity to apply personal discretion in the selection of interviewees based on their ability to provide relevant answers to the interview questions posed (Saunders, Lewis & Thornhill 2009). The snowballing sampling technique made it possible for the interviewer to get referred to other stakeholders who can be able to answer questions regarding the GCI phenomenon. As such, the interviewed participants were selected based on their involvement in the GCI in the HEIs during the development and management of built assets and those who utilize the built assets.

Although efforts are still on-going to conduct interviews with interviewees from the cases selected, this study reports on the interviews carried out within a case study. It was expected that the interviews would be conducted across four HEIs in South Africa. Unfortunately, due to certain constraints, only five internal stakeholders and

one external stakeholder were interviewed in a particular HEI (see Table 3). The interviews were contacted telephonically and the six that was interviewed are the ones that confirmed their availability. Data collection is still on-going.

The interviewees are shown in Table 3.

Table 3: List of interviewees

No.	Interviewee Code	External stakeholders	Internal stakeholders
1	FM1		Facility management
2	FM2		Facility management
3	F1		Faculty
4	F2		Faculty
5	S		Student
6	CS	Consultant	

Source: Author (2018)

Data collection technique

Data was collected through semi-structured interviews. The interviewees were reassured that the interviews were confidential and that their identities would be kept anonymous. Each interview lasted an average of 25minutes. Notes were taken during the interviews, as the participants did not want to be recorded, because they wanted to protect the identity of their HEIs. Three of the interviews were conducted in person and the remaining three were conducted telephonically.

The interviews questions were categorised in such a way that it would make it possible to determine and understand the following:

- the participants' level of knowledge, awareness and acceptance of the GCI concept;
- the degree of participants' participation in the initiative;
- the participants' perception of the GCI's significance and;
- the identification of GCI implementation impediments.

After the interviews were conducted, the author relied on the notes taken during the interview sessions for data analysis.

Data analysis technique

The collected data was analysed through using the thematic analysis technique. Pre-set themes were adapted from the sub-categories, namely:

- the participants' level of knowledge, awareness and acceptance of the GCI concept;
- the degree of participants' participation in the initiative;
- the participants' perception of GCI's significance and;
- the identification of GCI implementation impediments.

The interviewer made sense of the pattern of narratives observed in the transcripts. Conversely, the fragments of the narratives which are aligned with the pre-set themes

were identified. The collection and analysis of data are still on-going. As a result, only the preliminary findings would be discussed in the succeeding section.

PRELIMINARY FINDINGS

The preliminary findings are presented beneath

Level of knowledge, awareness and acceptance of the GCI concept

The interviewees were asked what they understand about the term sustainability and concept of a GCI. From the responses received, they sought to associate the term and concept with the reduction of negative environmental effects resulting from campus operations.

F2 related the GCI concept with the three pillars of sustainability. F2 said that " GCI can be related to the three pillars of sustainability, which are social (which is the people who are involved the GCI, for example, student, faculty, administration and facility management); environment (which is how the campus is being treated, for example, are people littering on campus, what kind of buildings are being constructed); and economic (how the GCI is being promoted relating to finances)."

Although, CS was not very familiar with the concept of GCI, she stated that "It has to do with creating an environment that is eco-friendly on campuses. Developing campuses to become less inclined to harm the natural environment."

Once the interviewer gave a clear explanation of the concept of GCI, it came to realisation that the interviewees became aware of how broad it is. In furtherance to this, they were able to align it with some of the "environmental" projects that are on-going at their HEI. This made it clear to the interviewer that the absence of a standard definition of the concept (Velasquez et al. 2005) might be one of the reasons behind the failure of the introduction and implementation of the initiative in South African HEIs.

Participation in the initiative and perception of its significance

When asked about the effectiveness of the initiative and whether the participants had participated in any of the activities, the responses received was that the GCI in HEIs might not be as effective when compared to HEIs in other countries (such as United States of America) due to certain impediments that they were facing. Additionally, interviewees alluded to the salient nature of the initiative.

F2 noted that it is important to have GCI implemented, especially with the climate changes and drought that South Africa is facing and related on the important role that the HEIs play in order to educate and achieve green or, sustainable environments.

According to CS, "Sustainable buildings are important for HEIs. Natural resources can be depleted if people do not start such initiatives and create some awareness around the need to conserve resources. I think this initiative is also important when we consider the fact that, encouraging a healthier environment will make for better space for the students that occupy it." In addition, S agreed that the implementation of the initiative would not only be beneficial to the environmental, but will make the campus environment a conducive one to study in.

Identification of GCI implementation impediments

According to Velazquez et al., (2005), there are countless impediments that are affecting the successful implementation of the GCI globally. In addition, according to

the interviewees, the main impediments that they noted consisted of lack of awareness and financial resource. Lack of financial resources was identified as a barrier since GCI projects cost a lot of money and when they do not have enough support and/or acceptable project proposals, they easily forfeit funding from sponsors. All interviewees noted that the lack of awareness of the initiative resulted in the insignificant level of support received from the HEI's management as well as student involvement in it.

According to FM1, the GCI is not as effect as it should be. FM1 stated that "Reasons for this are because greening a campus costs a lot of money and for example, if we are unable to get funding, it is impossible to carry on with the greening plans that we have to the buildings..."

Among the eighteen (18) impediments that were identified by Velazquez et al. (2005) lack of awareness, interest, involvement, support from the HEIs' administrators and funding form part of the impediments that lead to unsuccessfulness of the implementation of the GCI. This served as an indication of some degree of congruence between the findings in both studies despite the dissimilarities in the geographical contexts of the HEIs.

Suggestions for improved GCI implementation performance

The interviewees concluded that, for HEIs in South Africa to achieve the level of greening or sustainability in their campuses, it was important to have more visible and audible campaigns, i.e. effective communication. Also, they stressed the need for faculty and staff to attend workshops, to make it possible for them to transfer the knowledge and skills so obtained to the staff and students as well as the host community.

FM1 said that, "It will also be nice if we could be taken to workshops, in order for us to have a wider understanding of what the green campus is about. I believe that this will assist us in coming up with other better ideas in greening campus buildings."

Sharp (2002) concluded that one of the key mechanisms to achieving successful GCI is to have a continuity in improving the learning curriculum regarding the initiative. Furthermore, the interviewees added that raising awareness of the initiative through conducting greening programs and having small activities would be of future benefit for future greening activities.

CONCLUSIONS

This exploratory study set out to explore the level of awareness as well as the perspectives of stakeholders on the GCI in South African HEIs. It is one of the first studies being presently conducted to have an understanding on how various stakeholders within the comity of South African HEIs.

Adopting a qualitative multi-method case study, this study commenced by conducting interviews, to have an insight from the stakeholders. However, the study has two limitations: firstly, data could not be broadened to encompass the pre-selected South African HEIs, and; secondly, documents were not reviewed, as no formal permission was not given by the HEI. Data emanating from the qualitative sources was thematically analysed based on the pre-set categories.

The preliminary findings highlight the participants' level of knowledge, awareness and acceptance of the GCI concept; the degree of participants' participation in the

initiative; the participants' perception of the GCI's significance and; the identification of GCI implementation impediments.

This study is still on-going. It is expected that once the data collection and analysis has been completed, the findings would be used to assist in identifying the factors that influence the implementation of the GCI and the factors that contribute to the achievement of GCI in South African HEIs.

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AN ASSESSMENT ON THE CURRENT STATUS OF BUILDING INFORMATION MODELLING POLICIES AND STANDARDS IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

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Building Information Modelling (BIM) has been a valuable method used around the world in all the built environment industries. It has changed the building project development process, procurement method, management and project delivery in construction projects in the past 25 years globally. With this concept, not being new in South Africa, questions are asked why it has not been implemented completely. The concept of BIM is known to enable improved collaboration between disciplines involved in a construction project. The technology itself is not new, similar approaches have been adopted in the automobile and the aircraft industry. Currently there are limited studies that have been done with regards to the lack of BIM policies and standards in the South African construction industry. The aim of this study is to investigate the status of BIM policies and standards adoption and implementation in the South African construction industry. Furthermore, identify if there are globally used policies and standards that can be implemented in the South African construction industry to help increase the rate of BIM implementation. The research adopted the positivism philosophy and deductive approach. A survey research strategy was used, and data was also collected using a small-scale survey with structured questionnaires. Responses were obtained from a sample of 23 industry professionals, especially Architects and Engineers. The choice for the selection of these two professionals is that they hold the largest influence during a projects design phase. The outcomes show that the implementation of BIM in the South African construction industry still lags and there is significant lack of BIM policies and standards, hindering professionals from using benefits of the digital method. The deductions from literature highlighted that the construction industry is fragmented and the main issues that were identified in the industry revolved around high cost and ineffective time management. This study shows that the lack of BIM policies, and standards largely affect professionals involved in the design stage of construction projects.

Keywords: Building Information Modelling, policies and Standards, Construction Industry, South Africa

INTRODUCTION

Building Information Modelling (BIM) has been adopted all over the world by numerous countries with assistance of implementing through legislation (Smith, 2014). The effective implementation of BIM remains a huge issue for the construction industry globally. The technology supporting BIM has been around for well over a decade (Smith, 2014). The implementation of BIM has been relatively slow compared to other industries such as the manufacturing and engineering (Navendren et al, 2014).

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Over the past decades, live projects have been documented in Scandinavian countries which include Sweden, Norway and Denmark. Most of the western based countries have been capable of using more BIM products in ways that can sustain a construction project life cycle (Arayici, 2011). Consistent BIM policies and standards are very necessary for the South African construction industry. There are different systems that exist in the industry, but the BIM approach ensures collaboration during the development of a construction project (Smith, 2014). To ensure that collaboration occurs at a project level through BIM, government and built environment authorities need to develop common policies and standards for the South African construction industry. The key to this is making use of the industry foundation classes which is a vendor neutral format that allows models to be used independently for specific software (Smith, 2014).

The implementation of BIM in the South African construction still lags behind and the lack of BIM policies and standards hinders professionals from utilizing benefits of the digital method. The deductions from literature highlighted that the construction industry is fragmented and the main issues that were identified in the industry revolved around high cost and ineffective time management. This study shows that the lack of BIM policies, and standards largely affects professionals involved in the design stage of a construction project. Therefore, this paper will draw comparisons and look at successful developments of the implementation of BIM policies and standards globally and look at how they can be implemented in the South African construction. Professionals which hold the most influence in the design phase are Architects and Civil Engineers. This is due to their fundamental decisions during the design phase. This study investigates the status of BIM policies and standards adoption and implementation in the South African construction industry. To achieve that, next two sections review relevant literature to BIM use and standards in the world vs. South Africa.

BIM IN THE WORLD VS. SOUTH AFRICA

After the encounter of the global economic crisis, the government of the United Kingdom (UK) realized the need of having an industry that is more efficient and flexible (Wolstenholme et al, 2009). The Government Construction Strategy (GCS) has been influential on encouraging the UK government to adopt a measure that ensures a sustainable construction industry (Cabinet Office, 2011). One of the main issues that have been faced in the UK is the full adoption of the collaborative BIM method (Eadie et al., 2013). The UK government has presented a BIM implementation strategy that has been considered the most advance central driven BIM programme (HM Government, 2012). The strategy has influenced the construction industry as firms have started developing necessary technological programmes that meet standards that are required (Smith, 2012).

The General Services Administration (GSA) of the United States (US) has been the main driver of BIM implementation on public projects. The construction operation and the federal facilities operation based in the USA are taken charge by the GSA. The GSA has developed a vast number of standards that include the National BIM standards which is recognized worldwide. As a client of the public sector, the GSA has had a huge influence on the adoption of BIM which clearly demonstrates innovative leadership in the global construction industry (Building Smart Australasia, 2012). The Chinese construction industry is still in the early days of BIM adoption. It was discovered that through BIM based surveys that 58 out of 388 companies that

were part of the investigation used BIM method (McGraw-Hill, 2014). The commenced of this investigation was to gain a full understanding about the Chinese construction industry and their perception of BIM (McGraw-Hill, 2014). It was acknowledged that contractors adopted the BIM method faster than design professionals (Natspec, 2014).

The implementation of BIM in South Africa has been lagging due to numerous barriers. The most prominent barrier to the development of the digital technology in South Africa is the lack of governmental and legislative support (Wortmann et al, 2016). There are three identified categories that are known to hinder the progress of implementation of BIM in the South African context, the barriers are as follows; legal and contractual barriers, technological and technical barriers, and human barriers (Kekana et al., 2014). The South African construction sector currently has no mandated BIM standards and specifications (Kekana et al., 2014). BIM in South Africa was introduced around 2004 (Kotze, 2013). South Africa is less mature when it comes to exposure of using BIM products. Projects that have fully adopted BIM products are not increasing at an exponential rate (Kotze, 2013). A few examples of projects that have adopted BIM products and methods were the Mbombela stadium construction project based in Mpumalanga and the Nelson Mandela Bay stadium project (Kotze, 2013). There is an inadequate demand from public and sector to make BIM a mainstream technology (Kekana et al., 2014).

The main challenge encountered by the South African construction industry is the poor management of information which is making it a highly inefficient production industry (Kekana et al., 2014). One of the main strategies that have been depended on is the involvement of government and professional bodies to enforce the implementation of BIM standards and policies for construction projects (Kekana et al., 2014). Next section, discusses the importance of having such strategies in form of policies and standards.

BIM POLICIES AND STANDARDS

The construction industry is one of the many industries that are resistant to change. Amidst all the technological advancements taking place in the construction industry, the South African construction industry is still largely dominated by the traditional methods of project delivery. Though BIM has been adopted by certain South African construction firms its adoption is not that of a collaborative nature, because it is being utilized in a detached environment. This isolated use of BIM is mostly performed by architects for the design stage of a construction project (Froise & Shakantu, 2014). Many consultants in the country do not know the true benefits of BIM and 4D planning (Kassem, Brogden and Dawood, 2012). In a case study it was found that barriers to the implementation of BIM were identified and rated using a scale of 1 to 5; strongly disagree to strongly agree respectively (Stanley and Thurnell, 2014). In the table below the identified barriers are highlighted;

Table 1. Barriers to BIM implementation and their significance

Barriers	1	2	3	4	5
Lack of software compatibility restricts its use.			2	3	3
The setup cost inhibits its use i.e. software, training and hardware costs.			2	4	2
Increased risk exposure discourages companies e.g. legal issues		2	3	2	1

such as ownership of BIM models.					
Cultural resistance in companies hinders its effectiveness.		2	2	1	3
Incompatibility with industry recognised element formats for cost planning prevents companies from adopting the software) e.g. the NZIQS Elemental Analysis of Cost of Building Projects”).	1	3	1	3	
Lack of integration in the model decreases the reliability and effectiveness of 5D (e.g. Arch./Eng./MEP designers are not all working off the same model).	1	1	3	1	2
Lack of protocols for coding objects within BIM models by designers hinder the development of cost modelling using BIM (e.g. lack of complete specification information in BIM models inhibits accurate quantity generation for estimating).		1	1	3	3
Some companies feel their current software meets their needs, so see no need to change.			2	2	4
Some companies feel their current software meets their needs, so see no need to change.		1	3	3	1
The fragmented nature of the industry limits the potential of BIM.	1	1	1	4	1
Lack of an electronic standard for coding BIM software to Standard Methods of Measurement limits the potential of BIM for cost modelling.			2	2	4

The organizational support from professional bodies is inadequate, thus BIM implementation is hindered. If professional bodies can't ensure and enforce that their registered members are able to uphold policies and standards, then they won't abide by such policies and standards. Lack of supportive strategies for BIM adoption brings forth ineffectiveness in BIM implementation. In countries such as the USA and the UK, government mandates, policy frameworks have brought about an increase in BIM usage across their construction industries (Yan & Damian, 2013). Lack of effective regulatory authority that encourages the use of BIM has constraints in the success of BIM adoption in South Africa (Kiprotich, 2014). Companies are not eager to implement BIM as it is perceived as a very expensive form of technology that requires a lot of time and resources from the company for its implementation. Many construction companies in South Africa believe that their companies would need to allocate lots of time and resources to the BIM training (Yan and Demian, 2013).

The spread of knowledge and publicity of BIM in the South African construction industry is lacking. Clients and project managers look more at the projects current economic performance instead of following the implementation of standards (Wang, Zhang & King, 2016). It appears as if the South African construction industry is not eager to risk being at the forefront of the Building Information Modelling. If the method is not adopted in the current times and it can be quite costly soon (Kaber, 2010). Playing the catch-up game might appear as a better option but this can put the industry at some disadvantage as other countries will be advancing in terms of the development of BIM in projects. The gap at a later stage will be difficult or almost

impossible to close (Kaber, 2010). This paper highlights that there is a significant lack of BIM policies and standards to govern a faster BIM implementation in the South African construction industry. As such, the aim of this study is to investigate the current status of BIM in the South Africa construction industry and identify if there are globally used policies and standards that can be implemented.

The South African construction industry is moving at a snail's pace in the adoption of BIM. The digital method can provide a vast range of solutions to most challenges faced on construction sites such as policies and standards play a major role in ensuring that there is a faster rate of BIM adoption in the construction industry. Implementation of BIM Policies and Standards has been identified as a catalyst of making the BIM method a reality to the South African AEC industry. Due to the lack of standards and policies in the industry there hasn't been an effectively engaging adoption of BIM. The South African built environment sector could see its own paradigm shift and reap the benefits of using the BIM method when the governmental structures intervene and contribute in the advocacy of BIM adoption. Countries such as UK, USA and China have successfully implemented BIM. The presence of regulatory structures has been a huge driver in getting the construction industry professionals to adopt BIM. Lack of support strategies are a barrier to the implementation of BIM in South Africa. Regulatory authority will be in the form of government mandates and guidelines from professional bodies.

RESEARCH METHODOLOGY

The study utilizes the quantitative method. This method focuses on the subjective viewpoints of professionals, and social phenomena to obtain a statistically significant result. The research is centred on a small-scale survey with structured questionnaires. Responses from the structured questionnaires are analysed quantitatively. The target population is registered professional civil engineers and architects in the construction industry. This was decided on their high level of influence during the design phase of a project. A small-scale survey is therefore ideal for this research as the views of the target population are what we need for data analysis.

The research utilizes the deductive approach. Assumptions from the deductive approach are generated from existing theories; these developed theories are then used to test these assumptions (Silverman, 2013). A similar method was adopted by (Hyde, 2000) as they conducted a formal deductive strategy to formulate their quantitative data. The use of Qualtrics made the process of formulating and sending out structured questionnaires efficient and effective. A similar process of utilizing simple online surveys was conducted by Gardezi, et al., (2014) and Navendren, et al., (2014) where they used online questionnaires to identify challenges surrounding BIM. Furthermore, in a paper by (Becerik-Gerber et al., 2012) they also conducted an online survey to assess the status of BIM usage. The snowball sampling method will be utilized, and it requires less planning and is not time consuming.

The population from the research is narrowed down to two registered professionals, the architects and the civil engineers. These professionals are found under the following professional bodies: South African Institute of Architects: SAIA, South African Council for the Architectural Profession and the South African Institute of Civil Engineering, The Constructional Engineering Association (CEA). Professionals that are registered to the respected bodies and must hold more than five years of work experience in the South African construction industry. The population consists of registered professionals who are in the Gauteng province.

Next section presents the analyses and findings of this study.

ANALYSES AND FINDINGS:

This section starts with the presentation of study participants' profiles, followed by current level of BIM adoption in South Africa. Then, it looks at participants' viewpoints on significance of BIM adoption in the South African construction industry, and then existing barriers to that.

Industry Professional profiles:

A 44 % (23 of 52) response rate was achieved in the questionnaire which was sent out. The division of Architects to Civil Engineers is 39.13% and 60.87% respectively. The number of industry professionals was fair as many were reluctant to respond due to their company's reputation. The geographic for respondents were all from Gauteng as specified in our research design. Assessing the working experience of industry professionals, majority were spread out at the extremes of a standard deviation curve, (9 of 23) had less than 5 years' experience and (9 of 23) had 10 years or more. This gave us a wide spread of experience levels which gave more of a rounded response to the questions.

Current adoption of BIM:

Current usage of BIM in the construction industry was highlighted in all stages of the SACPCMP 6 stages of construction but majority in the design phase which was 31.25% of participants. This shows that the design phase is where majority of the usage of BIM is occurring and thus if there were policies and standards in place, there would be an eradication of the hindrance which is preventing complete utilisation of BIM.

An even spread of results across projects of different sizes was recorded. Of the 23 respondents, 7 had used BIM on small projects, 8 had used BIM on medium projects and 8 had used BIM on Large projects. This even spread illustrates that BIM is currently being used across multiple sizes of projects in the South African construction industry.

A question posed to the participants about their perception of their role in the implementation of BIM was intriguing. According to 60.87% of professionals, they believe that they do not play a major role in the implementation of BIM.

Significance of BIM policies and standards:

When it comes to the South African construction industry it was discovered that in literature the construction sector is still lagging behind in the adoption and implementation of BIM policies and standards (Froise & Shakantu, 2014). The study conducted in this paper was meant to address what industry professionals think about the adoption rate of BIM policies and standards and how significant it is to develop BIM policies and standards in South Africa. From the 23 responses captured, it could be noted that 60% of the respondents believed that it is significant for South African professionals to adopt globally accepted BIM policies and standards. This tends to show that industry professionals are aware that the adoption of international BIM policies and standards is a very important aspect which can be considered and be reviewed for adoption by regulatory bodies existing in the construction sector. Almost 60% of respondents pointed out that it is significant for the South African construction industry to have BIM initiatives that will support the adoption of BIM policies and standards. From the questionnaire that was released, 40% of industry professionals

from the 20 that responded revealed that the actions of an industry professionals are significant when it comes to supporting and increasing the implementation rate of BIM and 35% found it extremely significant. Figure 1 below shows a summary of the significance ratings of questions posed to participants in relation to BIM policies and standards implementation. The most significant columns to highlight would be column two and three.

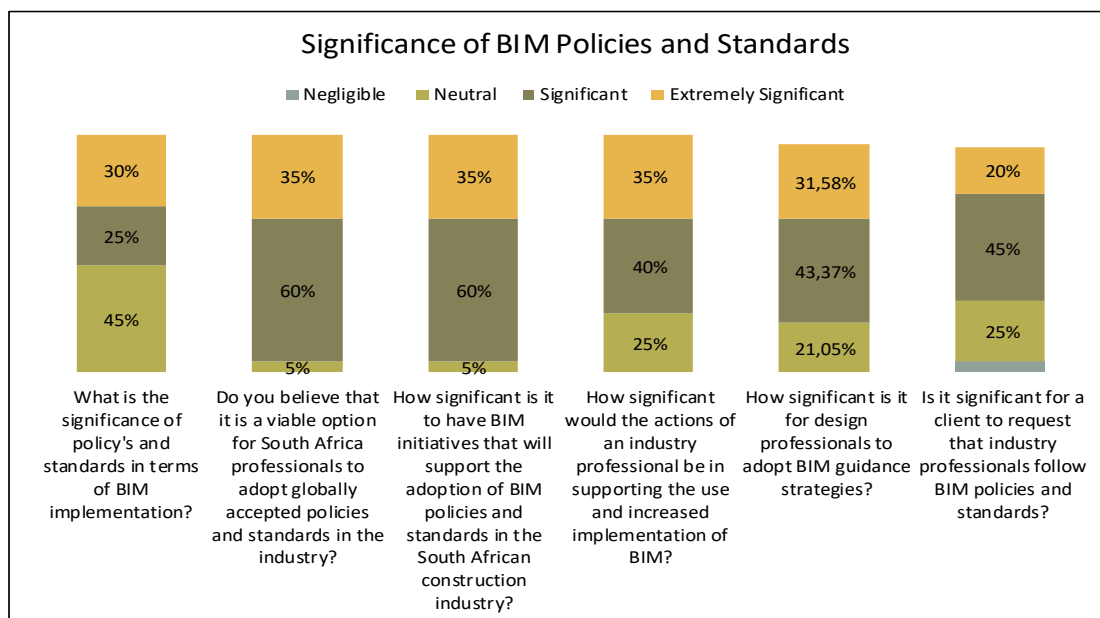


Figure 1: The significance of BIM Policies and Standards in the implementation of BIM

Barriers affecting BIM policies and standards implementation:

The slow implementation of BIM in the South African construction industry is due to various barriers, a list of barriers was given to respondents, for each barrier they had to state if they have encountered any of the barriers and they also had to state the extent to which the given barriers affect BIM adoption in the construction industry. Lastly the respondents were given an opportunity to state more barriers that they thought contributed to the slow adoption of BIM in South Africa.

The main barriers identified were the perceived high start-up costs, cultural, social and habitual resistance, inadequate organizational support, lack of a regulatory authority, inadequate research and training, lack of BIM database and little knowledge on financial benefits of BIM. In the Figure 2 below, it illustrates the participants' views and opinions on which barriers they felt were most hindering to the implementation of BIM policies and standards. The most significant barriers to highlight would be; Cultural, social and habitual resistance to change (column 2) and Inadequate research and training (column 5) as seen below.

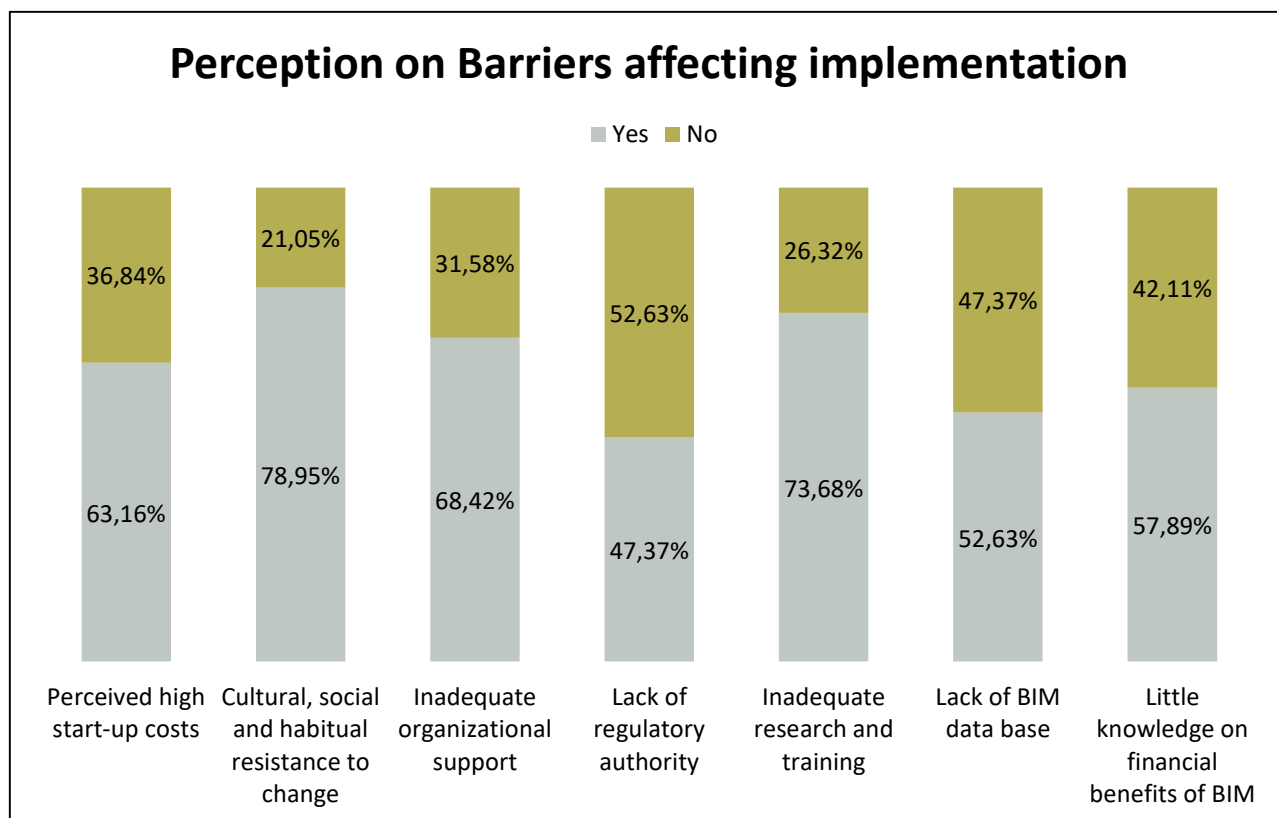


Figure 2: Barriers to the implementation of BIM Policies and Standards

DISCUSSIONS AND CONCLUSIONS

The general understanding from professionals who responded is that they agree that there are lack of policies and standards in the South African construction industry and furthermore agree that if there were such policies and standards in place for BIM usage that it would ensure improved implementation. In section 2.3.4, it was identified that countries that had regulatory standards and policies in place, had BIM dominating their construction industries and looking to develop it more. This trend of policies and standards having such a large influence on the implementation of BIM is why here in South Africa it is vitally important that such policies and standards get implemented and enforced.

An article by Wortmann et al (2016) pointed out that BIM policies and standards should be developed by government regulatory bodies, professional bodies, research committees and non-profit organisations. It was learnt that existing international BIM policies and standards cannot be duplicated due to the reason that countries have different challenges and they also have different aspects when it comes to policies, construction methods, design processes and procurement procedures (Wortmann et al., 2016). However, the international BIM standards and specification can be used as reference point to learn from when it comes to the implementation of BIM protocols. BIM in South Africa has no mandated standards and policies, but the country has been advised to take a step of adapting to the UK context in order develop a conceptual framework (BIM institute of South Africa, 2015).

The analyses of data from respondents showed that industry professionals are aware of the BIM concept and they also supported the adoption of BIM guidelines for design professionals. For South Africa to achieve the implementation BIM, a number of challenges and barriers are required to be solved first. Private sector companies and

organisations have already started utilizing some of the aspects of BIM. Government is recommended to develop a strategy that will promote the usage of BIM in infrastructural projects.

It is highly recommended that future studies focus on clarification and comparison of existing policies and standards easing BIM implementation in the world. It is also recommended to review existing South African policies and standards to find out their shortcomings to do with enhancing BIM implementation.

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THE FUTURE ROLE OF A QUANTITY SURVEYOR IN SOUTH AFRICA

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The quantity surveying profession is facing irrevocable and fundamental change arising from technological innovation and the automation of professional work. Referred to as the 4th industrial revolution, this change is both radical and transformational for the profession. This study seeks to understand this change so as to provide models of the future role of the quantity surveyor in the construction industry in South Africa through scenario planning. A review of literature proposes Geels's multi-level perspective (MLP) as a conceptual framework to understand revolutionary socio-technical transitions in industries and sectors. Scenario planning is reviewed as a methodology to investigate how the quantity surveying profession is currently constituted and the capacity of the current systems and structures within the profession to manage the envisaged changes. The findings reveal that there is consensus that the professions are going through change and this change will also impact on the quantity surveying profession. MLP is a suitable way to conceptualise fundamental change and the impact on the multi-levels of institutions. Scenario planning is an appropriate methodology for the QS profession to engage with and understand the challenges that the profession will face as a result of these socio-technical changes. MPL and scenario planning are useful in understanding change in the quantity surveying profession. They can be applied to understand change in other professions and institutions.

Keywords: Quantity Surveying, Profession, Multi-Level Perspective, Change, Scenario Planning.

INTRODUCTION

Quantity surveyors have evolved from “brick counters” to being regarded as highly skilled professionals in construction costs and contractual issues within the construction industry (Llale, 2015). Current technological innovations in the construction industry are threatening the existence of the profession in its current state. Some of the newer technologies have the potential to replace some of the core functions of the quantity surveyor. If core quantity surveying functions are replaced by new technologies what will the future role of quantity surveyors be? The study highlights the evolution of the quantity surveying profession in the past and the forces that have impacted its evolution and those that are likely to affect it in future. It also advocates for the application of multi-level perspective (MLP) as a conceptual framework for understanding revolutionary socio-technical transitions. Socio technical transitions incorporates changes not only in technology but also in associated markets, user practices, policy and cultural meaning (Geels, 2004). Scenario planning is proposed as a methodology best suited for projecting the future role of quantity surveyors in the construction industry.

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THE FIRST INDUSTRIAL REVOLUTION AND THE EMERGENCE OF THE QUANTITY SURVEYING PROFESSION

The first industrial revolution (1750-1850), which begun in Britain, is regarded as a period of fundamental change in the history of the world (Berg & Hudson, 1992). Society transformed from being agrarian to industrial. Machinery and factories accompanied by urbanization were some of the hallmarks of that era. There was an emergence of many professions including the quantity surveying profession. In fact, industrialisation is associated with professionalisation. Marxists purport that industrial capitalism influenced the development of the professions (Susskind & Susskind, 2017).

Henry Cooper and Sons of Reading, the first quantity surveying firm, was established in 1785 in the United Kingdom. Before 1859 “quantity surveyors” were called “measurers”, “custom surveyors” or “surveyors” (ASAQS, 2014a). Quantity surveyors were initially employed by tradesmen or builders to determine the cost of the building works before being directly employed by the building owners (Rashid, Mustapa & Wahid, 2006; Maritz & Sigle, 2016).

Tradesmen or builders employed their own quantity surveyor, who measured quantities and estimated the cost of works from the drawings prepared by the architect (Graham, 2010). As a cost reduction measure, tradesmen decided to employ one quantity surveyor, who measured the works and estimated the cost of the works, instead of each builder having his own quantity surveyor. The cost of the quantity surveyor was shared among the tenderers (ASAQS, 2014a; Maritz & Sigle, 2016). The document that quantity surveyors used to compile quantities and to solicit tenderers was called the bills of quantities (ASAQS, 2014a).

What Winch (2010) refers to as the “professional system” in the construction industry was firmly entrenched by the 1860’s that, ‘...no reputable builder would tender unless quantities were supplied by a recognized quantity surveyor [and] the taking out of quantities required very full working drawings and specifications from the architect’ (Summerson, 1973 p. 13 in Winch, 2010). One of the fundamental features of the professional system is the selection of the contractor based on the lowest priced tender following a competitive tender process. The driving force behind the selection lowest tender is the the client’s desire to obtain the best deal (Winch, 2010).

The second industrial revolution and the quantity surveying profession

The second industrial revolution took place between the period of 1860 and 1900. The period was characterised by rapid inventions of new technologies, including electricity. However, there was little change in productivity levels mainly because of manufacturers’ affinity and vested interest to old technologies (Atkeson & Kehoe 2001). It was during this period that the quantity surveying profession was introduced to South Africa through British architects as a result of the discovery of diamonds and gold in 1870 and 1886, respectively. South African quantity surveyors adopted the London system of measurement and issued quantities. After the Anglo-Boer war (1899-1902) and the establishment of the Union of South Africa in 1910, investment in the construction industry in South Africa increased. This resulted in increased formalization of the construction industry and the convergence of methods and practices with that of the UK. The professional body promoting the development of the quantity surveying profession was the Transvaal Society of Quantity Surveyors

(ASAQS, 2009). The South African Council for the Quantity Surveying Profession (SACQSP) is currently the jurist person mandated by the Quantity Surveying Profession Act, 2000 (Act 49 of 2000) to regulate the profession.

The third industrial revolution and the quantity surveying profession

The 3rd industrial revolution is estimated to have begun in the 20th century in the 1970s. The main characteristic of the third revolution is that production became digitally automated through electronics and information technology (Bloem, Van Doorn, Duivenstein, Excoffier, Maas & Van Ommeren, 2014). Social change was influenced by "...intelligent mechatronics that automate a part of the brain" (Kunii, 1997).

In a report published by the Royal Institution of Chartered Surveyors (RICS) in 1971, the work of the quantity surveyor was described thus; "...ensuring that the resources of the construction industry are utilised to the best advantage of society by providing, inter alia, the financial management for projects and a cost consultancy service to the client and the designer during the whole construction process." (RICS, 1971 in Ashworth, Hogg & Higgs, 2013).

The construction process involved quantity surveyors preparing estimates of approximate estimates based on the architect's initial designs. Once the estimated cost was accepted by the client, the architects would develop their designs further. From the architect's designs, quantity surveyors would prepare bills of quantities for tendering purposes. During the construction period interim payment would be issued based on the bills of quantities. On completion of construction a final account was prepared. In this process referred to as the measure and value system, the quantity surveyor performed what is regarded as his traditional role (Ashworth et al., 2013). Most quantity surveyors in South Africa still practice the measure and value system today.

One of the disadvantages of the measure and value system is that it is fragmented and litigious mainly because contractors and sub-contractors are not involved in the design stage of the process (Cartlidge, 2006). In this system contractors' claims for additional payment are common (Ashworth et al., 2013). As a result, there has been a need to change this system. Other factors that have necessitated the evolution of the quantity surveying profession in the UK has been, changes in the markets, globalisation, changing client needs, privatization and public private partnerships. Investment appraisal, whole life costing, value management, facilities management and programme management are some of the tasks that were added to the quantity surveyors as a result of the evolution (Cartlidge, 2006). However, in South Africa, the measure and value system remain largely unchanged. Politics, the economy and construction technology, particularly the introduction of steel and concrete in construction (ASAQS, 2009; Maritz & Sigle, 2016), have had a major influence on the evolution of the quantity surveying in South Africa.

However, both the second and third industrial revolution merely caused the automation of certain functions and procedures of the quantity surveyor. The profession was able to change and adapt to the demands made upon it by these changes (Ashworth et al., 2013). However, the fourth industrial revolution is set to revolutionize the profession in that new technologies have the potential to replace the quantity surveyor.

The influence of the fourth industrial revolution on the professions

According to Brynjolfsson and McAfee (2014), we are currently living in an era where digital technologies are going to enhance and bring revolutionary change in society like the steam engine steam did in the in the 18th century. They argue that machines “...will in the near future diagnose disease more accurately than doctors.” This view is also supported by Susskind et al. (2017) who claim that professionals underperform in their duties and in future their services will not be needed in the manner and method they are currently discharged to society. Undoubtedly the quantity surveying profession will also be affected by this wave of change.

Quantity surveyors have been amongst the first in the construction industry to embrace technology such as spreadsheets, word processing and bill production software to perform some of their duties more efficiently (Cartlidge, 2006). Building information modelling (BIM), is currently causing the construction professionals to have a fresh look at the manner and methods they use to provide their services.

BIM is described as, “...a rich information model, consisting of potentially multiple data sources, elements of which can be shared and be maintained across the life of the building from inception to recycling (cradle to cradle). The information model can include contract, specification properties, programming, quantities, cost, space and geometry” (NBS in Ashworth et al., 2013).

Kulasekara, Jayasena and Ranadewa (2013) argue that BIM has the potential to transform every aspect of the construction industry including the construction professional functions and boundaries. Table 1 shows some of the traditional tasks of a quantity surveyor they claim can be replaced by BIM.

Table 1: Traditional quantity surveying tasks vs BIM alternatives (Kulasekara et al., 2013)

Traditional Quantity Surveying task	BIM alternatives to the traditional QS tasks
Quantities take-off	Autodesk QTO, BIM Measure from Causeway
Bills of quantities preparation	CostOSTM, Nomitech
Cost estimation	DProfiler, Beck Technology
Cost planning	Vico Cost Planner
Cost reporting	Vico Office Client
Cost control	Vico Office Explorer
Material procurement	Quantities of material can be obtained using BIM tools
Payment application	Bentley
Value management	BIM tools can be used to obtain the estimated costs of various design options
Life cycle costing	Integrated Environmental Solutions Virtual Environmental

Bills of quantities forms a very important part of the quantity surveying profession in South Africa even though bills of quantities' usefulness in the UK has declined (Rashid et al., 2006). However, the process of bills production is time consuming and error prone. Errors associated with data transfer from one file to the other, missing taking off elements and double accounting are common (Baldwin & Jellings in Kulasekera et al. 2013). BIM can potentially reduce this risk associated with such errors. Ashworth et al., 2013, claim that by using BIM, bill production time can be reduced by as much as 80%.

Other technological changes in the construction industry that have the potential of changing the quantity surveying profession include; standardization and offsite construction, the use of common ICT and information-sharing platforms (e.g. Common Data Environments), automation and the use of robots, 3D technology (3D printing of buildings) and new/smart construction materials (Harty, Goodier, Soetanto, Austin, Dainty & Price, 2007). These technological changes have the potential to cause a decrease in skilled labour as robots and some technology can perform some of the work that humans do even better in terms of quality and speed. ICT and information sharing platforms can potentially result in a blurring of professional lines. On the economic side the construction industry can expect; 1) pressure for a more profitable, efficient and competitive construction industry, 2) globalization, a consolidated and defragmented construction industry; 3) a wider use of whole-life costing, and 4) Public Private Partnerships (PPPs) and Private Funds Initiatives (PFI) (Harty et al., 2007).

Thus, the fourth industrial revolution has the potential to fundamentally change the organization and structure of the construction industry and upset the current roles of its professionals on an order of magnitude of the first industrial revolution which led to the disappearance of the master builder. Although the second and third revolution brought some changes in the construction industry, the changes they brought were evolutionary. They did not disrupt the status quo in respect of the underlying socio-technical process. In contrast fourth revolution has the potential to bring transformational change. It will disrupt the status quo. The type of change envisaged will affect the construction industry and its professional at their core.

Ways of looking at revolutionary change

To try and understand how this change will unfold, it is necessary to look at how such technological changes can be conceptualised. While there are other ontologies to look at change, such as conflict theory, functionalism and symbolic interactionism, the multi-level perspective (MLP) framework provides a more comprehensive perspective for understanding multi-dimensional complexity of transitions in socio-technical systems (Geels, 2010). The multi-level perspective arranges the analysis of transition into a socio-technical system that comprises of three heuristic levels; niches, regimes and landscapes (Smith, Vob & Grin, 2010; Geels, 2005). Technological niches form the micro-level where change originates. In the construction industry, the actors in niches are made up of individual professionals, firms, researchers, etc. Socio-technical regimes form the meso-level and the macro-level is formed by a socio-technical landscape (Geels, 2005). The socio-technical regimes refer to institutions that regulate the activities of the industry such as the Councils for the Built Environment (CBE), the Engineering Council of South Africa (ECSA), SACQSP, policies, standards, norms, etc. The socio-technical landscape refers to the technology-exogenous environment factors such as the macro socio-economic and political factors. The three

levels are independent of each other even though there may be elements of co-evolution. Change takes place when there is interaction between the three levels (Geels, 2005).

Geels (in Van Ewijk, nd) defines MLP thus; "...the multi-level perspective (MLP) is a middle-range theory that conceptualizes overall dynamic patterns in socio-technical transitions. The analytical framework combines concepts from evolutionary economics (trajectories, regimes, niches, speciation, path dependence, routines), science and technology studies (sense making, social networks, innovation as a social process shaped by broader societal contexts), structuration theory and neo-institutional theory (rules and institutions as 'deep structures' on which knowledgeable actors draw in their actions, duality of structure, i.e. structures are both context and outcome of actions, 'rules of the game' that structure actions). [...] The MLP views transitions as non-linear processes that result from the interplay of developments at three analytical levels: niches (the locus for radical innovations), socio-technical regimes (the locus of established practices and associated rules that stabilize existing systems), and an exogenous sociotechnical landscape (Rip and Kemp, 1998; Geels, 2002, 2005 in Van Ewijk, S, nd)."

Geels (2005) refers to the relationship between the niches, regimes and landscape as a "nested hierarchy" where regimes are set within the landscapes and the niches within the regimes. There are four phases of transition in a multi-level perspective framework. The first phase involves the emergence of innovation in the niches. The second phase occurs when the innovation is used in technical specialization in a small market niche. The third phase occurs when there is a breakthrough in the new innovation that involves wider application and competition with the incumbent regime. The fourth phase occurs when the new innovation replaces the old regime. The new regime may influence the socio-technical landscape to change. From an MLP perspective, transitions are non-linear and unpredictable (Geels, 2005). Figure 1 illustrates how transition takes place in a MLP framework.

The current changes taking place in the construction industry are unprecedented, uncertain and involve various stakeholders. They will require a multi-level perspective framework to fully comprehend and prepare for.

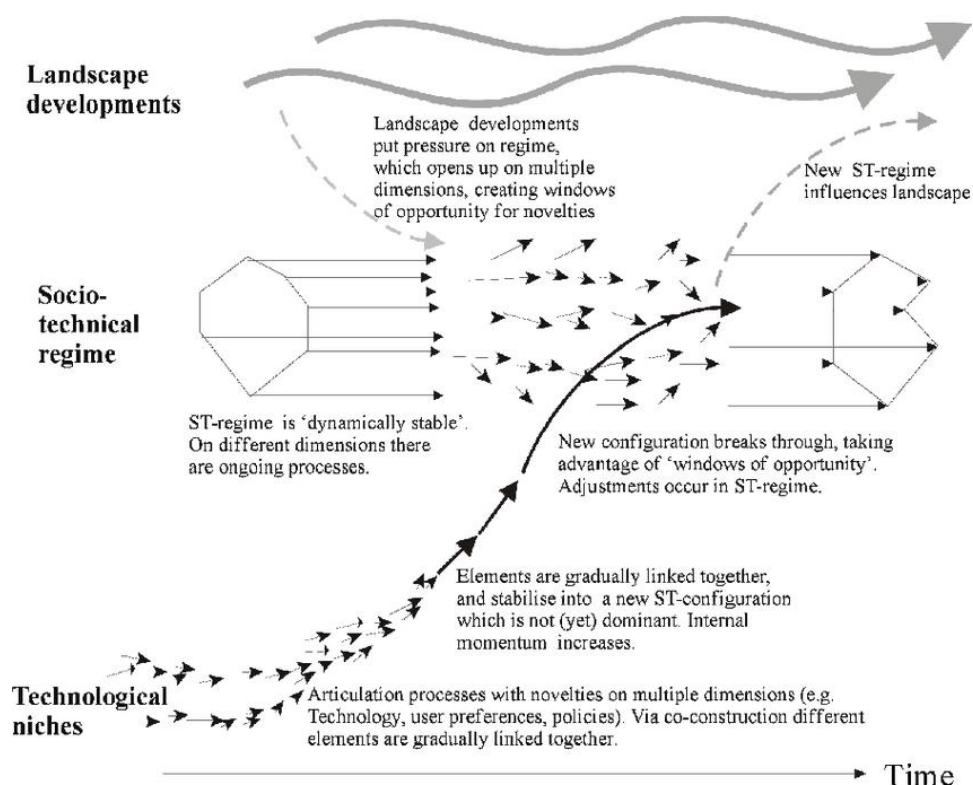


Figure 1: Multi-level Perspective (Adapted from Geels, 2005).

Exploring the MLP through scenario planning

Scenario planning is one of the methodologies used to project or predict the future in future studies. Future studies are described as “...a field of studies, focusing on a methodical exploration of what the future might be like” (Forward Thinking Platform, 2014). Since the future in unknown methodologies for studying the future differ from conventional scientific research methodologies. The conventional research methodologies rely on existing data or on data that can be generated, which future studies do not possess (Groff & Smoker, 1997).

Some of the main methodologies utilized to project or predict the future include; trend extrapolation, technological forecasting; Delphi technique, and scenarios. Trend extrapolation is concerned with studying past trends and projecting them into the future with the assumption that the future will, to some extent, resemble the past. Technological forecasting seeks to predict future technological changes including when they are likely to happen (Groff & Smoker, 1997). The Delphi technique is a method of obtaining and sifting expert opinions about a probable future or preferred future (Dalkey 1967, Brown 1968 in Lang ,2001; Groff et al., 1997). Rialland and Wold (2009) define scenarios as;” ...structurally different stories about how the future might develop, that are believed to have an impact on the field/businesses on focus.”

Shoemaker (1991) claims that scenarios as a preferred research methodology are most useful where; 1) the level of uncertainty is high and cannot be predicted, 2) significant change in the industry has occurred or is about to occur, 3) there have been too many costly surprises in the past, 4) fewer new opportunities are identified and created, 5) strategic planning is poor in quality, 6) there are differences of meritorious opinions about the future, a common framework and language is sought and 7) where competition is using scenarios.

Trend extrapolation cannot produce reliable forecasts for medium to long range future because they provide a single-figure forecast. The level of uncertainty within this single-figure forecast is usually difficult to estimate. Scenario planning on the other hand provides multiple scenarios that attempt to bind inherent future uncertainties in multiple scenarios. By observing 1) causal relationships, 2) prevailing trends, 3) the behavior of key stakeholders and 4) internal consistency, multiple scenarios about the future are developed (Shoemaker, 1991).

According to Goodwin and Wright (2001), even though scenario planning lacks the theoretical and axiomatic underpinnings of other decision-aiding tools such as decision analysis and statistical forecasting it has a number of advantages over them. One of its advantages is that it precludes the need to estimate probabilities and thus avoids biases associated with subjective probabilities (Goodwin & Wright, 2001). The presentation of future scenarios as stories makes them likable, conversational and memorable (van der Heijden, 1994 in Goodwin et al., 2001; Chermack, 2004)). According to Chermack (2004) scenario planning can potentially address four core causes of unexpected decision failure; "...1) bounded rationality, 2) the consideration of exogenous and endogenous variables, 3) information stickiness and knowledge friction, and 4) mental models and decision premises."

In scenario planning the future is not a singular concept but a plural concept. Scenario planners seek to identify a number of equally plausible futures, usually two to four different futures. Scenarios are developed through a five-step methodology. Firstly, by identifying what the client wants to know within a specific time frame. For example, what are the long-term implications of BIM on the quantity surveying profession? Secondly, every economic, social and political factor that might influence that question are identified. Thirdly, trends in the socio-economic and political trends are grouped into groups of related major trends. The fourth step involves ranking the trends according to their likely impact on the question at hand and its associated uncertainty. The ranking is done using a two axes graph. In the fifth step possible sudden shifts in trends are identified by plotting the trend of the highest impact against the trend of the greatest uncertainty (Cronje, 2017).

Scenario planning compels stakeholders to consider both exogenous and endogenous variables and forces that are impacting or might impact an organization or profession (Chermack, 2004). Given the multiple trends that are currently having an impact on the quantity surveying profession a single future forecast of the future quantity surveyor will not assist the profession to adequately prepare for the future as the future is not singular but plural. There are at least more than one plausible futures for the quantity surveyor and thus scenario planning provides a useful methodology for projecting its future.

CONCLUSIONS

There is enough evidence to suggest that the construction industry and its professionals are on the brink of fundamental change that will require proper understanding and preparation. Unless the envisaged changes are properly understood, analysed and prepared for the envisaged inevitable change will leave many casualties. Hence a multi-level perspective framework and scenario planning are recommended for understanding the change and preparing for it.

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COMMUNITY'S PARTICIPATION IN THE DELIVERY OF PUBLIC INFRASTRUCTURE PROJECTS

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This study attempts to identify the extent to which community participation influences project delivery in public infrastructure projects. A review of literature focussed on the major journals and conference proceedings in the spectrum of construction project management and business management. The principles of stakeholder management have been adopted as a body of knowledge by most traditional project methodologies such as Project Management Body of Knowledge (PMBOK). The aspiration of stakeholder management is to allow public participation in public projects so as to allow an effective decision-making process in a form of collaborative engagement. Communication and collaborative engagement of parties having interests in the projects maximises the chances of attaining Critical Success Factors (CSF) of projects. Despite the rise in public participation there seems to be no formal mechanisms and processes resulting in satisfactory results. The structures and mechanisms in place allows public consultations however, the important public options are sometimes not incorporated into decision-making process and execution by the project team. The findings are indicative that most public infrastructure projects are not successful due to inappropriate stakeholder management strategies. Other areas of the built environment like urban development Planning have changed approaches in project delivery by active participation of the community during the conceptualisation stages of the projects. The active participation yields some improvements in the way projects are delivered and increased the success rate of the projects.

Keywords: Stakeholder Management, Community Participation, Public-Infrastructure projects, Urban Development Planning

INTRODUCTION

The nature of construction projects is that they are made up of temporary teams of professionals consisting of consultants working on behalf of clients, contractors and subcontractors. The professional teams are regarded as the internal stakeholders and they are responsible for all direct activities within the project. The stakeholders that are not directly linked to the project are called external stakeholders and they normally consist of suppliers, municipal authorities, communities, end-users, and others. Both external and internal stakeholders influence the project's success depending on how influential they are on the project.

All the stakeholders needs to be managed so that the project objectives can be successfully met. Since Stakeholder Management forms part of the body of knowledge for project management, a proper stakeholder management plan should be in place in order to manage all the stakeholders that have interest in the project. If a proper stakeholder management plan is in place there can be minimal incidences of

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conflicts arising from project stakeholders and leading to success of the project (Mandják and Szántó, 2010).

Construction projects are found to be unique and consisting of many internal and external stakeholders with different levels of interests and their active participatory roles on projects (Egan, 1998). The stakeholder theory by Freeman (1984), recommends that project managers should incorporate policies and strategies that engage all stakeholders and respond to their needs in an inclusive, all-encompassing manner.

Aim and objectives of the study

The aim of the study is to determine how community participation affects the delivery of public infrastructure projects. This will be achieved through the following objectives:

1. To explain the relationship between stakeholder management and community participation.
2. To find out on how project success is affected by community participation.
3. To evaluate how traditional project management methodologies influence the extent of community participation in public infrastructure projects.
4. To bench mark with Urban Development Planning on how community is engaged during the activities at planning stages.

REVIEW OF LITERATURE

Socio-economic contributions by the construction industry

The construction industry is one of the worldwide contributor to employment generation to most economies (Alhowaish, 2015) and these skills range from technical and non-technical skills as well as trained and untrained labour .The industry contribute significantly towards the economic growth of Gross Development Products (Khan, 2004) . The contribution to growth of the economy is also towards the formal and informal sector of the country's GDP. (Alhowaish, 2015). The contribution of the construction industry to the growth of economies is due to the fact that it involves many stakeholders and as well as linking different economy sectors (Hillebrandt, 2000).

Stakeholder Management

The theory of stakeholder management gained momentum when Freeman (1984) defined the stakeholders as the individuals or groups of individuals who can lead in influencing the outcomes of the organisation or co-operation's purpose. The application of stakeholder management theory in construction projects classifies the stakeholders as internal and external stakeholders (Leung and Olomolaiye, 2010). Over the years the theory evolved, and as Phillips (2003) declares, the theory of stakeholder management involves individuals who are responsible for decision-making in the organisation, as well the individuals who will benefit once the decisions have been made.

The principles of stakeholder management have been adopted as a body of knowledge by most traditional project methodologies such as the Project Management Body of Knowledge (PMBOK) and Project Management Professional (PMP) for a long time (Eskerod et al 2015).

Construction projects are found to be unique and consisting of many internal and external stakeholders with different levels of interests and their active participatory roles on projects (Egan, 1998). The stakeholder theory by Freeman (1984), ascertain that project managers should incorporate policies and strategies that engage all stakeholders having interest on projects so that it enables to satisfy the needs of all stakeholders having interest in projects. Construction projects are divided into phases of initiation, planning, construction and closeout, and within all the phases there are interactions, negotiations and collaborations of different stakeholders either being directly or indirectly involved in the project (Winch 2010).

Construction stakeholders play a crucial role in projects, which can either lead to the success, or even failure of a project (El-Nayway et al, 2015). It is, therefore, important to manage stakeholders so that Critical Success Factors (CSF) in a project are attained. In most construction projects the critical success factors include working within budget, meeting expected quality standards and completing the projects with the expected time frames (Belout and Gauvreau, 2004). Despite the measure of traditional factors such as time, cost and quality, (Cooke-Davies, 2002) argues that there seems to be wide range of variables that can be considered CSF, depending on how the project team perceives them.

The studies reveal that there is a high concern about communication management and mutual understanding about project objectives and goals by stakeholders (Toor and Ogunlana, 2009). They argue that improper communication and lack of mutual understanding by stakeholders have a negative effect on other critical success factors. Molwus et al (2017) state that it important to understand the critical success factors of a project and match them with stakeholders that will have an interest in each factor. In so doing it will enable the person responsible for stakeholder management to assign and create a logical and structured process that should lead to meeting critical success factors.

Stakeholder list can also consist of indirectly linked individuals such government departments, environmental societies, community or political parties having interest on the projects even though they are not directly involved in the projects (Wadenpohl, 2015). Leung and Olomolaiye, (2010) identifies other external stakeholders such as the media, labour organisations, nationalised industries and suggest that it is crucial to identify these stakeholders at early stages of the project and determine the interests they have in the project. They can constitute influential forces, which can later affect the processes which are used to deliver the project. The project management team should have mechanisms in place to satisfactorily involve the external stakeholders in participating in the project so that the project meet success. In so doing it will enable the person responsible for stakeholder management to assign and create a logical process that leads to meeting critical success factors.

The other important stakeholders that are perceived to be important in construction projects are end-users (Windapo and Goulding, 2013), furthermore the end users are mostly the community in which the projects is developed for. The end users normally play a critical role in housing projects where they demonstrate the acceptance of the product and finding value within the end product (Afolayan 2003).

Community Participation

Some developing countries, like China, have seen an increase in active community participation in infrastructure and construction projects. This increase in community participation was due to the socio-economic and environmental issues affecting those communities (Chan, 2014). Even though there seems to be a rise in public participation in developing countries like China there seems to be no formal mechanisms and processes resulting in satisfactory results (Li et al, 2012). Although the structures and mechanisms in place allow public consultations, important public options are sometimes not incorporated into decision-making processes and execution by the project team (Chan, 2014).

Enserink and Koppenjan, (2007) suggest that the intensification of public participation is to allow an effective decision-making process by allowing collaborative engagement with the internal and external stakeholders having an interest in the project. Therefore, community participation falls under the umbrella of stakeholder management within the body of knowledge for project management. Arnstein (1969) mentions that the concept of public participation was adopted by the developed countries in order to improve the livelihood of their citizens as well as cater for environmental hazards that the projects can pose. Sanoff (2000) avers that the developed countries enabled the community to take part in public project as a democratic tool to show inclusivity in the decision making process. It is stressed by Enserink and Koppenjan (2007) that inclusivity in public participation leads to delivery of a successful project with good governance and minimal disputes. It is evident that construction projects tend to be held up due to poor and improper stakeholder management.

In the South African context there have been instances of housing projects where beneficiaries reject the houses due to the dissatisfaction of the community (Turok, 2001; Windapo and Goulding, 2013). The beneficiaries of the houses tend to complain about both the delivery process and the house units (Jay and Bowen, 2011). Mawela et al (2016) highlights that there have been instances where the public had displeasure in delivery of certain infrastructure projects due to non-participation of the public even though the projects had the good intensification of providing sustainable services to the public.

Emerging trends of community participation

In the field of Urban and Development Planning, the emerging trends tend to have a different approach when it comes to community engagement. The planning trends have shifted from the traditional planning where the professional urban planners impose the designs on the community, towards the more participatory and open approach where the community forms part of team that drives the process of planning (Foth, 2009 et al). This planning process takes into consideration the socio-cultural systems and trends within the community. Castel (2004) and Graham (2004) report that information and communication technology have played a crucial role in actively involving the communities to take part in the planning of the communities and shaping up the cities.

The current theoretical frameworks in the field of Urban and Development Planning (UDP) have changed the approaches adopted in planning processes (Ertio, 2015). There seems to be a shift from the traditional planning process where the community is imposed planning on how they can use the land and cities rather the approaches have moved towards the inclusive planning processes where the community is actively taking part in the planning activities and processes (Stewart and Lithgow,

2015). The community engagement processes adopted by UDP have even developed participatory mobile applications that the community can use to actively engage and contribute to the decision making process (Ertio, 2015).

CONCLUSIONS

The traditional project management methodologies can create tension in the delivery of public infrastructure projects in terms of the way stakeholder management is perceived by the project team as compared to the by the community. The tension arises due to a possible clash of worldviews between technocratic management practices in project management and the community development grounded theories and practices. It seems that community participation and stakeholder management in traditional project management practices do not address the community participatory role in the view of social-cultural development perspectives.

Community participation in public infrastructure projects forms an essential aspect of stakeholder management. The success of engaging community participation is evidenced in the new approaches adopted by the Urban and Development sector, which can give lessons to the construction industry to learn. The process and approach adopted by the Urban and Development planning sector can assist the construction project management methodologies to re-think the extent and the ways in which the community is participating in public infrastructure projects is viewed, especially where the community becomes the end user in the final product. It is suggested that the project management methodologies and approaches should align with a much more community participatory approach rather than the prevailing technocratic approach where the main critical outcomes for the success of the project is limited to purely technical criteria, rather than a community's real needs.

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DEVELOPING A HUMAN FAILURE FRAMEWORK IN CONSTRUCTION USING THE TRAINING WITHIN INDUSTRY METHOD

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People produce human failures through unsafe acts and conditions that yield accidents. To remove human failures in construction, a lean tool called 'Training-within-Industry' (TWI) method is used to frame the solution to the problem. This paper proposes a conceptual framework that could help people to identify and eliminate failure in the form of errors and violations on project sites. The existing literature on the impact of human failure and the TWI method facilitated the development of a conceptual framework. The framework highlights how the TWI method could help practitioners to eliminate human failure that result from poor safety management system (SMS) governing construction sites. The framework could be implemented to train people regarding the knowledge and skills they need to eliminate errors and violations in the industry. However, the conceptual framework is yet to be assessed with real time construction data. The assessment of the framework will determine its adaptability in the construction industry context.

Keywords: Accidents, Construction, Human Failure, Training within Industry Method

INTRODUCTION

The nature of construction projects influences the method of construction. In a typical construction project, project teams often experience challenges. For example, Yorio and Wachter (2014) explained that the construction industry is a complex system where the basis of failure can be traced to management and the organizational aspects that influence workers' actions and decisions.

Human failures are produced by people in the workplace. People are considered hazardous due to their unsafe acts and conditions that often produce incidents and accidents on construction sites (Emuze, 2017). In construction, accidents could be traced to a systematic failure linked to people at different organizational levels (Awwad et al., 2016). Accidents are complex and comprises of either proximal factors (including behaviour / unsafe acts by the workers and leaders) or latent factors (by management, organization, or decision maker) (Manu et al., 2017). In most cases, accidents happen because of the physical or mental unsuitability of people. Unsuitability involves a lack of attention or carelessness, and lack of appropriate training, and supervision (Reason, 2008; Misiurek and Misiurek, 2017).

In an industrial workplace, workers may avoid or reduce incidents and accidents if their employers address the subjects of human performance in the SMS of the project (Yorio and Wachter, 2014). Perlman et al. (2014) state that the issue of poor SMS can be improved if employers or management could develop models for tackling hazards and risks on construction sites. The models would assist workers to better understand

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that human failure often leads to incidents and accidents which affect SMS of a project negatively (HSE, 2017). However, anecdotal evidence from practice and the construction management literature shows the impact of human failure in the construction industry. To overcome this dilemma, Huntzinger (2016) as well as Misiurek and Misiurek (2017) propose the adoption of the TWI method. The TWI method is a training programme designed to teach management and supervisors the knowledge and skills of instructions, methods, and relation in an industrial workplace (Huntzinger, 2016; Misiurek and Misiurek, 2017).

HUMAN FAILURES IN THE CONSTRUCTION INDUSTRY

Failure in the industries comes as disagreeable surprises and do not belong to the system. Dekker (2014) explains that errors are introduced to the system through the inherent unreliability of people. According to the study by the HSE (2009), human failure can be described as an unplanned action that leads to incidents and accidents. Accidents in the labour-intensive driven industries such as the construction industry are unexpected. Such an industry is rated as high-risk when compared to other industries (Asanka and Ranasinghe, 2015). There are several factors, which could lead to human failures. For example, human failures in construction could be linked to management actions or inactions, unsafe acts of workers, non-human related events, and other hazardous conditions on sites (Emuze, 2017).

The construction industry is not a friendly environment because construction work is carried out in a hazardous or dangerous environment. The industry exposes people to various accidents in different conditions, resulting in minor, and major injuries, and even fatalities (Asanka, and Ranasinghe, 2015). It is notable that the biggest challenge in the construction industry lies with the fact that occupational injuries, fatalities, and illnesses are not mostly recorded within the industry (Manu, et al, 2017). For example, the direct causes of many incidents and accidents are often the outcome relating to the unsafe acts of people in construction; also, these acts can be influenced by latent failures that are remote in time or position from the incidents (Manu et al., 2017). Reason (2008) explains the influence of unsafe acts by stating that an act does not need to be either an error or violation for it to turn out to be unsafe for the workers. Accident are caused by multiple factors due to the complex connection of numerous system failure (human and non-human (organizational) (Holden, 2011).

The employers' and employees' attitudes and behaviour negatively influence the status of safety system in a workplace (Nielsen, 2014). Manu et al. (2017) argue that there is an excessive amount of evidence showing that human values affect the behaviour of workers and that little is done to improve their behaviour. For example, workers are often motivated or pushed to their limits by management, with the purpose to achieve a higher level of productivity (Perlman et al., 2014). High production demand from management influences the extent of fatigue experienced by workers. In turn, fatigue could expose people to hazards.

In most cases, accidents happen because of activities deviate from the plan of action. The different types of human failures commonly experienced in the labour-intensive driven industries are highlighted in Figure 1.1.

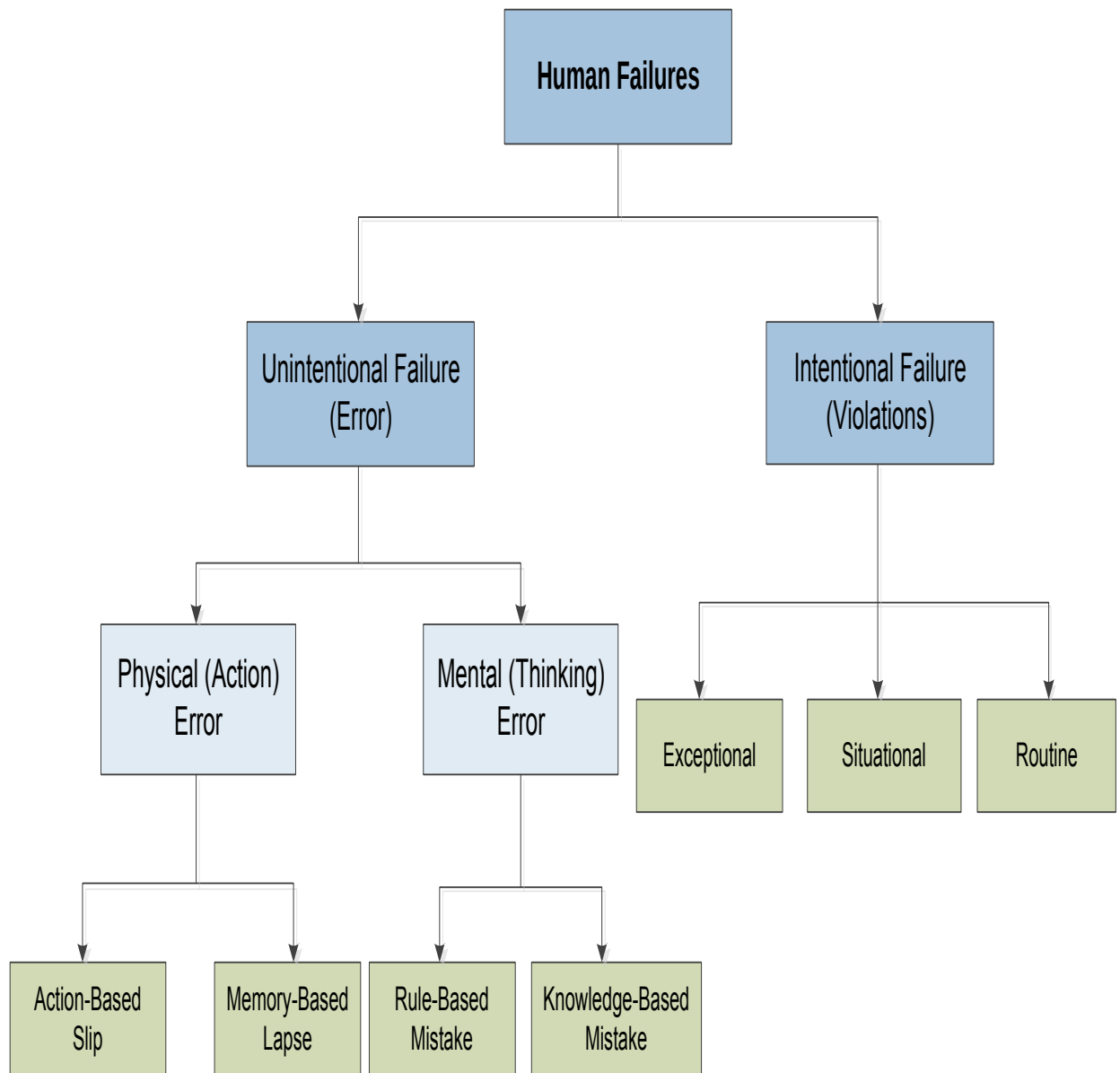


Figure 1: Types of human failures (adapted from HSE, 2009)¹

THE ‘TRAINING-WITHIN-INDUSTRY’ (TWI) METHOD

The conception of the TWI method dates to the 1940s when it was recognized by the National Defence Advisory Commission in the United State of America (USA). The rationale for introducing the TWI method was to increase manufacturing production output to support the Allied Militaries’ war strength (Huntzinger, 2016). The TWI method helped the Americans to improve productivity in the manufacturing industry

¹ Note:

- Unintentional failures (errors) (for example, slips, lapses and mistakes, action or decision which was not planned).
- Intentional failures (violation) (for example, routine, situational and exceptional, action or decision which was deliberate or planned).

as it guaranteed production of airplanes and weapons while working with people that had no work experience in manufacturing (Latijnhouwers and Berendsen, 2014). The TWI method is a historically well-proven methodology that has long been a hidden part of the Toyota Production System (TPS) (Huntzinger, 2016). The purpose of the TWI method was to help manufacturing industries in war time to meet manpower needs by Training within Industry each worker to make the fullest use of skill up to the maximum of individual ability, thereby allowing production to keep pace with demand (Huntzinger, 2016).

The implementation of the TWI method was focused mostly on training the production leaders, masters, foremen and experienced operators. Its objective was to acquire complete knowledge or skill in training employees, improve current working methods and maintain a good working relationship between the employers and employees in the manufacturing industries (Misiurek and Misiurek, 2017). The TWI method trains the production supervisors in the skills they need to build an environment of continuous improvement and standardization of work (Latijnhouwers and Berendsen, 2014). Huntzinger (2016) notes the four principles, which must be followed to optimize worker training. The principles include standards must be set, optimum instruction must be issued, continuing training must be the norm, and scheduling of training must be appropriate.

The philosophy of the TWI method promotes ‘learning by doing’ that implies solving production problems with the guidance of a properly trained instructor (Huntzinger, 2016). Between 1940 and 1945, the TWI method became universal in the manufacturing industries in the United States of America (USA) because it described the work of man (for example, construction workers' duties), not procedures (construction methods) (Misiurek and Misiurek, 2017). The philosophy of the TWI method is based on the five needs of a good supervisor illustrated in Figure 2. The need entails (Huntzinger, 2016):

- Knowledge of the work;
- Knowledge of responsibility;
- Skill in instructing (TWI IP);
- Skill in improving methods (TWI MP), and
- Skill in leading (TWI RP).

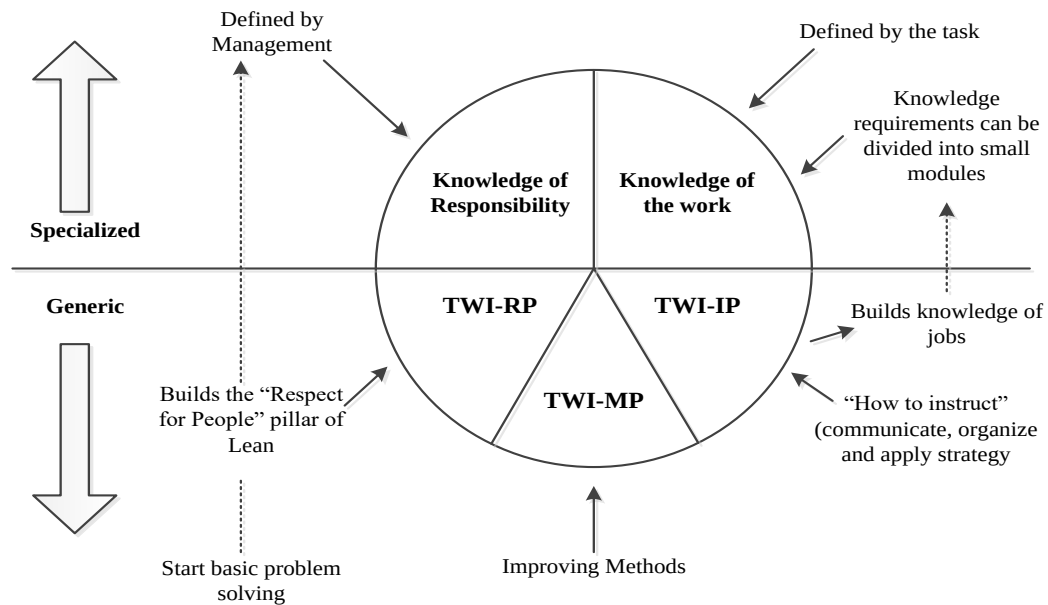


Figure 2: Training-within-Industry Framework (Adapted from Warren, 2015)

The TWI method can be described as the comprehensive method to transfer knowledge and skills to employees (TWI IP), building good relations between employees (TWI RP) and improving working methods (TWI MP) (Sinocchi, and Bernstein, 2016). The philosophy of the TWI method is adopted in the manufacturing industry with the aim to reduce human failure by training the employees to reduce accidents and avoid hazards in the workplace (Misiurek and Misiurek, 2017). Misiurek (2016) reiterated the importance of the TWI method. He opined that the method would serve the interest of construction management as a discipline by using training to address human failure on the site.

THE CONCEPTUAL FRAMEWORK

Miles et al. (2014) state that a conceptual framework is a written or structured diagram that explains either graphically or in narrative form, the main study problem including the key factors, or variables and the speculated relationship amongst the key factors. The process of developing a conceptual framework starts with the research interest, and the gap the researcher wants to close (Ravitch, and Riggan, 2017). The research problem that is reported in this paper is that human failure leads to accidents in the construction industry as reported by Yorio and Wachter (2014). Furthermore, the sources of human failure could be traced to the unintentional failures (errors) and intentional failures (violations) of people (Reason, 2008). Unintentional failures relate to physical errors (causing the error one did not mean to cause), and mental errors (doing something wrong while believing it is the right thing to do). The intentional failures relate to errors which are created deliberately, taking shortcuts or failure to follow procedures (HSE, 2017; Reason, 2008).

The impact of accidents in the construction industry often do not have an effect only on the victims, but also everyone associated with the victims, and the project. Awwad et al. (2016) state that the construction industry should develop a SMS that would help to prevent injuries and accidents since construction risks are high in frequency and impact. It is evident that poor SMS caused by human failure is a problem within the industry (Misiurek and Misiurek (2017). Misiurek and Misiurek (2017 citing Leveson, 2004) state that accident blamed on human failures could be resolved because failures

are influenced by the organizational working culture related to management, workers, engineers and clients. The aforesaid influence the compilation of Figure 3, which is a graphical representation of a conceptual human failure training framework that is aimed at solving the problem reported in this on-going study.

The framework reinforces the idea that human failure in construction could be resolved and should not be blamed on individuals (Misiurek and Misiurek (2017)). The conceptual human failure training framework is an attempt to guide the construction firms on how to reduce or eliminate human failure using the TWI method. In the framework (Figure 3), the diagram emphasised that the working culture in an organisation is a fundamental root cause of the study problem. The organizational working cultures, decisions and actions often cause a systematic failure, which is connected to the human failure in the construction industry. The effect of human failure push either the intentional or unintentional failure, which pushes either the unsafe acts or unsafe conditions. When the unsafe acts or unsafe condition is pushed, they often produce accidents in the workplace. When accidents happen in the construction industry, it reflects negatively on the image and finance of involved parties to a project. Accidents also raises questions about SMS used in projects.

To solve this problem of human failure, this study proposes the adoption TWI method, which is a method derived from lean production. As an illustration, the construction managers (CM's) or supervisors should identify the problem (human failure). Thereafter, they should have the knowledge of work and responsibility regarding the impact of human failure in the construction industry. The CM's or supervisors must be trained and skilled on how to give instruction (job instruction (JI)). Thereafter, they must be skilled on how to improve the construction methods (Job method (JM)). Then, they must be skilled on how to build respect (job respect (JR)) for people in construction. In effect, the skills of instruction flow with the skill of methods and relations.

A good CM or supervisor must be able to adhere the following rules:

- Must be able to give good instruction to his/her workers;
- Must have a good relationship with his/her workers;
- Must be able to master the method of construction to avoid error during the construction processes.

Therefore, a good CM or supervisor should be able to promote “learning by doing”, which is crucial to the success of the implementation of the TWI method. Learning by doing is encouraged because it allows the workers to be taught how to do the work right in the workplace (on-site).

CONCLUSIONS

The aim of this paper has been to explore the role that a conceptual human failure training framework could play in identifying the human failure problem and steps which can be adopted to reduce or eliminate human failure in the construction industry. The literature reported upon in this paper supports the notion that human failure leads to incidents and accidents. For example, an accident can be traced to human behaviour observed in a construction operation. The often-cited cause of incidents and accidents in construction is the unsafe acts of the people working in the industry. The acts of people in construction can be influenced by both active and latent failures in a system. Figure 1 and 2 provides foundational thinking that

underpins the ideas espoused in Figure 3. Figure 3 illustrates the issues around human failures and how the industry can begin to re-imagine the required solutions.

The conceptual framework supports the notion that the ‘bad apple’ theory is counterproductive in safety (Dekker, 2014). For example, “telling people to be vigilant or observant on construction sites does nothing to remove probable causations on the site. In contrast, such ideas, when excessively promoted, promote ignorance about the actual problem”. This is the reason why in the framework, human failure is pulled from the organizational working cultures, not just the individuals working on construction sites.

The main thrust of the discourse in this paper is that construction practitioners should understand that a systematic failure connected to human failure must not be blamed on people working on construction sites alone, but on the organizational working culture.

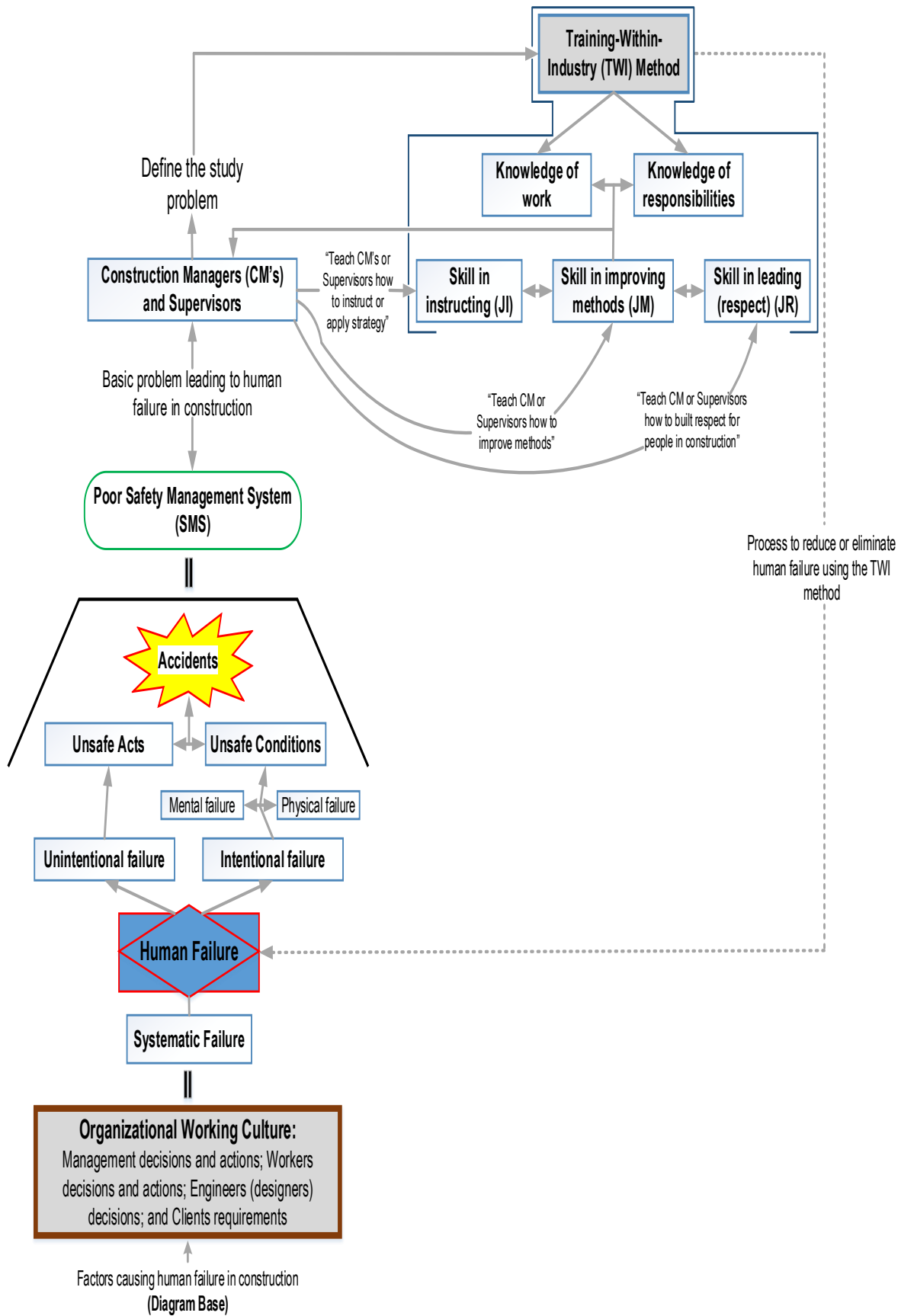


Figure 3: A conceptual human failure training framework (Author, 2018)

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SUSTAINABLE CONSTRUCTION PRACTICES THROUGH ORGANISATIONAL INTERNAL FACTORS: A PILOT STUDY

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This paper presents an investigation of the level of agreement on the items proposed on a conceptual framework on the influence of organisational culture and organisational structure in achieving sustainable construction practices with organisational resources as a moderating effect. A pilot study was carried out to investigate the level of agreement on the items proposed to measure each construct as a means towards the validating the conceptual study. Data were analyzed with the use of the Statistical Package for the Social Sciences (SPSS) version 18. The result shows that 87% of the measuring items were tending towards strongly agree. The finding may be considered in the context of organisational theories and managerial insights about the influence of organisational internal factors in achieving sustainable construction practices.

Keywords: organisational culture, organisational resources, organisational structure, pilot study, sustainable construction practices.

INTRODUCTION

The construction industry has impact on the environment, economy, and society (Kucukvar & Tatari, 2013; Onat et al., 2014). The business environments in which the construction companies operate also improve productivity (Smol et al., 2015). Construction professionals in South Africa have expressed that the efforts being made to encourage green construction have not been satisfactory (Windapo, 2014). The dissatisfaction is as a result of the failure of the industry to embrace sustainable construction practices towards achieving construction sustainability (Bamgbade & Babatunde, 2017). Consequently, this incapacitates the sector to compete in the global market favorably (Bowen et al., 2013). Previous research projects have pointed out the role of South African government in enforcing construction professionals to implement sustainable practices because of the increasing requirement for resource efficiency and climate change (Murray & Dainty, 2013; Kibert, 2016). Notably, the studies by Millar et al. (2012) and Wolf (2013) investigated the perception of how organizations deal with sustainability challenges and the extent to which sustainability practices are embedded in the organizational structure. These two studies recommended the involvement of employees to moderate the relationship between organisational structure and sustainability to some extent. The culture that developed in an organization can function as stabilisers to stimulate sustainable change (Bennet et al., 2014; Cameron et al., 2014). For instance, the ways an organization conducts business and treats its employees, customers and broader community towards common objectives can lead to sustainability (Chhokar et al., 2013).

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Central to the preceding discussions are four constructs which have received attention among the existing studies and they include: organizational culture (Chhokar et al., 2013), organizational structure (Csaszar, 2013), organizational resources (Leonidou et al., 2013), and sustainable construction practices (Kibert, 2016). This present study is a follow-up to an earlier study (Bamgbade & Babatunde, 2017), which has developed a conceptual framework on the relationships among these four constructs. Consequently, the aim of this pilot study is to investigate the level of agreement on the items proposed to measure each construct as a step towards the validating the conceptual study. The objective is to validate the conceptual framework on the influence of organisational culture and organisational structure in achieving sustainable construction practices with organisational resources as a moderating effect.

LITERATURE REVIEW

Sustainable construction practices are different in various countries and depends on how the concept of sustainable construction is developed (Ogunbiyi et al., 2014). These practices involve the design, construction, and operation of high- performance green buildings and encompass architecture, engineering, and construction as well as all aspects of the green building process, from materials selection to building systems (Kibert, 2016). Contractors in the construction industry are increasingly being forced to implement sustainable practices because of increasing requirement for resource efficiency and climate change (Tan et al., 2011). There are internal and external variables constituting the force. Organizational internal factors are internal variables which the organization can control, review, and improve upon (Glennie & Lodhia, 2013). Internal factors rely on the theories of entrepreneurship and organisation with the specific focus on dynamic capabilities, network, organisational learning and knowledge management (Dlugoborskyte & Petraite, 2017). Prior research studies have consistently identified organizational culture and organizational structure as the most important among the internal factors that influenced sustainable construction (Zheng et al., 2010; Fekete & Bocskei, 2011; Duke II & Edet, 2012; Chen & Chang, 2012).

This present study adopts the competing values framework (CVF) to measure the influence of organisational culture on sustainable construction practices. CVF provides for the clan, market, hierarchy, and adhocracy organisational culture (Cameron and Quinn, 2005). The transaction of each of this culture types is governed by the mechanisms namely, leader style, strategic emphases, bonding and dominant attributes as presented in Appendix A.

Organisational structure which is the second construct is a framework within which managers perform their tasks, and it depends on the environment (Herper, 2015). Environmental factors such as centralization and formalization explain the division of the task to every detail (Chhokar et al., 2013). Centralization is measured by the extent to which the chief executive involves others in crucial decision-making (Cosh et al., 2010). Formalization refers to the area to which rules and sanctions or penalties, roles, authority relations, the line of communications, norms and procedures are defined within an organization (Yang & Ng, 2015).

Sustainable construction practices involve the design, construction, and operation of high performance green buildings, encompass architecture, engineering, and construction, and detailed all aspects of the green building process, from materials selection to building systems and more (Kibert, 2016).

The organisational resources at a given time could be defined as those (tangible and intangible) assets which are tied semi-permanently to the firm (Caves, 1980). In this present study, organisational resource is conceptualized as transformational leadership style (Peteraf & Barney, 2003) and organizational learning (Grant, 2016; Greene & Brown, 1997). The transformational leadership is a process in which leaders and followers help each other to advance to a higher level of morale and motivation. Organizational learning refers to the process of improving actions of members in a firm through better knowledge and understanding (Fiol & Lyles, 1985). Based on this argument, there are four constructs, organisational culture, organisational structure, sustainable construction practices and organisational resources which have been developed into the framework presented in Figure 2.1.

Independent variable

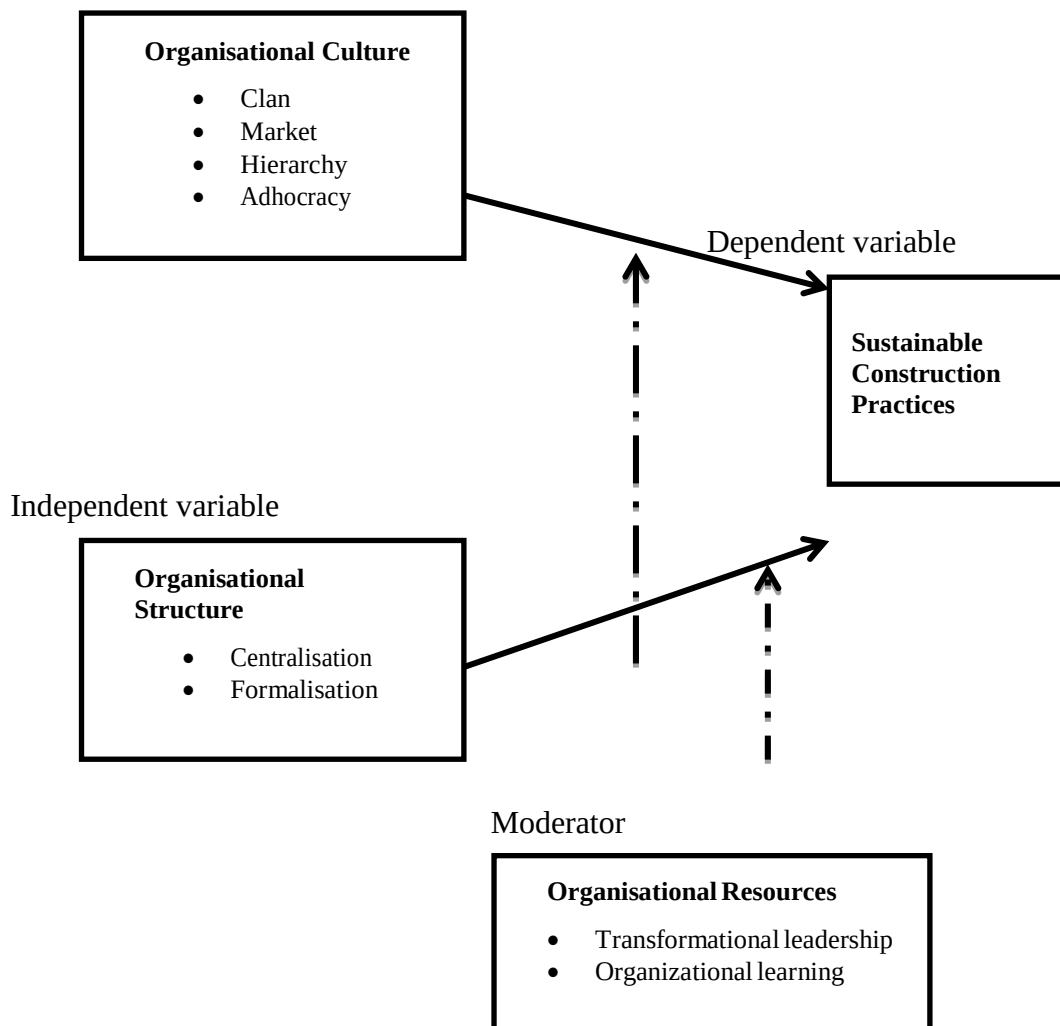


Figure 2.1: Conceptual framework (Adapted from Bamgbade & Babatunde, 2017)

Figure 2.1 shows the four relationships in the conceptual framework namely, the relationship between: (1) organisational culture and sustainable construction practices (2) organisational structure and sustainable construction practices and the moderating effect of organisational resources on: (1) the relationship between organisational

culture and sustainable construction practices (2) the relationship between organisational structure and sustainable construction practices. The level of agreement on the items proposed to measure each construct as a means of validating the conceptual framework is discussed in the data analysis section.

RESEARCH METHOD

Questionnaire

The structured questionnaire designed using the online platform consists of Likert scale questions on the level of agreement on the items. The list of items used to measure the agreement is presented in Appendix B. This scale is ranging from 1(strongly disagree) to 5(strongly agree with three as the mid-point which indicates the neutral agreement (Hartley, 2014; Wakita et al., 2012). The questionnaire consisted of two main parts, (1) the general information of the respondents and (2) the items to measure the four constructs presented in the conceptual model.

Reliability and validity

Reliability is a measure of the consistency of instruments when using a different point in time (Pallant (2013). A reliable instrument measures the same parameter over time and reflects of homogeneity of the questionnaire items in the constructs (Sekaran & Bougie, 2016). Cronbach's coefficient alpha measures the internal reliability. The recommended criterion is .7 for established scales and .6 for newly developed scales (Bonett & Wright, 2015; Bryman & Bell, 2015). Table 3.1 shows that the coefficient alpha for the 49 items used to measure the constructs developed in the conceptual framework exceeds .7.

Table 3.1: Reliability Level of Instruments

Cronbach's Alpha items	Number of
.827	49

Most research has focused on Cronbach's alpha coefficient (Cronbach, 1951) as the most popular test of inter-item consistency reliability (Bonett & Wright, 2015; Peterson & Kim, 2013; Tavakol & Dennick, 2011). However, studies have criticized Cronbach's alpha has being a lower bound (e.g., Boduszek et al., 2013; Bonett & Wright, 2015; Cho & Kim, 2015; Peterson & Kim, 2013). Composite reliability has become the alternative to coefficient alpha and calculation goes in conjunction with structural equation modelling (Hyland et al., 2015). For this pilot study and the time constraints, Cronbach's alpha coefficient is employed to measure the internal consistency of the instrument after running the data with the SPSS version 18.

Population and sampling

Pilot sample should be large enough to detect flaws in methodology (Eldridge et al., 2016; Henly, 2015; Hulley et al., 2013; Whitehead et al., 2014). Pilot study should be conducted with small sample size such as ten to one hundred (Bentley et al., 2016). If a research plan is to analyse data using statistics, a probability sample is needed (Babuscia & Cheung, 2012; Patten & Newhart, 2017). Thirty structured questionnaire were sent out to consulting firms namely quantity surveying, architecture, mechanical engineering, electrical engineering, civil engineering, and construction project management across the nine provinces of South Africa. The companies were selected

based on probability sampling technique where the targeted population of the consulting firms has equal and unbiased chance to be chosen as a subject in the sample (Sekaran & Bougie, 2017).

Response rate

Seven responses were received representing 20% response rate. Similar studies (e.g., Song et al., 2011; Zafar et al., 2013) recorded 20% response rate in pilot study. This response rate achieved is low because of the use of the online questionnaire. Few studies have shown that online surveys of construction professionals are low and probably declining, almost certainly leading to unknown levels of bias (Fowler Jr, 2013). In the main study, it is recommended that multiple strategies including email questionnaire, mailed questionnaire, online reminder, reducing relatively lengthy questionnaire and doubling of sample size should be used to increase the response rate (Schmidt & Hunter, 2014).

The general information of the respondents is provided in Table 3.2.

Table 3.2: Profile of the respondents

No	Type of consulting firm	Years of professional registration	Academic Level	Province
1	Quantity Surveying	1-10	Honors	Gauteng
2	Architecture	11-20	Masters	Gauteng
3	Architecture	31-40	B.Tech	Western Cape
4	Architecture	21-30	Honors	Western Cape
5	Not stated	1-10	Honors	Gauteng
6	Not stated	Not stated	B.Tech	Gauteng
7	Architecture	21-30	B.Tech	Gauteng

DATA ANALYSIS AND RESULT

Data Analysis

The main objective of this study was to validate the four relationships in the conceptual framework of this study. The second part of the questionnaire collected data on the level of agreement on the items proposed to measure each construct as a means step towards the validating the conceptual study.

Sustainable construction practices

The test result in Table 4.1 shows that 8 out of 9 items (89%) were tending towards strongly agree and 1 item (11%) was neutral agree.

Table 4.1: The level of agreement on the items proposed to measure sustainable construction practices

Items for sustainable construction practices	Code	Mean	Standard Deviation	Variance	Count

Our firm has an active commitment technology and innovation	4.83	0.14	7
Our firm complies with sustainability legislation	4.67	0.22	7
Our firm promotes education and training on sustainability	SCP2 4.50	0.47	7
Our firm has a strong commitment to sustainable design before construction begins	SCP3 4.17	0.50	7
	SCP4	0.69	
Our shared vision for sustainability provides measurement and reporting	4.00	0.33	7
	SCP5	0.58	
Our firm has suitable organisational structure and operation to determine responsibilities, authority, lines of communication	3.83	1.81	7
	SCP6	1.34	
Our firm has appropriate organisational structure and process to establish the process and the resources needed to implement sustainable systems	3.83	1.81	7
	SCP7	1.34	
Our clients express interest in the sustainable building despite the potential increase in the initial cost.	3.67	0.89	7
	SCP8	0.94	
Our subcontractors have the technical understanding of the benefits of sustainable construction practices.	3.00	0.67	7
	SCP9	0.82	

Organisational structure

The test result in Table 4.2 shows that 4 items (57%) were tendering towards mostly agree, 3 items (43%) were tendering towards slightly agree.

Table 4.2: The level of agreement on the items proposed to measure formalized organisational structure.

	Code	Mean	Standard Deviation	Variance	Count
In our firm, I feel that I am my boss in most matters.	F1	3.75	1.68	2.82	7
In our firm, staff can make decisions without checking with any other person	F2	2.86	1.12	1.27	7
In our firm, how they work is done is up to the person doing involved.	F3	2.71	1.28	1.63	7

In our firm, employees can do as they please	2.43	2.24	7
F4	1.50		
In our firm, most employees make their own rules on the job.	1.86	0.98	7
F5	0.99		
In our firm, employees continually are being checked on for the rule violation.	1.57	0.53	7
F6	0.73		
In our firm, employees feel as though they are always being watched to see that they obey all the rules.	1.29	0.20	7
F7	0.45		

The test results in Table 4.3 shows that the entire 5 items (100%) were tendering towards slightly agree.

Table 4.3: The level of agreement on the items proposed to measure centralized organisational structure

Items for centralization	Code	Mean	Standard Deviation	Variance	Count
In our firm, there can be little	C1	1.71	0.70	0.49	7
In our firm, a staff member who wants to make his own decision would be discouraged.	C2	1.57	0.73	0.53	7
Any decision I make must have my boss's approval.	C3	1.57	0.49	0.24	7
In our firm, even small matters are referred to top management for final endorsement.	C4	1.43	0.73	0.53	7
In our firm, I should ask my boss before I do anything.	C5	1.29	0.54	0.20	7

Organisational culture

Organisational culture types based on the competing values framework is measure with each transaction mechanism namely leadership style, strategic emphases, bonding and dominant attribute.

The test results in Table 4.4 shows that shows that the entire 4 items (100%) were tendering towards mostly agree.

Table 4.4: The level of agreement on the items proposed to measure – leader style

Items for the leader style	Code	Mean	Standard Deviation	Variance	Count
The head of my organisation point is considered to be a mentor, sage, or father or mother figure	LS1	3.86	1.12	1.27	7
The head of my organisation is deemed to be a coordinator, an organiser, or an administrator	LS2	3.57	1.05	1.10	7
The head of my organisation is considered to be a producer, a technician, or a hard-drive.	LS3	3.29	1.58	2.49	7
		3.29		1.63	7
Our organisation is a very dynamic and entrepreneurial place. People are willing to stick their neck out and take the risk.	LS4		1.28		

The test results in Table 4.5 shows that the entire 4 items (100%) were tendering towards strongly agree.

Table 4.5: The level of agreement on the items proposed to measure strategic emphases

Items for the strategic emphases	Code	Mean	Standard Deviation	Variance	Count
My organisation emphasises permanence and stability. Efficient, smooth operations are essential.	SE1	4.29	0.70	0.49	7
My organisation emphasises human resources. High cohesion and morale in the firm are essential.	SE2	4.29	0.70	0.49	7
My organisation emphasises growth and acquiring new resources. Readiness to meet new challenges is essential.	SE3	4.00	0.76	0.57	7

My organisation emphasises competitive actions and achievement. Measurable goals are important.	SE4	3.71	1.28	1.63	7

The test results in Table 4.6 shows 3 out of 4 items (75%) were tending towards mostly agree and 1 item (25%) was tending towards neutral agree.

Table 4.6: The level of agreement on the items proposed to measure bonding

Items for the bonding	Code	Mean	Standard Deviation	Variance	Count
The glue that holds my organisation together is loyalty and tradition. Commitment to this firm runs high.	B1	4.00	0	0.00	7
The glue that holds my organisation together is the emphasis on tasks and goal accomplishment. A production orientation is shared	B2	3.71	0.70	0.49	7
The glue that holds my organisation together is a commitment to innovation and development. There is an emphasis on being the first.	B3	3.00	0.76	0.57	7
The glue that holds my organisation together is formal rules and policies. Maintaining a smooth-running institution is essential here.	B4	2.71	0.88	0.78	7

The test results in Table 4.7 shows that the entire 4 items (100%) are tendering towards mostly agree.

Table 4.7: The level of agreement on the items proposed to measure dominant attribute

Items for the dominant attribute	Code	Mean	Standard Deviation	Variance	Count
Our organisation is a very personal place. People seem to share a lot about themselves.	D1	3.85	1.12	1.27	7
Our organisation is a very dynamic and entrepreneurial place. People are willing to stick their neck out and take a risk.	D2	2.43	1.50	2.24	7
Our organisation is a very formalised and structural place. Established procedures considered govern what people do.	D3	2.43	1.50	2.24	7
Our organisation is a very production oriented. A primary concern is with getting the job done, without much personal involvement.	D4	2.33	1.65	2.43	7

Organisational resources

The test results in Table 4.8 shows that the entire 6 items (100%) were tendering towards mostly agree.

Table 4.8: The level of agreement on the items proposed to measure organisational resources (Transformational leadership style)

Items for Transformational leadership style	Code	Mean	Standard Deviation	Variance	Count
Our firm has leaders who can guide the employees on their	TL1	4.00	1.07	1.14	7

job					
In our firm, the management succeeds in motivating the rest of the company employees	TL2	3.71	0.88	0.78	7
In our firm, the management is always on the lookout for the opportunity for the organisation.	TL3	3.71	1.03	1.06	7
In our firm, the management always acts as the leading organisational force.	TL4	3.43	0.73	0.53	7
Our firm has leaders who can motivate the employees on their job.	TL5	3.43	0.73	0.53	7
In our firm, the management has a clear view of its final goals	TL6	3.29	1.16	1.35	7

The test results in Table 4.9 shows that the entire 6 (100%) items were tendering towards mostly agree.

Table 4.9: The level of agreement on the items proposed to measure organisational resources (Organisational learning)

Items for Organisational learning	Code	Mean	Standard Deviation	Variance	Count
Our firm promotes a learning culture	OL1	4.43	1.68	2.82	7
Our shared vision provides the focus for learning	OL2	4.29	1.12	1.27	7
Our firm has a strong commitment to learning.	OL3	4.29	1.28	1.63	7
Our firm promotes open-mindedness.	OL4	4.14	1.50	2.24	7
Members of the company management team act	OL5	3.57	0.99	0.98	7

as learning agent for
our firm.

Our firm proactively questions long-held way routines	OL6	3.29	1.48	2.20	7

CONCLUSIONS

The recommended minimum acceptable interrater agreement is 80% (McHugh, 2012). From the above the test results, 87% of the items proposed to measure the proposed constructs were tendering towards strongly agreement. Therefore, the items proposed to measure each constructs in this conceptual study are suggested to be reliable.

An empirical data from the representatives from 7 South African consulting firms suggests that the following findings: (1) 8 out of 9 items (89%) measuring items for sustainable construction practices are tendering towards mostly agreement and 1 item (11%) was neutral agreement, (2) 4 items (57%) measuring items for formalized structure were tendering towards neutral agreement and 3 items (43%) were tendering towards slightly agreement (3) the entire 5 measuring items (100%) for centralized structure were tendering towards slightly agreement, (4) the entire 4 measuring items (100%) for leader style were tendering towards slightly agreement, (5) the entire 4 measuring items (100%) for strategic emphases were tendering towards mostly agreement, (6) 3 measuring items (75%) for bonding were tendering towards mostly agreement and 1 item (25%) was tendering towards neutral agreement, (7) the entire 4 measuring item (100%) for dominant attributes were tendering towards mostly agreement (8) the entire 6 measuring items (100%) for transformational leadership style were tendering towards mostly agreement (9) the entire 6 measuring items (100%) for organisational learning were tendering towards mostly agreement.

One limitation of this study is that it focuses on internal factors. It is possible that external factors such as partners profile, profit managing, financial issues, sales, and marketing as well as customer demands (Shamsuzzoha & Al Kindi, 2016) might influence sustainable construction practices.

The implication of this study is that managers might be interested in finding other factors that might influence and moderate the achievement of sustainable construction practices. It is also crucial for managers to investigate the barriers and issues to implement effective sustainable construction practices. The finding may be considered in the context of organisational theory. Organisational theory suggests that organisations become more and more similar over time because the similar external organisational forces reward the similarity (Jepperson, 1991; North, 1991). It signifies those firms tend to take similar actions based on the similar organisational forces.

The findings in this study suggest at least two feature research opportunities. First, the comparisons of firms that emphasize sustainable construction practices but not integrate the influence of organisational culture and organisational structure as well as a moderating effect. Second, the model in this study can be extended to other firms performance measures as sustainable performance, similar to Serpell et al. (2013) that addresses the overall practices of the construction industry towards Sustainable Construction and Duke and Edet (2012) that address an association between

organizational culture and the performance of non-governmental organizations (NGOs).

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IMPLEMENTING EFFECTIVE COLLABORATION IN CONSTRUCTION THROUGH A BOTTOM UP APPROACH

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Change has been a byword of the construction industry over the last two decades. In most cases procurement strategy change has been spearheaded by government on public projects. This type of change focuses on practices without a corresponding change in culture. Using desktop research this review examines clients as agents of change as they are in a position to positively influence the construction industry through the manner in which they procure. A shift from procurement practices modelled after Principal Agent Theory to those modelled after Stewardship Theory would help enable this change. The findings provide insight into why client change is effective and highlight the importance of collaborative procurement. Practically this review encourages clients to be at the fore of change to encourage an industry culture with a focus on value and shared interests. Since the review provides a theoretical perspective, further empirical research could be conducted to delve into actual expert client inspired change.

Keywords: change, collaboration, culture, procurement

INTRODUCTION

The Construction Industry is an integral part of most global economies. Unfortunately it is regarded as a hostile environment that tends to create stakeholders who prioritise their interests above all else (Babic and Rebolj, 2016; Holley and Ben Farrow, 2012; Memon et al., 2015; Osipova, 2015; Van Marrewijk et al., 2014). This is exacerbated by industry characteristics such as the separation of the design phases from construction phase, the organisation of the construction process and the methods used for price determination (Ankrah et al., 2009; Stephen Barthorpe et al., 2000). These characteristics created a need for change within the industry

Detailed research has been conducted by various countries into ways of improving the industry. Most common is the United Kingdom (UK) report by Latham that emphasised the need for client involvement, partnering in projects and the use of relational contracts such as the NEC which emphasised working more collaboratively within the industry (Latham, 1994). Egan's report that was conducted a few years later also reiterated the concept of working together with a focus on government and major clients working to completely overhaul the industry (Egan, 1998). All in all, research has resonated with the theme of changing procurement in order to improve the industry.

The problem identified in literature is that successful change of the industry is at risk because in some instances it has been found that organisations are reverting back to the traditional procurement they know (Bowles and Morgan, 2016). This implies that change though implemented can be superficial (Gardiner, 2014) and driven by a need

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to qualify for tenders. The aim of this research was thus to determine how change can be implemented such that it has a more permanent impact in both organisations and industry.

RESEARCH METHODOLOGY

Desktop research was conducted using Web of Science (WOS). This choice was made based on the fact that WOS has a wide range of indexed scholastic journals from which good representations of metadata lists can be drawn. WOS also provides details of the Impact Factor meaning one can determine the strengths of chosen journals.

Using a list of approximately 525 articles that were downloaded into Zotero, the research keyed in on problems in the industry. Latent analysis determined these to include cost and time overruns, fragmentation and adversarial relationships. Most major problems were related to procurement and suggested solutions intimated that collaboration was a means of improving the industry. Focusing on procurement problems reduced the articles to 53. Collaboration thus became the content area and content analysis determined that two categories were present in terms of collaboration.

In these articles, collaboration was a content area and content analysis determined the presence of two categories. These were reluctance to change and changing of procurement practices. The theme that evolved from the latter category was that a different type of change needed to occur as changing only practices was not producing the desired change within the industry. From this theme latent analysis further produced the themes of attitude, values, beliefs and behaviour. These in a nutshell pointed to the fact that beyond practices, culture also needed to change to ensure a permanent type of change. This discovery then brought to the fore the fact that culture change is an undertaking best suited to clients who are also starting to have a wide influence within the construction industry.

EVOLUTION OF THE CONSTRUCTION INDUSTRY

Procurement is the process that creates, manages and terminates contracts making it in essence a process concerned with activities preceding and following the signing of a contract (Govender and Watermeyer, 2000). The inadequacy of traditional procurement methods has been a driving factor in the need for change in various construction industries globally (Stephen Barthorpe et al., 2000).

Traditionally, procurement in the construction industry is characterised by lack of trust and goal alignment between the client and vendor (Snippert et al., 2015). It is also through an extremely fragmented supply chain which is driven by lowest cost instead of maximum value (Thomas et al., 2002). Since the industry is also adversarial, tensions occur in the supply chain limiting the cohesion necessary for both efficiency and innovation (ibid).

Relationships among the stakeholders are at arms-length with self-interest being the norm in interactions (Sinclair, 2011). In a manner reflecting the principal-agent model, the client (principal) hands over responsibility for the project to a specialist (agent) who is supposed to create value for the client (Bosse and Phillips, 2016). While the agent should be trusted to act in the client's best interest they are considered opportunistic (Davis et al., 1997) and likely to act in self-interest. This results in a control oriented management style in projects (Giritli et al., 2006) which does not help in improving relationships.

History of the Construction Industry

The history of the UK's construction industry as depicted in Figure 1 is reflective of the process of change within construction industries. The industry shifted from the craft guilds of the middle ages that worked as a sharing collective (Epstein, 1998) with cultural cohesion (Thomas et al., 2002) to more fragmented relationships with a myopic focus on cost and short term goal attainment (Thomas et al., 2002) by the 19th century. This resulted in a loss of openness, trust, respect and the development of long term relationships all of which are essential for the strong cultures necessary for successful projects (ibid).

While change tends to be inevitable, the construction industry has managed to remain steeped century old practices (Babic and Rebolj, 2016). By the late 1980's, Design & Build which was originally intended for simple procurement matured into various design, build and management systems (Constructing Excellence, 2009). The lack of cohesion in the industry, preoccupation with lowest price (Babic and Rebolj, 2016; Osipova, 2015) and increase in levels of claim culture are what eventually led to the commission of the Latham and Egan reports which iterated the need for change in the industry.

The Collaboration angle

With the evolution of roles, clients are conscientious of the need for more collaborative attitudes and values (Eriksson and Westerberg, 2011; Phua and Rowlinson, 2003). This need has been driven by the lack of cooperation found among project stakeholders (Phua and Rowlinson, 2003).

“Collaboration has been defined as a process in which autonomous or semi-autonomous actors interact through formal and informal negotiation jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together; it is a process involving shared norms and mutually beneficial interactions” (Thomson et al., 2009).

Collaboration engenders greater involvement of clients in projects and encourages them to procure in a manner that does not alienate stakeholders (Boughzala and De Vreede, 2015; Osipova, 2015). These Obligational Contractual Relations (also known as Bridging) involve forming of strategic partnerships with stakeholders (Sinclair, 2011) by establishing common ground and action (Austen et al., 2008).

In contrast to the traditional antagonism, conflict and disputes, a culture of collaboration, open interaction, trust, commitment, mutual advantage, learning, innovation and productivity is developed with expertise transmitted from project to project (Ankrah et al., 2009).

Collaborative procurement is thus modeled after Stewardship Theory which is a polar opposite of Principal Agent Theory. Collectivist behaviour is the priority and higher value is placed on cooperation of stakeholders (Davis et al., 1997). Relationships are expected to create value, improvement, alignment and implement the most cost effective solution (Constructing Excellence, 2009). Focuses on goal convergence between agent and principal instead of self-interest while using responsibility and autonomy to limit opportunistic behaviour (Snippert et al., 2015).

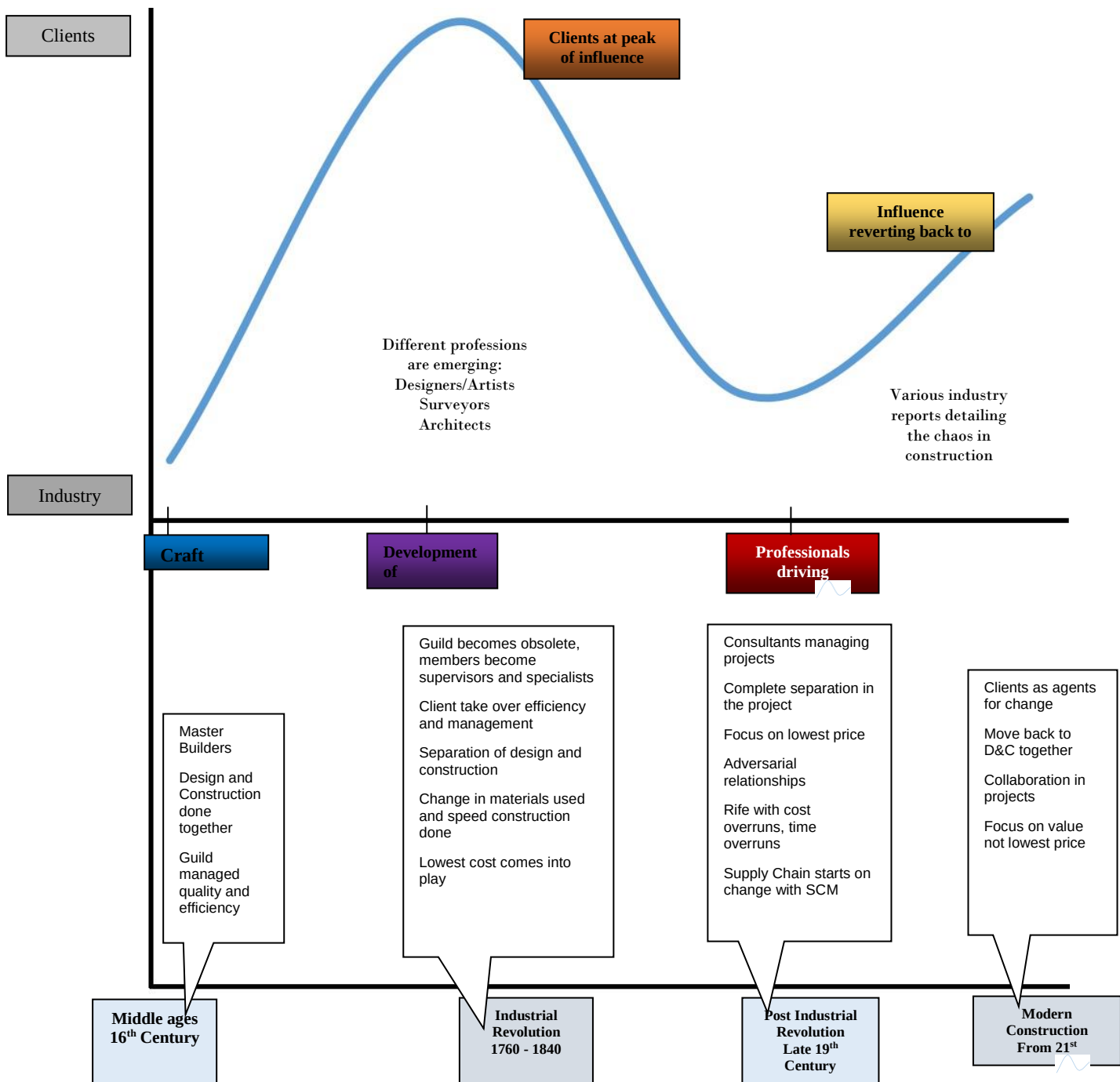


Figure 1: A timeline of construction

While stewardship has its advantages, most principals who want to reduce their risk prefer set governance measures which allow them more control over what the agent is doing (Davis et al., 1997).

This is in contrast to global construction industries that have woken up to the fact that new procurement and risk management procedures when aligned with modern partnering arrangements and integrated delivery schemes can improve project success (Snippert et al., 2015). This emphasises the need for adaptation to the changing landscape in construction (Cheng and Liu, 2007). Some countries have taken specific adaptive steps. From April 2016 the UK has mandated the use of BIM Level 2 for all centrally procured construction projects (NBS, 2016), the USA has mandated use of

ECI for all its highway projects (Pearman, 2006), while Singapore is urging the adoption of progressive procurement methods that integrate the activities of various industry players to achieve synergy and attain productivity breakthrough (Kwan and Ofori, 2001). The previous preoccupation with lowest price is also being replaced with a focus on maximum value (Aapaoja et al., 2013).

IMPLEMENTING CHANGE

Advocacy is widespread for partnering arrangements and integrated delivery systems which include designing and construction especially for high risk projects (Bowles and Morgan, 2016; Holley and Ben Farrow, 2012). They encourage the sharing of risk and create opportunities for shared gains (Bowles and Morgan, 2016; Memon et al., 2015; Nukic and Huemann, 2016; Osipova, 2015).

Lag and resistance to change

In spite of advocacy and the fact that use of collaboration is not new to construction (Bowles and Morgan, 2016; Holley and Ben Farrow, 2012; Memon et al., 2015) change has not been easy in the industry (Thomas et al., 2002). It has a conservative and sometimes laggard approach to new ideas mainly due to its fragmented nature and lack of ability to invest time and money into innovation, research and development (Stephen Barthorpe et al., 2000). Change has historically been met with scepticism, resistance and a reluctance to move away from well-established work practices and procedures (Babic and Rebolj, 2016; Van Marrewijk et al., 2014).

It has been suggested that the industry is subject to historical, industrial and market forces that perpetuate its existing culture and management style (Kwan and Ofori, 2001). These inhibit the industry's ability to initiate change and makes it especially unwilling to invest in technology (ibid).

While some construction professionals may appreciate the changes that have occurred in other industries, they have difficulty envisioning how to harness these advantages to benefit the construction industry (Thomas et al., 2002). The types of relationships in the industry also imply that some professionals could be happy with the current status quo and not willing to lose out on their advantage in the industry.

Need for in-depth change

Where change has been accomplished it has focused on the use of various tools and techniques. While these are great to utilise they do not produce a change in attitudes from industry stakeholders; they simply enable stakeholders to change practices.

Nummelin asserts that change should not merely encompass adoption of new systems and methods; it should include changing underlying assumptions and values which in essence implies a change in organisational culture (Nummelin, 2006). Höök and Stehn refer to this as a focus on the mind (Höök and Stehn, 2008). In their study on knowledge management, Fong and Kwok found that besides utilising new technologies, there is a need for understanding and integration of human aspects as well as determination of the right culture to operate (Patrick S. W. Fong and Kwok, 2009). The clear implications are that transformation has to go deeper than using particular tools and techniques. Instead of changing only practices, behaviour, attitudes and values also need reassessment (Ankrah et al., 2009). Changing culture is a means of internalising and entrenching change (Babic and Rebolj, 2016). A more robust conception of culture is necessary for change in the industry to be understood and responded to appropriately (Stephen Barthorpe et al., 2000).

The issue of culture

Culture has no single definition (Stephen Barthorpe et al., 2000). In Stuart Hall's simplistic terms it is the practices which characterise a particular society (Billington et al., 1991, p. 28). There is consensus though on culture being the shared values and basic assumptions of an organisation that are manifested in organisational practices (Ankrah et al., 2009). Culture is so powerful it can actually prove to be a barrier to productivity if it is not adaptive and congruent with organisational structures and the prevailing environment (Zhang and Liu, 2006).

According to Abeysekera, within construction, culture is considered to be about the characteristics of the industry, approaches to construction, competencies of those working in the industry and the strategies, goals and values of the organisations in which they work (Ankrah et al., 2009). The issue of culture has gained importance because of internationalization of construction markets and the fragmented nature of the industry (Ela Oney-Yazıcı et al., 2007)

Industries tend to have a dominant culture. This dominant culture implies that there is a driving force behind it (Billington et al., 1991). T.S. Eliot and Althusser recognised the existence of an elite class in every culture who have special knowledge and skills within a class society (ibid).

Figure 1 points to the presence of an elite class that has evolved over time within the construction industry. Just as the craft guild eventually gave way to industry specialists, in this modern age clients are taking on a dominant, expert role by becoming better informed and involved in construction projects.

CHANGING PRACTICE VS. CULTURE

When conceptualising change, the focus has been on changing practices. Though practices are a part of culture, a synergy exists between them such that changing one without the other short changes the change process.

Drivers of Practice and Culture

It is important to note that an organisation's norms and values play a critical role in the strategy of the firm meaning a match is needed between culture and strategy (Hartmann, 2006). While culture is manifested in practices (Cheung et al., 2012), practices too can influence culture (Ankrah et al., 2009). This is emphasised by the fact that success in an organisation is a result of the successful translation of values and beliefs into policies and practices (Cheung et al., 2012).

Culture dictates the way an organisation responds to environmental stimuli (Yong and Pheng, 2008). While it is influenced by working practices (Höök and Stehn, 2008) it is also a reflection of practices and basic values (Yong and Pheng, 2008).

As shown by Figure 2 below, the practices influence the working culture, which in turn determines the practices in the organisation. As a culture becomes entrenched, the organisation uses practices that are consistent with the existing culture (Yong and Pheng, 2008). Problems occur when after practices change, the culture is so ingrained it fails to adequately respond to the change (Babic and Rebolj, 2016; Brinkman et al., 2015). The end result is an ineffective change.



Figure 2: Synergy between Culture and Practices

The need for both Practice and Culture change

Trying to solve all problems using new tools and techniques is unlikely to address the underlying culture issues. It has been established that when practices change, the underlying behaviour behind those practices also needs to change; in essence there needs to be a corresponding culture change (Cheung et al., 2012). It is not that a particular cultural orientation is inherently wrong, it may simply not be conducive for overall implementation of collaborative practices (Yong and Pheng, 2008). Strategies for facilitating more rapid improvements can also be developed by consciously attempting to simultaneously shape the cultural profile (Riley and Clare-Brown, 2001). The practiced organisational culture may need to be changed so that attitudes and expectations within the organisation are in line with new philosophies (ibid).

Culture modification takes time so it may be prudent to implement practices in line with emergent culture (Yong and Pheng, 2008) so as not to rush the process and allow enough time for the necessary changes in both behaviour and culture to occur (Baiden et al., 2006).

CLIENTS AS AGENTS OF CHANGE

Latham's report back in 1994 stressed the need for change with clients being in the best position to implement it (Latham, 1994). The client's pivotal position is shown by the fact that motivation for quality improvement in construction has come from two sources; client dissatisfaction and government action (Thomas et al., 2002). This implies that the client has always potentially been a driving force of change.

Clients are essential because the manner in which they procure affects the degree of integration and cooperation among project participants (ibid). Where industry professionals are depicted as being at the helm of procurement separation, clients have been hailed as bridging the divide between various stakeholders by advocating cordial and long term relationships (Brinkman et al., 2015; Ling et al., 2015; Memon et al., 2015). Their emphasis on teamwork and cooperation has also brought the design and construction back together.

Client motivated change has occurred in two ways. In most scenarios, government as a client has imposed change on the industry such that there are particular credentials necessary in order to qualify for public projects (Babic and Rebolj, 2016). In other scenarios, clients in the private sector take it on themselves to insist on a particular manner of behaviour and procurement and impose it for their projects (Memon et al., 2015; Osipova, 2015; Van Marrewijk et al., 2014). These are referred to as the top down approach and the bottom up approach respectively.

Public Sector for change (The Top-Down approach)

Change in construction has traditionally focused on a top-down tool approach (Höök and Stehn, 2008) which is reflective of government intervention.

Various studies have been commissioned to determine how to improve the state of the construction industry. These reports suggested the implementation of procurement practices that are more collaborative with an emphasis on team integration, long term relationships and a move away from lowest price tendering in order to improve the industry's success statistics (Bowles and Morgan, 2016; Van Marrewijk et al., 2014).

Table 1 – Various industry reports

Country	Report	Focus
UK	Constructing the Team Rethinking Construction	Value procurement, partnering, NEC, better relationships
Hong Kong	Tang Report	Focus on partnering, alliancing and NEC
New Zealand	Valuing the Role of Construction in the NZ Economy	Value procurement, PPPs and Alliancing
Singapore	Construction 21	Value procurement, skills enhancement, integrated approach to construction

Source: C21 Committee, 1999; CIRC, 2001; Egan, 1998; Latham, 1994; PWC, 2016

This practice/tool driven approach has imposed change on the industry such that they take on particular practices in order to win public contracts but ultimately values and attitudes remain the same. Given a choice it is likely some stakeholders would work the way they have always worked and given the opportunity they revert back to what they know best (Babic and Rebolj, 2016; Van Marrewijk et al., 2014). It cannot be emphasised enough how a corresponding change in culture is necessary for practices to change effectively (Challender et al., 2013) especially since strategy and culture are symbiotic (Undercurrent, 2012).

Private Sector for Change (The Bottom-Up approach)

When private, expert clients impose their collaborative culture on the industry they can influence all stakeholders to work in a different way. This can produce a ripple effect especially when multiple projects are worked on by the same stakeholders.

To enable this shift to collaborative behaviour, a conducive culture has to be in place (Cheung et al., 2011). Collaboration needs to be considered an important part of each project with emphasis placed on team culture and fostering right attitudes (Bresnen and Marshall, 2000). The stronger the collaborative climate the better any cooperative procedures will be performed (Eriksson and Westerberg, 2011). An examination of most organisational values is likely to have a collaborative tone. Relying on industry specialists has eroded these values to an extent as they have had to adapt to the construction industry environment in order to allow them to get work done in the industry. Reverting back to original values and culture fosters the collaborative climate necessary for change.

Culture is said to gain from the process of friction with other cultures and by class conflicts (Billington et al., 1991, p. 11). As expert clients find their cultures at odds with the culture displayed by the industry they are clamouring for change and distancing themselves from the rampant traditional practices in industry. Clients while

changing practices also have the added advantage of addressing individual behaviours, attitudes and values which are critical for the success of change (ACRCCI, 2001; Challender et al., 2013).

Envisioned change needs to pervade the entire organisation with senior management leading (Bresnen and Marshall, 2000). Where change focuses simply on individual projects, problems come up when project culture clashes with the wider organisational values and norms thus diffusion of appropriate norms and values is required organisation wide (ibid).

When change has been accomplished culture needs to be progressive, adaptive and enduring so it can be a foundation for efficiency (Cheung et al., 2011). A strong culture is able to adapt to any changes in the environment. With progress, changes are inevitable and as the construction climate evolves, the culture needs to be able to change accordingly so that organisations and the industry can run at maximum efficiency. Effective collaboration is then realised through implemented changes that are enduring and continually improved on (ibid).

CONCLUSIONS

Change in any organisation or industry runs the risk of not being effective or even permanent. The construction industry is lagging several decades behind other industries in terms of change and there is a need to rectify the situation. With a change in the elite class in construction, clients mainly in the form of governments are spearheading change. Their focus has been top down with a focus on tools and techniques which limits the effectiveness of change. A move to an approach that encapsulates government involvement but brings into focus the internalising of change would be more beneficial as culture change would also be incorporated.

Change in the industry has focused on moving to more collaborative working. A conducive environment is necessary to accomplish this and only a simultaneous change in attitudes and values can promote the necessary climate. To effectively change the construction industry especially to a more collaborative environment, a corresponding change in culture is required.

Future studies which would delve into how private clients actually implement their bottom up change are recommended. It would also be prudent to determine how government mandated change can provide a more holistic approach by also incorporating culture change within their organisations that has the ability to further influence the construction industry.

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ASSESSMENT OF BUILDING INFORMATION MODELLING RELATED RISKS IN PREVENTIVE MAINTENANCE OF BUILDING SERVICES INSTALLATIONS

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Real estate comprises the major wealth of the world, generally estimated at 50% of total global worth. There are major costs associated with maintenance of real estate projects to achieve optimal performance. Building Information Modelling (BIM) is regarded as a way around this challenge. BIM is a concept that has been identified as a technology that digitally constructs accurate virtual model of a building. BIM can be defined as an Information Technology enabled approach that involves the application and maintenance of a fundamental digital representation of a building and all its information throughout the distinct stages of the project. Surprisingly, numerous studies have mainly focused on the application of BIM during the planning, design, construction and operation stages of a building, but they have rarely focused on the risks associated with its implementation, specifically when it comes to the benefits for preventive maintenance of infrastructure. This research assesses the risks associated with the use of BIM in preventive maintenance of building services installations. This paper uses the existing body of knowledge to justify the need for this study. Without reservation, this research identifies and provides recommendations of BIM risks in preventive maintenance of building services installations. The significance of this study lies on the fact that, risk management is key to the success of any endeavour. For the same reason, there is a need to care about the risks associated with the use of BIM in preventive maintenance of building services installations.

Keywords: Building Information Modelling, Risk, Preventive Maintenance, Building Services Installations

INTRODUCTION

Building maintenance conserves, the value of a building, whilst making it enjoyable for occupants (Wahab and Basari, 2013). Scarret (1995) suggests that, building maintenance is “work undertaken in order to keep, restore or improve every facility that is every part of a building, its services and surrounds, to a currently accepted standard and to sustain the utility and value of the facility”. Nevertheless, building structures relatively have longer life spans when compared to the mechanical components that are installed within (Wahab and Basari, 2013). Effective building maintenance therefore requires preplanning of all the foreseeable mechanical components that will require maintenance in future and the time the maintenance will be required. Maintenance is broadly categorised into planned and unplanned (Zulkarnain et al, 2011).

Research has shown that there are many benefits to be enjoyed through the implementation of Building Information Modelling (BIM) as a preplanning tool, from the conception stage into the operation and maintenance phases (Korpela et al, 2015).

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However, the fact that risk can be unpredictable makes research on the risks associated with the introduction and use of BIM in preventive maintenance of building mechanical components interesting. Besides, risk management is a key part of strategic management in any organisation (IRM, 2002). Risk management is pivotal in the successful maintenance of buildings hence the need to determine and provide recommendations for dealing with BIM related risk. The aim of this research is to evaluate the need to assess BIM risks associated with preventive maintenance of building services installations. Whilst other researches have mainly focused on the application of BIM during the planning, design, construction and operation stages of a building, this research seeks to cover the existing gap of the need to assess risks associated with preventive maintenance of building services installation. The following section reviews the literature associated with the major concepts in this study.

LITERATURE REVIEW

This section reviews literatures on building maintenance, building services installations, BIM concept, and the need for assessment of risks for BIM implementation associated with preventive maintenance of building services installation.

Building Maintenance

Maintenance involves a combination of both technical and administrative actions which contribute to the protection and satisfactory operation of an asset (Wahab and Basari, 2013). The wear and tear of building components creates hazards which in turn lead to building failure thus putting lives at risk while subsequently becoming costly to rectify (Hong Kong Buildings Department (2002). Effective building maintenance therefore requires preplanning of all the foreseeable mechanical components that will require maintenance in future and the time the maintenance will be required (Lateef, 2008). There are various forms of maintenance, but this research will focus mainly on preventive maintenance. According to Zulkarnain et al (2011) preventive maintenance is maintenance carried out at predetermined intervals or corresponding to prescribed criteria and intended to reduce the probability of failure or the performance degradation of an item. Preventive planning avoids overworking of building mechanical components beyond their life span (Ishak, Chohan and Ramly, 2007). This helps in the prevention of breakdowns that can lead to undesirable or even fatal situations. The next section reviews building services installation.

Building Services Installations

According to the Hong Kong buildings department (2002), common mechanical components that require regular checking and maintenance within a building include;

a) Water supply

Fault warning signs are usually detected by insufficient water pressure, brownish water and sudden rise in consumption. The probable causes could be related to pipe blockages and or leakages, rusty pipes, and pump(s) failure.

b) Electricity supply

Electrical faults are usually signalled by the stoppage of supply, heating of switches, electric sparks and shocks. These are most likely caused by the failure of a fuse, circuit breaker, overloading, uneven distribution of phases and inadequate earth bonding.

c) Fire services

Fire services are important from a safety perspective and the symptoms of failure are normally detected through inadequate water pressure or no water supply and malfunctioning alarm systems. These faults are probably caused by pipe blockages and leakages, pump failure and defective alarm wiring.

d) Lift and escalator

Stoppage, excessive noise during operation, unstable lifting, doors not closing properly, and occasional overrun are some of the warning signs of defective lifts and escalators. These could be due to ageing of parts, landing misalignment and mechanical failure.

e) Air conditioning/heating

Default warnings are usually detected the system not being cool enough or warm enough, noisiness and poor indoor air quality and are mainly caused by malfunctions.

f) Other installation services that require regular checking and maintenance include, gas supply, solar supply, security systems and telephone signalling systems.

Present day buildings are becoming more complex, making the need for operating and maintaining information vital. Effective maintenance now requires the facilities management team to obtain and integrate diverse facility information including but not limited to building elements, operational costs and maintenance (Arayici, Onyenobi and Egbu, 2012). The next section introduces BIM which is regarded as key in preventive maintenance of buildings. This is since BIM can store all the information of a building and makes it easy for users to retrieve the information when needed.

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Building Information Modelling

Pasarneshad and Dimyadi (2014) argue that accessibility of information is vital to efficient management and operation of facilities. Without information of the facility, the job of a facilities manager is limited as maintenance to the facility becomes difficult to implement. As a result, high time and monetary costs are experienced by the owners of the facility (Hong Kong Buildings Department, 2002). Most contractors are required to handover drawings and any other documents containing information about the building for ease of reference by the facilities managers (Kassem, 2015). Lee et al (2012), pointed out that about US\$10.6 billion out of US\$15.8 billion losses caused by interoperability inefficiencies are attributed to the operations and maintenance phase of a building. Research has proven that BIM will enable the smooth handover of real time information for example Motamedi et al (2014) noted that the 3D visualisation which comes along with BIM helps facility managers to use their cognitive and perceptual reasoning for problem solving. The availability of information will enable preventive maintenance to be carried out smoothly as all the information about the mechanical components installed as part of the building finishes will be at the disposal of the facilities manager.

The BIM task group (2013) suggested that the adoption of BIM is expected to provide ways for managing information about building operation which can be utilised in future designs. Teicholz (2013) asserts that, BIM brings positive value as it will improve the quality and reliability of data resulting in increased workforce efficiencies. The BIM task group (2013) summarised the benefits as follows: “BIM will provide a fully populated asset data set into computer aided facilities management (CAFM) systems and therefore reducing time wasted in obtaining and populating asset information enabling us to achieve optimum performance quicker, reducing running costs and refine target outcomes”.

Azhar (2011), agrees indeed that, facilities management departments stand to benefit through BIM as it can be used for works such as renovations, space planning and maintenance operations. The importance of BIM can be discovered in the event of say, a maintenance problem such as a leaking pipe. BIM will provide information on the exact location of the problem, how the pipe relates to other pipes within the building, thus making it easier for the team to identify and rectify, save time and

money in the process (Arayici et al, 2012). Furthermore, risk management allows facilities managers to balance the operational and economic costs of building protective measures (Stoneburner, Goguen and Feringa, 2002). As noted by Stoneburner et al (2002), risk management is not unique as it permeates across all spectrums of decision making. The following section reviews literature relating to the need for risk assessment in the use of BIM in preventive maintenance.

The Need for Risks Assessment

Risk is an unknown, unexpected, undesirable and unpredictable endeavour (IRM,2002). Risks can be classified as physical, technological, financial and economic and political and environmental (Zavadskas, Turskis and Tamosaitiene, 2010). All projects have some element of risk, be it cost overruns, delays or failure of the building performance to meet expectations (Pryke, 2016). Furthermore, Pryke (2016) is of the view that adopting BIM cannot eradicate all risks but can de-risk most sections throughout the project life cycle. According to case study results carried out by Pryke (2016), savings of up to 45% on unplanned maintenance activities and 20% on planned maintenance tasks have been achieved using BIM. Pryke further notes that the response rates to problems have also improved by 54% and productivity increased by 50% during planned preventive maintenance tasks.

According to the IRM (2002), risk management gives value and protection to organisations and their stakeholders through; the provision of an organisational structure enabling a consistent and controlled manner of future activities, optimisation of operational efficiency, the development and support of people and the organisation's knowledge base, protection and enhancement of assets and the company image, reduction of volatility in the non-essential areas of business, contributing to more efficient use/allocation of capital and resources within the organisation, improvement in decision making, planning and prioritisation by comprehensive and structured understanding of business activity, volatility and project opportunity or threat.

Zavadskas et al (2010) affirm that, risk analysis involves risk identification which seeks to determine an organisation's exposure to uncertainty. IRM (2002) emphasises that the identification process requires an intimate knowledge of the organisation, the market in which it operates, legal, social, political, and cultural environment in which it exists, as well as the development of a sound understanding of its strategic and operational objectives, including factors critical to its success as well as threats and opportunities related to the achievement of the objectives. Business activities and decisions can be classified in different ways which include but is not limited to strategic, operational, financial, knowledge management and compliance.

Evaluation of risk is critical in decision making about the significance of risks to the organisation and whether each specific risk should be accepted or treated. In fact, risk evaluation is important to compare the estimated risks against the organisation's established risk criteria. Next is risk treatment which is a process of choosing and implementing measures to modify the risk. This includes risk control or mitigation, risk transfer just to mention a few.

RESEARCH METHODOLOGY

Existing literature is used to evaluate the need for research relating to the risks associated with the use of BIM in preventive maintenance of the mechanical components of buildings. This is since some of these publications are written by

experts thus resulting in the collection of valid information based on authenticity, representativeness, meaning and credibility (Platt 1981; Scott et al 1990). The literature review method enables the researcher to review the existing knowledge regarding the use of BIM in building maintenance. This helps the researcher to identify strengths and weaknesses of the existing knowledge, which helps the researcher to identify a gap, in this case the gap is the risks associated with the use of BIM in preventive maintenance.

DATA ANALYSIS

Analysis is important in gaining a better understanding of the collected data (Creswell and Clark, 2007). Unquestionably, the remark by Lateef (2008) that, effective building maintenance requires preplanning of all the foreseeable mechanical components that will require maintenance in future and the time the maintenance will be required, is fundamental in understanding the basic need of risk management in building maintenance. This remark emphasises the need for preplanning in order to maintain the operation of the building at an optimal level.

Lee et al (2012) claims that, about US\$10.6 billion out of US\$15.8 billion losses caused by interoperability inefficiencies are attributed to the operations and maintenance phase of a building. These figures are telling and should thus raise alarm bells for the need to properly manage the building during its operation phase. This calls for intensive research aimed at reducing the claims made by Lee. The research should cover the operation phase including the risks associated with using concepts such as BIM in trying to reduce the maintenance costs. The BIM Task Group (2013) and Teicholz (2013), both agree that BIM brings positive value, but no mention is made on the need for risk management in their research. Thompson and Miner (2007), emphasize that, prior to the full implementation of BIM, the risks associated with its use must not only be identified and assigned, but the cost of implementing it should also be paid for. This clearly shows the need for identifying and dealing with the risks associated with the use of BIM before it is implemented. Without a doubt, the views of Thompson and Miner (2007) provides the motivation for this research which seeks to evaluate the need for assessment of risks associated with the use of BIM in preventive maintenance of mechanical components of buildings.

Thomson and Miner (2010) point out that, regardless of all the savings and efficiencies associated with the use of BIM, it is vital to note that its use is not without risk. Thomson and Miner (2010) emphasise that the inaccuracy of the BIM generated data can be disastrous. Azhar (2011) broadly classifies BIM risks into legal (contractual) and technical. The first risk identified by Azhar (2011) is that of ownership of BIM data. Disputes are most likely going to arise between the Owner of the building and the project team on who owns the BIM data. Obviously, the owner, as the funder of the project would assume ownership whereas the project team, having played a role in the collaboration process, would also want ownership rights of the information. This is also affirmed by Thomson and Miner (2010) who add that; there is a need to determine ownership of the generated BIM data as well as its protection through copyright and other legal frameworks. It is critical to take note of the fact that the realisation of the model's potential must not be affected in spite of these challenges.

The second risk as identified by Azhar (2011) arises from the issue of who is supposed to control data entry. According to Thomson and Miner (2010), taking responsibility for updating BIM data and ensuring its accuracy involves a lot of risk.

Considering a scenario where say, the owner of the building sues the project team over a perceived maintenance program error, there is need to know who lies with the responsibility. However, Azhar (2011) suggested that the best way to deal with these risks is to have “collaborative, integrated project delivery contracts in which risks of using BIM are shared among project participants among with rewards.” Tomeka and Matejka (2014), reiterate the importance of the topic of risks in BIM by suggesting that the use of BIM creates big impacts on standard risk levels.

Pryke (2016) points out that the adoption of BIM cannot eradicate all risks but can de-risk most sections throughout the project life cycle. What’s more important in the work of Pryke (2011) is the fact that there has been an acknowledgement that there are certainly risks associated with the use, the research done by Pryke in 2011, reports that up to 20% savings have been achieved from the use of BIM in maintenance of buildings. This figure is significant considering the fact that lifecycle costs of buildings are higher during the operation and maintenance stages. Pryke’s research also claims that there has roughly been a 54% improvement in response rates to problems through the use of BIM in maintenance of buildings. These statistics clearly show that BIM has some major benefits in maintenance and will likely result in more organisations adopting the concept. The major challenge though is that BIM risks need to be assessed for improved results.

CONCLUSIONS

In conclusion, there are numerous risks that arise in using BIM for better preventive maintenance of building services installations. While risk assessment and management have a potential to improve the use of BIM, no formal research has focused on risk management lately. The fact that maintenance should and can not be circumvented coupled with the benefits of using BIM in preventive maintenance makes it almost impossible not to consider the issue of risk. Extensive research on the risks associated with BIM in preventive maintenance is therefore vital. This should involve the identification of all potential risks and coming up with treatment options for those risks. While this paper looks at the negative risks associated with the use of BIM in preventive maintenance of building services installations, there is a need for further research which looks at the positive risks associated with its use in preventive maintenance as well.

The following recommendations can be made for future studies:

- A proper risk management process for the use of BIM in preventive maintenance of building service installations needs to be implemented.
- With such proper risk management processes, facilities managers can actively consider the use of BIM in preventive maintenance of building services installations.
- Response to the list of available risks for BIM implementation associated with preventive maintenance of building services installation is highly recommended.

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ATTRITION RATES IN APPRENTICESHIP TRAINING PROGRAMS FOR CRAFTSPEOPLE: A REVIEW

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The purpose of this research was to systematically review the existing knowledge on non-completion of apprentice training programs for craftspeople. A systematic literature review approach was used to highlight the trends and gaps in this area of research. The findings indicated that the most common factors responsible for apprentice attrition are: race/ethnicity, gender, and the highest level of prior education. The value of the outcome of this systematic review is providing critical insights into the current state of the existing knowledge on this topic. The work reported in this paper is limited to studies published in academic journals. The study has, thus, contributed to the understanding of factors responsible for apprentice attrition. This information would facilitate the improvement of the outcomes of training programs for craftspeople. Findings from this study help academics and industry practitioners to become aware of the trends and gaps in apprentice attrition research.

Keywords: Apprentice, attrition, craftspeople, industry, literature review

INTRODUCTION

The construction industry creates constructed space for productive activities in an economy. Previous studies have shown that economic growth and volume of investment in construction projects are positively related (Dang and Low, 2011; Chiang et al., 2015). Based on this relationship, there have been calls for increased investment in infrastructure projects, especially in developing countries (Anaman and Osei-Amponsah, 2007). However, evidence has shown that increased investments in the construction sector do not necessarily lead to economic growth (see Lewis, 1984; Awotona, 1990). This situation observed could be attributed to the poor performance of construction projects, which is largely due to increasing project cost. For instance, Flyvbjerg et al. (2003) posited that 9 out of 10 transport infrastructure projects exceed initial project cost. It can be reasoned that the strategic management of project costs has the potential of improving the construction industry's impact on the economy.

There is a large volume of published studies describing the factors responsible for cost overrun in construction projects. Increasing labour costs is one of the main reasons linked to cost overruns (see Kaming et al., 1997). The construction sector is currently witnessing a shortage of construction workers and an aging construction workforce (Thomas and Horman, 2006). As a consequence of the scarcity of construction workers, construction cost has been increasing and contractors' profits are shrinking (see Construction Industry Development Board, 2017). Accident and low productivity are risk factors associated with aging workforce (Dong et al., 2014; Jebens et al.,

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2015). Also, it has been reported that lower productivity and higher labour cost are related with aging workforce (Chan and Dainty, 2007; Conen et al., 2012; Vandenberghe et al., 2013). In a bid to address these challenges, a number of apprenticeship training programs have been developed to attract young adults to the construction sector. In Hong Kong, the enhanced construction manpower training scheme (ECMTS), which was initiated in 2010, is an example of a 'catch them young' program (see Ho, 2016). WorldSkills South Africa (WSSA) is another example of an initiative targeted at improving the outcomes of vocational training programs in South Africa (see Construction Industry Development Board, 2017). Similar apprentice training programs can be found in other countries around the world.

Despite the existence of these programs, aging workforce remains a challenge in the construction sector. Evidence gleaned from literature has shown that attrition rates from apprenticeship programs are high (see Ryan and Unwin, 2001). Although there are several reviews reported in construction management literature (see, for example, Darko et al., 2017), few of these reviews pay specific attention to the outcome of the apprenticeship training program. A review of factors responsible for attrition of craftspeople from apprenticeship training programs is, therefore, highly desirable. Consequently, the purpose of this paper is to present a systematic review of the literature on this topic in order to make the following contributions: (i) this is the first comprehensive review of factors responsible for trainee attrition from apprenticeship training programs; (ii) identify the factors responsible for trainee attrition; (iii) based on the gaps and trends of research in this area, provide insights into paths that can be explored in future research; and (iv) by organizing and consolidating the literature on training attrition, the outcome of the study would provide valuable insights for relevant stakeholders (such as contractors, government and administrators of apprenticeship training programs, among others).

RESEARCH METHODOLOGY

A variety of methods can be used to review the existing literature on a particular problem. Each method has its advantages and drawbacks. In the study whose findings are reported in this paper, a systematic literature review was used to uncover the underlying factors responsible for trainee attrition from apprenticeship training programs. A systematic literature review is the preferred approach due to replicable findings and calls for strengthening methodological rigours of reviews (Tranfield et al., 2003). An initial search showed that the studies carried out in the field of construction management were relatively few. Hence, the search was expanded to other academic disciplines.

The sample for this study was limited to academic journal papers published in English. The process of identifying the relevant papers was carried out in four stages: (i) SCOPUS database search; (ii) filtering based on article categorization; and (iii) visual examination of the abstract and conclusion sections; and (iv) content analysis of the relevant studies. The search for relevant works was limited to the SCOPUS database because the database is the most commonly used search engine for a systematic search for published works (see Ke et al., 2009; Yi and Yang, 2014). The keywords used for the SCOPUS database search are: "apprenticeship" AND "attrition"; "apprenticeship" AND "completion"; and "apprenticeship" AND "dropout". As a result, a total of 101 related articles were identified. At the filtering phase, published articles categorized as: editorial, book review, forum, discussion/closures, letter to the editor, article in press, introduction,

conference/seminar paper, and comments were excluded from the search results. At the end of the second phase, 74 articles that did not meet the inclusion criteria were excluded from the search results and subsequent examination.

In line with the purpose of the study, the abstract and conclusion sections of the remaining 27 articles were analysed critically. Subsequently, 6 articles that did not address the factors affecting trainee attrition from apprenticeship training programs were excluded. This led to a total of 21 articles with the relevant contents being subjected to the final stage of the analysis.

ANALYSIS AND DISCUSSION OF RESULTS

Holistic view of papers published on factors responsible for apprentice attrition

The purpose of this investigation is to present a state-of-the art review of the current knowledge on apprentice attrition from training programs. The results presented herein are exclusively based on the analysis of academic papers obtained from a search described in the preceding research method section.

Table 1 presents a summary of the relevant published studies found in the literature. From Table 1, it is seen that the studies on apprentice attrition have been conducted both in the developed and the developing countries. This suggests that apprentice attrition is a problem which attracts global interest. However, majority of the studies were conducted by researchers from developed countries (about 90% of the relevant published works). Australia has the largest representation at 33.33% (i.e. 7 papers). Furthermore, it is worth nothing that developing nations such as South Africa and Ghana also made good attempts in advancing knowledge on apprentice attrition, contributing one paper each.

From Table 1, it is evident that the subjects (i.e. apprentices) used in the relevant studies were selected from various sectors of the economy. Only 6 studies considered apprentice from trades in the construction industry (see Glover and Bilginsoy, 2005; Bilginsoy, 2017). In contrast, a study each targeted apprentices in the health and manufacturing sectors of the economy (see Berik and Bilginsoy, 2000; Monsó et al., 2000). Multiple factors such as access to research grant, national economy, construction education, awareness of apprentice attrition and publication culture may have contributed to developing countries being less active in this area of research (Pastrana et al., 2010).

Table 1: Summary of studies on factors responsible for attrition of apprentices

S/N	Author(s)	Country	Target industry
1	Berik and Bilginsoy (2000)	US	Construction, manufacturing and services
2	Monsó et al. (2000)	Canada	Health (Animal health technology and dental hygiene technology) and Services (pastry-making)
3	Bilginsoy (2003)	US	Construction (carpenters, electricians, pipefitters, plumbers and sheetmetal workers)
4	Glover and Bilginsoy (2005)	US	Construction

5	Berik and Bilginsoy (2006)	US	Construction (female construction workers)
6	Robinson and Barron (2007)	Australia	Services (chef)
7	Mangan and Trendle (2008)	Australia	All sectors
8	Mangan and Trendle (2010)	Australia	All sectors
9	Lewis et al. (2011)	Australia	All sectors (disabled)
10	Taylor and Freeman (2011)	Canada	Construction (carpenters) and services (automotive)
11	Donkor (2012)	Ghana	Services (automotive)
12	Coe (2013)	Canada	All sectors
13	Dumbrell and Smith (2013)	Australia	All sectors
14	Groener (2013)	South Africa	Not available
15	McDonald and Worswick (2013)	Canada	All sectors
16	Fries et al. (2014)	Germany	All sectors
17	Forsblom et al. (2016)	Switzerland	Services (painters and cook)
18	Gambin and Hogarth (2016)	UK	All sectors
19	Bilginsoy (2017)	US	Construction (carpenters, electricians, pipefitters, plumbers and sheetmetal workers)
20	Mangan and Trendle (2017)	Australia	All sectors
21	Zoellner et al. (2017)	Australia	All sectors

Identification of factors responsible for apprentice attrition

The second objective of this study was to identify the factors responsible for apprentice attrition. The factors identified from reviewing the papers selected are summarized in Table 2. It is evident that a number of factors influence and shape the decision of apprentice to complete their training programs. The findings of the current study identified the factors responsible for apprentice attrition.

Table 2: Factors responsible for attrition of apprentice identified from the literature

Label	Factors	References

Label	Factors	References
F1	Race/ethnicity	[1, 3, 5, 7, 8, 10, 15, 18, 19, 20]
F2	Gender	[1, 3, 5, 7, 8, 10, 18, 19]
F3	Highest level of prior education	[7, 8, 10, 14, 18, 19, 20]
F4	Sponsor of training program	[1, 3, 4, 5, 7, 19]
F5	Remuneration	[1, 7, 14, 16, 20]
F6	Unemployment rate/Labour market condition	[1, 3, 12, 18, 19]
F7	Industry	[1, 7, 8, 18]
F8	Age	[1, 8, 12, 18]
F9	Business cycle/ Macro-economic environment	[3, 5, 19]
F10	Language (use of English)	[7, 8, 20]
F11	Disability/learning difficulty	[10, 18, 20]
F12	Support provided to apprentice during training program	[9, 14, 16]
F13	Apprentice's commitment to completion of training program/interest	[10, 16]
F14	Conflict with trainer or colleagues	[11, 16]
F15	Employment/other training opportunities	[11, 16]
F16	Licensing/certification requirement	[1, 12]
F17	Length/duration of training period	[1, 12]
F18	Occupational exposure to hazardous materials	[2, 16]
F19	Parent's level of educational training	[10, 15]
F20	Proportion of male/female trainees	[1, 12]
F21	Size of training program	[3, 5]
F22	Selection process	[9, 17]
F23	Social class	[10, 19]
F24	Volume of technical training	[12, 16]
F25	Wrong career choice/loss of interest in the trade	[11, 16]
F26	Accommodation problems	[11]
F27	Bullying	[11]
F28	Climatic conditions	[20]

Label	Factors	References
F29	Deskilling	[6]
F30	Distinction between academic and vocational training	[10]
F31	Exploitation of apprentice	[11]
F32	Financial difficulties	[11]
F33	Health problems unrelated to apprenticeship	[16]
F34	Location for the training program	[16]
F35	Mismatch between the ability of apprentice and training program	[14]
F36	Mismatch between classroom and on-the-job training	[10]
F37	On-the-Job (OJT) credit	[1]
F38	Other personal reasons	[16]
F39	Placement process	[9]
F40	Pre-apprenticeships programs/events	[13]
F41	Standardisation	[6]
F42	Structure of training program	[7]
F43	Training continuity	[7]
F44	Working hours	[16]

The information presented in Table 2 highlights the causes of non-completion of apprentice training programs and gives researchers a wider base to develop further studies on apprentice attrition. As presented in Table 2, a total of 44 factors were identified from the papers selected for review, which were, in turn, classified and discussed in the subsequent subsections.

The categorization of the factors presented in Table 2 was to summarize into manageable groupings based on two premises: (1) the commonalities and similarities that exist; and (2) pre-existing classifications found in previous research. For example, Berik and Bilginsoy (2000) categorized certain factors into 'personal characteristics' grouping. The review in the current study suggests that factors responsible for apprentice attrition can be classified into five main categories: (1) personal and apprentice background grouping; (2) financial/economic grouping; (3) apprenticeship training program grouping; (4) health-related grouping; and (5) unclassified grouping. The unclassified grouping was for the factors that could not be categorized into any of the other four discrete groupings.

Apprenticeship training program grouping

The factors under this group include sponsor of training program, industry (industry providing the training), support provided to apprentice during training program, length/duration of training period, proportion of male/female trainees, size of training

program, selection process, volume of technical training, mismatch between classroom and on-the-job training, placement process, structure of training program, training continuity, and working hours.

These factors categorized into the apprenticeship training program grouping reduce the attrition rates. Berik and Bilginsoy (2000) identified that involvement of unions reduces the attrition rates of females from apprenticeship programs in the United States. Also, adopting job interviews and participation in company visits, during the process of selecting apprentices for training, has been found to generate lower attrition rates (Forsblom et al., 2016).

Personal and apprentice background grouping

The factors under this group include race/ethnicity, gender, highest level of prior education, age, language (e.g., the use of English), disability/learning difficulty, conflict with trainer or colleagues, parent's level of educational training, social class, wrong career choice/loss of interest in the trade, apprentice's commitment to completion of training program/interest, and other personal reasons (i.e., undisclosed reasons).

Personal and background factors refers to variables that are mainly due to issues relating to the personal life/background of the apprentice. Personal factors can be in the form of the age of the apprentice. Race/ethnicity was reported in 10 out of the 21 different publications (about 50% of the entire papers selected for review). Therefore, race/ethnicity is the topmost factor responsible for apprentice attrition from training programs. Gender and highest level of prior education are the second and third most reported factors responsible for apprentice attrition, respectively.

Information gleaned from literature shows that race/ethnic background is an important factor that influences the completion of apprentice training programs (e.g., Berik and Bilginsoy, 2000; Mangan and Trendle, 2010). Due to space/word limitation, only a few of these studies are discussed in detail. In the US, Berik and Bilginsoy (2000) undertook a study targeted at uncovering the factors responsible for apprentice attrition using secondary data. It was found that gender, sponsor of apprenticeship training program, industry (where the apprentice would work), unemployment rate, earning (i.e., post-graduation remuneration), proportion of male/female trainees, licensing requirement, length of training period, race/ethnicity, age and on-the-job training credit are factors responsible for apprentice attrition.

Financial/economic grouping

The factors under the financial/economic grouping consist of remuneration (in the form of wages, stipends, etc.), unemployment rate/labour market condition, business cycle/macroeconomic environment and financial difficulties.

Financial/economic grouping simply refers to financial/economic issues that influence apprentice decision to complete training program. This takes place when an apprentice's decision to complete his/her training is influenced by economic and financial gains. Previous research shows that the macroeconomic environment influences the amount of investments in construction project (Goh, 2005). The desire to earn more money and job prospects at the completion of training influences the career decision of apprentices. There is a likelihood that apprentices would move to other sectors of economy during recessions. Labour shortage is one of the consequences of such decisions/actions.

Health-related grouping

According to the findings of this study, occupational exposure to hazardous materials and health problems unrelated to apprenticeship are categorised into the health-related grouping. From the viewpoint of stakeholders, the benefits of apprenticeship are beyond dispute. Apprenticeship training programs provide distinct benefits which include: improved availability of workmen and lower average age of workforce, among others. Relevant stakeholders (such as government) are increasingly demanding safe work environments for execution of works. For example, studies have demonstrated that the construction industry needs to improve its health and safety practices (Neitzel et al., 2001). An occupational exposure assessment study conducted among apprentices in Canada revealed that exposure to high-molecular-weight agents is one of the reasons for apprentice attrition (Monsó et al., 2000).

Unclassified grouping

This last grouping can also be termed as 'unclassified'. This is because no classification exists for this group of factors in the existing literature. The factors in this group include: employment/other training opportunities, licensing/certification requirement, accommodation problems, bullying, climatic conditions, deskilling, distinction between academic and vocational training, exploitation of apprentice, location for the training program, mismatch between the ability of apprentice and training program, on-the-job (OJT) credit, pre-apprenticeships programs/events and standardisation. 13 factors out of the total of 44 (about 29.6%) fall under this category, suggesting the need for a future in-depth study to sub-categorize these factors.

Data collection and analysis methods

The approaches used for data collection and analysis in previous research are many. Seven methods have been used most frequently for collection of data in studies on apprentice attrition. These methods include: document and records, mixed method, interview, conceptual, experiment, longitudinal, and survey. Table 3 provides information on the data collection methods used in the studies selected for the review reported in this paper.

Table 3: Data collection and analysis methods in selected studies

Data collection methods	Number of papers	Percentage (%)
Document and records	15	65.22
Mixed method	2	8.70
Interview	2	8.70
Conceptual	1	4.35
Experiment	1	4.35
Longitudinal	1	4.35
Survey	1	4.35
Data analysis methods		
Statistical analysis	17	47.22
Descriptive statistics	16	44.44

Qualitative/thematic analysis	3	8.33

Document and records, mixed method and interview are found to be the three most popular methods used to gather data in apprentice attrition research. Document and records (i.e. secondary data) accounts for 65.22% of the total number of papers. Despite the fact that a few of the previous studies focused on the construction sector, this finding is contrary to previous studies which showed the preference for survey as a data collection method in the field of construction management (see Li et al., 2014).

The techniques used for data analysis in previous studies on apprentice attrition are also shown in Table 3. Statistical analysis (such as logistic regression) was adopted in a large majority (17 papers, 47.22%) of published studies on apprentice attrition. Also, descriptive statistics, such as percentages, have been used to identify the factors responsible for apprentice attrition. The use of statistical analysis provides an objective basis for evaluating the relationship between the identified factors and apprentice attrition.

DISCUSSION AND A PATH FOR FUTURE RESEARCH

Existing studies have identified the factors responsible for apprentice attrition in various sectors of the economy (ranging from construction, services and manufacturing). For instance, climatic condition (such as hot and humid work environment) has been identified as one of the main factors responsible for apprentice attrition in Australia (Zoellner et al., 2017). A large majority of craftspeople carry out their work in outdoor environments, especially those in the construction sector (such as bricklayers). Heat stress can be a major contributory factor to the occurrence of apprentice attrition in training programs in the construction industry (see Chan et al., 2012). In order to improve the completion rates for apprentice training programs, there is a need to address these factors identified in the existing literature (see Table 2).

The present results highlight the state of knowledge on apprentice attrition. Based on the findings of the review, the gaps in this field of research are discussed. The need to address methodological issues has been recognised in the field of social science and management. First, most of the studies have focused on exploring the relationships that exist between apprentice attrition and identified factors. This approach can contribute to development of theories based on the hypothesised relationships (Shmueli and Koppius, 2011). However, the practical relevance of such theories can only be evaluated through prediction modelling (Shmueli, 2010). Similarly, there have been calls for the greater use of qualitative analysis in construction management (Fellows, 2010). The adoption of qualitative research methods would uncover the issues that cannot be evident from quantitative studies. Second, lack of studies on apprentice attrition in developing countries in Africa, South America and South East Asia needs to be addressed. Finally, the present study consolidates the literature on apprentice attrition into a concise whole. Taken together, these findings provide valuable insights that can facilitate the reduction in apprentice attrition to relevant stakeholders.

CONCLUSIONS

Apprentice attrition is a global problem. Grasping an in-depth knowledge about the factors responsible for apprentice attrition is vital. This information provides

stakeholders with capacity to tackle the issues associated with apprentice attrition. Apprentice attrition has also been linked to worker shortages and aging workforce. Because of this, an appreciable body of literature has been devoted to identifying the factors responsible for apprentice attrition. However, because no study has conducted a review of the current state of knowledge in this area, this present study has identified this gap and filled it by conducting a systematic review of studies focused on apprentice attrition.

From the eventual 21 publications analysed, 44 factors were identified. The review revealed that race/ethnicity is the most notable factor responsible for apprentice attrition. The factors identified were further classified into five groups, namely: apprenticeship training program, personal and apprentice background, financial/economic, health-related, and unclassified grouping. The findings of the current study provide insight into the factors responsible for apprentice attrition. This information can be used by relevant stakeholders (such as government) for developing more specific and comprehensive measures for improving the outcomes of apprentice training programs. Two main gaps were identified namely, low usage of specific research methods (i.e. prediction modelling and qualitative approaches) and lack of studies focused on apprentice attrition in developing countries. Future studies should focus on addressing the identified gaps in the current knowledge on apprentice attrition.

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COMPETENCES FOR MANAGING MEGA INFRASTRUCTURE PROJECTS: A PILOT STUDY

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Mega infrastructure projects have been conceptualized as complex adaptive systems characterized by emergence, coevolution, and self-organization. These projects have been found to persistently underperform technically, financially, socially, and environmentally due to gaps in traditional project management practices regarding complexity management. Consequently, project management teams have been spurred to utilize unique processes and complexity management competences. This paper is a pilot study of an ongoing PhD research program. It aims to assess the appropriateness and feasibility of the proposed data collection methods, sampling frame and data analysis techniques. It also aims to establish potential logistical challenges and consequently to review the main survey's methods and processes. A semi-structured interview was used to collect data from 5 subject experts working on a Bus Rapid Transit project in Polokwane. The results were analysed using content analysis. The study findings assisted in highlighting some of the potential logistical challenges which could have been encountered during the main research interviews. The results were also used to assess the appropriateness of the proposed research approach, sampling frame and size as well as the data collection tool. Overall, the lessons drawn from the study findings will be used to review the proposed methods and processes prior to the commencement of the main research. Despite the important insights drawn from this study, the data collected will not be used under the main study but only to improve the associated methods and processes.

Keywords: mega infrastructure projects, complexity, competences, pilot study

INTRODUCTION

This paper uses insights which were drawn from a previous publication (Nyarirangwe & Babatunde, 2016) which focused on presenting the findings from a detailed review of existing literature on mega project complexity and required management and leadership competences as part of a PhD research proposal. The findings from that publication and the valuable inputs which were obtained have since been used to refine and update the key constructs and in designing the proposed methodology under the PhD research proposal. Consequently, this study is a subsequent step in the research processes. It focuses on piloting the proposed methodology and processes before rolling out the main research. The paper begins with a brief review of relevant literature on mega project complexity, the required management competences as well as the importance of conducting pilot studies in guiding the main research. This is then followed by a brief description of the methodology which has been used as well as the key findings that emanated from the study.

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LITERATURE REVIEW

This section of the paper provides a summary of the findings from an integrative review of existing literature on mega project complexity, required management processes and competences as well as pilot studies. In addition to explaining these constructs, the importance of conducting pilot studies and their role in informing and guiding the main research has also been enunciated.

Mega Infrastructure Projects

Mega infrastructure projects as a developing phenomenon have been found to be largely elusive (Brooks & Locatelli, 2015). Consequently, some authors attempted to define them broadly under investment, operations and economic perspectives (Flyvbjerg, 2014; Brooks & Locatelli, 2015; Mišić & Radujković, 2015). Under the investment perspective, mega infrastructure projects have been delineated in terms of budget size, technological components and levels of innovation involved (Flyvbjerg, 2014). On the other hand, the operations perspective has been construed to cover aspects such as the implementation timeframes, socio-economic and environmental impacts so on (Brooks & Locatelli, 2015). Lastly, the economic perspective has been found to focus on the contextual issues which impinge on the project (Locatelli, Littau, Brookes, & Mancini, 2014).

Haida and Ellis (2010) further distinguished mega infrastructure projects from other projects using size and degree of complexity involved. While metrics such budget and schedule thresholds have been advanced as important features that distinguish mega infrastructure projects from other conventional projects (OMEGA Centre, 2012), they have been found to be largely arbitrary and hence, not universally applicable across different settings (Brooks & Locatelli, 2015). Consequently, contextual elements such as the size of host country's Gross Domestic Product (GDP) have been espoused as important attributes of mega infrastructure project definition (Flyvbjerg, 2014).

Mega infrastructure projects have also been found to exude certain characteristics which distinguish them from other conventional projects (Dimitriou, Wright, & Ward, 2015). Some of the commonly cited characteristics include long implementation periods, multiple and diverse stakeholders, novel technology, high social and political significance and so on (Johnson & Mulder, 2016). The interaction among these different attributes has been suggested as one of the key sources of mega infrastructure project complexity (OMEGA Centre, 2012). Consequently, complexity has been advanced as the single most important impactful characteristic on mega infrastructure project performance (OMEGA Centre, 2012).

Mega Infrastructure Project Complexity

Complexity Theory (CT) in general and Complexity Adaptive System (CAS) Theory in particular have been used to provide the necessary theoretical framework for analysing mega infrastructure project complexity dimensions, levels and attributes (Wood & Gidado, 2008). The ability of CT and CAS Theory to explain non-linear relationships and interactions has been underscored in investigating how mega infrastructure project systems adapt to their environments as well as the resultant emergent properties that emanate from interactions among the systems' components (Schalcher, 2015).

CAS Theory has been found to be applicable at construction industry, project and site levels (Schalcher, 2015). On the one hand, the construction industry has been construed as a complex phenomenon within which firms operate as autonomous

agents that are loosely governed by voluntary institutional structures, rules and standards (Bertlesen, 2014). On the other hand, construction projects have been conceptualised as non-linear and complex phenomena which demand highly agile processes than those espoused under the traditional project management philosophy (Wood & Gidado, 2008). Lastly, construction sites have been accentuated as complex environments for cooperation and social interactions which are characterised by multiple layers of formal and informal human relationships (Schalcher, 2015). Consequently, CT and CAS Theory have been advanced as suitable lenses to illuminate the non-linearity associated with mega infrastructure project systems (The Standish Group, 2012).

Processes and Competences for Managing Complexity

The failure of infrastructure projects across the globe has been attributed to some of the gaps in traditional project management approaches, tools and processes (Johnson & Mulder, 2016). By using the Pareto Principle, 80% of mega infrastructure project failure have been attributed to human factors in general and project management-related processes in particular (Shenhar, 2011). Consequently, from a complexity perspective, it has been postulated that mega infrastructure projects demand unique approaches and delivery models (Johnson & Mulder, 2016). In Nyarirangwe & Babatunde (2016) it was posed that the success of mega infrastructure project delivery can be enhanced through the unique balancing of administrative, enabling and adaptive leadership models in line with the levels of complexity involved. This balancing process was construed under the Complexity-Leadership Alignment Model (Nyarirangwe & Babatunde, 2016). The levels of complexity have also been associated with the size of the project and this has been presented using the Size-Complexity Matrix which has been presented as a framework for determining the required delivery competences and processes (The Standish Group, 2012).

Additionally, it has also been postulated that competences and processes required to deliver mega infrastructure projects should be distinguished from those commonly found in traditional project management literature (Australian Construction Association, 2015). It has been distilled that such competences and processes should be flexible and emergent in nature in order to deal with the unique characteristics of complex adaptive systems (Johnson & Mulder, 2016). In corroborating with this assertion, Flyvbjerg (2014) equated the competences and processes required to deliver mega infrastructure projects to a jumbo jet pilot's license. Consequently, delivering mega infrastructure projects using traditional management competences and processes has been equated to attempting to fly a jumbo jet using a motor vehicle driver's license and hence the widely reported failures (Flyvbjerg, 2014). The competences and processes required to delivering mega infrastructure projects which have been drawn from reviewed literature are summarised in Table 1.

Table 1: Competences and Processes for Managing Megaprojects as CAS

COMPLEXITY MANAGEMENT	
MANAGEMENT PROCESSES	MANAGEMENT COMPETENCES
Processes that emphasize leadership approaches more than techniques of control and power.	Ability to create an engaging ecosystem for stakeholder engagement, adaptive concept scoping and human engineering.
Processes that propagate positive behaviour and success e.g. unique	Creating an enabling environment for innovation through space for creativity,

incentives and inhibitions.	engagement, debate and co-creation.
Processes that emphasize the assessment of the value of outcomes rather than efficiency optimization.	Architecting complex change through diffused leadership, agile project processes and so on
Processes that leverage and encourage adaptive and learning attributes than enforcing of optimization-focused systems, contracts and processes.	Building a performance culture by e.g. structuring of contracts around shared accountability, mutual achievement and collaborative partnerships.
Processes that emphasize incentives and encourage personal commitments which include transparent organizational practices, policies and outcomes.	Aligning business models through deliberate migration from strict compliance to contracts towards using human collaboration.
Models that shift decision making from centralized command and control to points of interface in the mega infrastructure project structure.	Changing leaders through distributed leadership models which shifts focus from managing complicated technological projects to leading complex social interactions.
Organizational structure and processes which are flexible enough to adapt as more knowledge is gained in the system.	Learning agility through moving away from risk averse governance frameworks and methodologies to embedded learning models.

Pilot Studies

Pilot studies have been defined in diverse ways by different authors (Dikko, 2016; Marinas, Stefania, & Irina, 2014). However, what has been commonly found across different studies has been the fact that pilot studies constitute small-scale investigations designed to test the feasibility of the methods and procedures to be used under a large-scale research projects among other things (Arain, Campbell, Cooper, & Lancaster, 2010; Vogel & Draper-Rodi, 2017).

Reasons for Conducting Pilot Studies

The utility of pilot studies has been underscored for both quantitative and qualitative research (Dikko, 2016; Hazzi & Maldaon, 2015). Under both research approaches, pilot studies have been found be used to assess the feasibility and adequacy of proposed research instruments, illuminate unforeseen problems regarding the proposed data collection strategies and methods, to answer methodological questions and so on (Thabane, Ma, Chu, Cheng, Ismaila, Rios, Robson, Thabane, Giangregorio, & Goldsmith, 2010). The rationale behind conducting pilot studies has been conceptualised under process, resources, management and scientific perspectives (Hazzi & Maldaon, 2015; Thabane et al., 2010). In terms of process, pilot studies have been used to assess the feasibility of the steps that need to take place as part of the main study (Hazzi & Maldaon, 2015; Nunes, Martins, Zhou, Alajamy, & Al-Mamari, 2010). On the hand, under resource dimension, pilot studies have been used to assess the time and budget problems that can occur during the main study (Marinas, Stefania, & Irina, 2014). The management perspective of pilot studies has been construed as addressing the potential human and data optimization problems which could be encountered under the main study (Nunes et al., 2010). Lastly, the scientific dimension has been found to be applicable mainly under medical research in terms of

aspects such as the assessment of treatment safety, determination of dose levels and so on (Hertzog, 2008).

Some of the key questions a pilot study can assist in addressing include whether the proposed methods are appropriate, should be adjusted or changed; whether the questions will be well understood or should be reformulated? (Marinas, Stefania, & Irina, 2014; Nunes et al., 2010). Pilot studies have also been found to assist in checking the terminology used in the data collection tool as well as refining the research plans (Hazzi & Maldaon, 2015). It has also been advanced that pilot studies assist in revealing potential logistical challenges and consequently improving the quality and efficiency of the main study (Nunes et al., 2010). Additionally, it has also been posed that well-conducted pilot studies can assist in designing a clear road map by refining the data collection and analytical procedures which increase the likelihood of getting clearer findings in the main study (Hazzi & Maldaon, 2015). Consequently, pilot studies have been strongly recommended as a way of timely identifying and correcting possible errors and avoiding potentially disastrous consequences before resources have been committed under the main study (Nunes et al., 2010).

Some of the gaps associated with pilot studies have been found to include the limited information they generate which constrain their ability to guarantee the main study's success (Nunes et al., 2010). Additionally, it has been suggested that many pilot studies remain unpublished due to factors such as incorrect reporting of results with too much emphasis on analysing statistical significance, poorly designed objectives, absence of analytic plans and success criteria and so on (Thabane et al., 2010). Consequently, researchers have been spurred to use pilot studies mainly to establish the feasibility of the main research as opposed to as hypothesis testing or sample size calculations (Hazzi & Maldaon, 2015).

Sample Size for Pilot Studies

Generally speaking, it has been observed that there is limited published guidance regarding recommended sample sizes for pilot studies (Vogel & Draper-Rodi, 2017). Consequently, some researchers have opined that even though all studies should have a sample size justification, pilot studies do not require a sample size calculation (Thabane et al., 2011). Some authors however, suggested that 10–20% of the main study sample size is generally sufficient for associated pilot study (Hertzog, 2008) while specifically for a PhD research pilot study, 4 to 5 interviews have been considered as acceptable (Hazzi & Maldaon, 2015; Hertzog, 2008).

Other authors posed that regardless of the sample size used, the sampling frame for a pilot study should be representative of the target study population and apply similar inclusion and exclusion criteria to those of the main study (Thabane et al., 2010). Additionally, it has been espoused that if there is a compelling need for pooling pilot and main study, caution must be exercised to ensure that the key features of the main study are preserved in the pilot (Sorzano, Tabas-Madrid, Núñez, Fernández-Criado, & Naranjo, 2017). Consequently, it was recommended that any such pooling should be planned beforehand, described clearly in the protocol together with the statistical consequences and remedial measures to be used to avoid or minimize the potential bias that may occur due to multiple testing issues (Sorzano et al., 2017, Thabane et al., 2011).

Interpreting Pilot Study Results

In order to derive the optimum benefit from pilot studies, it has been suggested that the analysis and reporting of pilot study results should highlight the key challenges that might affect the feasibility of the main study as well as recommend the suitable remedial or mitigation measures under the main study (Arain, Campbell, Cooper, & Lancaster, 2010). Consequently, the outcomes of a pilot study have been construed as recommendations to either stop the main study if not feasible, continue the main study with modifications, continue the main study without modifications but with close monitoring or continue the main study with neither modifications nor close monitoring (Thabane et al., 2011).

RESEARCH METHODOLOGY

This study used a qualitative approach which has been proposed under the PhD proposal. The choice of this research approach was informed by the epistemological and ontological aspects as articulated by Creswell (2003) and Hall (2013). The two authors advanced that the epistemological and ontological questions constrain a study's methodological questions as well as the investigator's choices of research approach (Creswell, 2003; Hall, 2013). Consequently, the study's research approach focuses on establishing the informants' perspective regarding mega infrastructure project complexity and the required management processes and competences.

Under the main research, the sampling frame firstly, consisted of mega projects drawn from the list of Strategic Infrastructure Projects (SIPs). A sample size of 6 projects covering the transport, water, gas and electrical sectors was selected. Secondly, the main study sampling frame also consisted of institutions mandated by the Presidential Infrastructure Coordinating Committee (PICC) to implement these projects and senior managers responsible for delivering the projects. Only those institutions responsible for delivering the 6 selected projects have been earmarked for data collection under the main study, with special focus on senior managers from clients, consultants and contractors involved. The selection of these three project stakeholders under the main study has been guided by Winch's stakeholder mapping framework (Winch, 2004). Findings from the review of literature on mega infrastructure projects where this framework was espoused the need to focus on internal stakeholders instead of external stakeholders due to the diversity of interests associated with the latter (Brookes & Locatelli 2015).

This pilot study used a similar approach in defining the same sampling frame and associated exclusion and inclusion criteria as proposed under the main study. Consequently, this pilot study is based on a mega project drawn from the list of Strategic Infrastructure Projects (SIPs). In a similar approach to the main study, this pilot study also focused on internal project stakeholders who consisted of senior professionals currently working on a Bus Rapid Transit (BRT) project in Polokwane. These professionals were considered to exhibit the same traits as those targeted under the main research. The decision regarding the sample size was based on insights drawn from literature where it has been recommended that the size of a pilot study's sample should be equivalent to between 10 and 20 percent of that to be used under the main study (Hazzi & Maldaon 2015). The proposed sample for the main study consists a minimum of 42 senior managers drawn from internal stakeholder institutions responsible for delivering the selected mega projects. Consequently, a minimum sample of 4 interviews was required to satisfy the sample size guidelines outlined by Hazzi & Maldaon (2015). Under this pilot study a total of 5 senior

professionals involved in delivering the Polokwane BRT project were interviewed. This is equivalent to about 14% of the sample size for the main study.

In terms of data collection, a semi-structured interview guide with the same questions as the main research has been used under this study to collect data from 5 subject experts currently working on a Bus Rapid Transit (BRT) project in Polokwane. The semi-structured interview guide consisted of 6 broad questions which have been designed based on insights drawn from existing literature on mega infrastructure project complexity and the required management processes and competences. The interview questions were designed to enable the interviewees to use their personal experiences on the project in discussing the different complexity attributes, management processes and competences which have been discussed under the preceding sections. Each of the questions was also designed to align with the objectives of the main research. In order to ensure that all the elements under each construct had been adequately covered, each of the main questions was complemented by a set of probing sub-questions.

The data collection process was guided by recommendations from the reviewed literature regarding the expected focus of pilot studies as discussed in the preceding sections. It was recommended that no statistical analyses or hypothesis testing be conducted under pilot studies due to the small sample sizes involved. Instead, it was exhorted that the analysis processes should focus on assessing the feasibility of the proposed data collection methods, research protocol, sampling frame and to establish potential logistical challenges that could be experienced under the main study.

In order to assess the clarity of the different questions and the terminology used the responses were content analysed. This assisted in assessing whether there are specific terminologies used in different disciplines and the extent to which the respondents were familiar with the industry jargon used in the interview schedule. Consequently, the analysis process under this study focused on establishing these elements with the aim of using the findings to refine the research methodology, tools and processes before the commencement of data collection under the main study. Due to the sample size used under this study, this process will be undertaken manually and limited to situations where marked variations would have been established. The different elements of the findings from this study are explored in the subsequent sections.

FINDINGS AND DISCUSSIONS

The study findings focused on the appropriateness of the proposed research approach, sampling frame sample size, proposed data collection methods as well as the face reliability and validity of the interview guide. Face reliability and validity assessments have been posed to be limited to establishing whether the questions have no errors and are clear, enough to ensure that they generate appropriate responses required to address the research's questions and objectives (Lancaster, 2015).

Appropriateness of Proposed Research Approach

To establish the appropriateness of the proposed research approach, the interviewees were required to use their personal experiences on the project in discussing the different elements under study. For instance, based on their current experience on the BRT project, interviewees were requested to explain their perception regarding the flexibility of the project management processes, ease of change management procedures, diffusion of leadership processes, extent of decentralisation and mutual ownership of decisions, successes and failures and so on, to deal with emergent

complexity aspects. These elements have been found to be largely experiential nature and hence best explored using a qualitative approach. Consequently, this approach enabled the interviewees to provide a narrative of their personal experiences with the different competences and processes when delivering mega infrastructure projects. This is in line with the approach used in other studies where similar constructs have been found to be best explored using a qualitative rather than a quantitative approach (Brooks & Locatelli, 2015, OMEGA Centre, 2012).

Suitability of Sampling Frame and Size

The suitability of the sampling frame was assessed based on the extent of compliance with the inclusion and exclusion rules defined in the main study which were outlined in the preceding sections. The selected project falls under the Strategic Infrastructure Projects category number 7 (SIP 7) and qualified as a megaproject based on size of budget, number and diversity of stakeholders involved and so on. The selected interviewees qualified as comprised of senior project managers as required under the main study. All the 5 interviewees involved at least held a degree qualification in either the built environment and/ or project management. Their average project management experience ranged from 5 to over 20 years. With respect to their involvement on the project under study, their experience ranged from 18 months to 4 years. These attributes were considered sufficient to qualify the interviewees as experienced enough to both understand and articulate the subject matter and elements addressed in the interview. Consequently, the sampling frame was considered suitable and will be maintained for the main study.

The sample size was guided by recommendations from literature where it has been exhorted that pilot study samples should be between 10 and 20 percent the size of the main study samples (Hertzog, 2008; Lancaster, 2015). Consequently, the 5 semi-structured interviews which were used under this study complied with this suggested guideline. Some authors have also posed that 4 to 5 interviews constitute a generally acceptable sample size for PhD research pilot studies (Hazzi & Maldaon, 2015; Hertzog, 2008; Lancaster, 2015). Based on these suggested guidelines, this pilot study poses that the main study's proposed sample size of 42 interviews should be maintained.

Appropriateness of Data Collection Methods and Instrument

This study used the same protocol and set of open-ended questions as proposed under the main study's interview schedule. However, an analysis of the responses obtained revealed some of the potential pitfalls associated with the diversity of responses that were obtained from the open-ended questions. While different responses had been expected from the open-ended questions, the range of response diversity revealed some potential analytical challenges. To a certain extent this diversity of responses has been attributed to the interviewees' tenure on the project and consequently, their levels of awareness and understanding of applied processes and competence levels among the project teams. For instance, variations were found among responses to questions that focused on the existence and application of management processes on the project. These variations were particularly found in responses provided by professionals who have been working on the project for about 18 months as compared to those who have been on the project for over 4 years.

In order to minimise the range of responses provided, insights were drawn from similar studies where semi-structured group interviews were used instead of individual interviews (Brooks & Locatelli, 2015). These group interviews have been upheld for

enabling the experts to share their experiences and consequently core-create meaning regarding the different elements of the study constructs (Colucci, 2008; Kinchin, Streatfield, & Hay, 2010). Other studies have also complemented the group interviews with integrative engagement tools such as decision matrices and cognitive maps (Mojtahed, Baptista Nunes, Tiago Martins, & Peng, 2014). Consequently, this study underscored the importance of utilising similar complementary methods under the main research in order to manage the diversity of responses and also utilise the collective experience of expert groups.

The research instrument was also evaluated against the planned duration. On average each of the interviews was found to have exceeded the planned 1-hour duration by between 10 and 20 minutes. This was attributed to two main reasons. Firstly, the interview guide consisted of main questions and pre-planned probes. The latter were carefully designed to ensure that none of elements of the main study's constructs inadequately addressed. However, the pilot interviews resulted in additional probing questions which had to be asked to follow-up on issues that emanated from the open-endedness of the interview questions. The net effect was a blotted number of questions which consequently, compromised the interview duration.

Secondly, the interview protocol had been designed to distinguish questions in line with the different study objectives. Consequently, a number of questions were repeated under management processes and competences. For instance, questions about the flexibility of project management procedures, decentralisation of decision making, change management processes and contract management had been asked twice under management processes and management competences. This resulted in resulting in response redundancy. In order to address this ambiguity and redundancy, this pilot study underscored the need for reviewing the interview protocol by merging some of the questions based on the subject matter under investigation instead of objectives. This study also posed the need to keep the number of pre-planned probing questions to a minimum in order to allow room for additional follow-up probes within the planned time constraints.

The semi-structure interview schedule was also assessed in terms of the clarity of research questions. The assessment mainly focused on establishing the extent to which the interviewees struggled to understand the subject matter and terminology used under each of the questions. Indicators such as the number of times interviewees sought clarity on the subject matter and terminology as well as the precision of answers provided for the different questions were used to assess the extent to which the interview questions were easily comprehended. During the pilot interview it was found that none of the participants either struggled with the subject matter or the terminology used under the different questions.

In terms of the terminology used a short glossary covering key the terminology used including complexity, competences, project management processes and governance procedures and so on was provided and explained beforehand to guide the interviewees. By the time the interviews commenced, these terms were well understood. All the interviewees were also familiar with project management and governance processes as well as the main guides provided by institutions such as the South African Council for Project and Construction Management Professionals (SACPCMP), the Project Management Institute's (PMI) Project Management Book of Knowledge (PMBOK) Guide and the Engineering Council of South Africa's (ECSA). Minor variations in the responses were largely attributed to the interviewees' different

backgrounds and experiences. For instance, while some interviewees referred to a "Project Charter" as the governing document for the project others referred to it as an "Inception Report". Similarly, some respondents used the term "workstreams" while other used "functional lines" when referring to the specialist segments of the project structure. Consequently, where these terms were used interchangeably under this study. The outcomes of the pilot study resulted in some important decisions that will be used in reviewing the semi-structured interview guide and data collection processes before the commencement of the main research. These different aspects are summarised in Table 2 below.

Table 2: Findings and Required Reviews for Main Study

ELEMENTS	KEY FINDINGS	REQUIRED ACTIONS
Logistical aspects	Interview exceeds planned duration.	Combine questions and sequence them based on subject matter.
Proposed research approach	Qualitative approach was upheld.	Maintain research approach.
Proposed sampling frame	Sampling frame was upheld.	Maintain the sampling frame
Data collection instrument	The diversity of responses is too high and must be controlled to avoid data analysis challenges.	Use groups instead of individual interviews. Complement with interactive methods such as decision matrices or cognitive maps.
Proposed sample size	4-5 interviews or 10-20% of main study sample size are adequate.	Maintain sample size (minimum of 5 experts in each of the proposed group interview sessions).
Clarity of questions	Questions were easy to understand and terminology used was well understood.	Maintain the terminology used but complement with a short glossary of terms.
Instrument validity and reliability	Only face validity and reliability assessed. Further assessments needed to improve the validity and reliability.	The instrument will be assessed by at least 2 research experts before main study commences.

CONCLUSIONS

The findings from the pilot study provided some important lessons which need to be incorporated in reviewing the proposed methods, tools and processes before undertaking the main research. The review process will assist in addressing potential pitfalls and logistical challenges in undertaking the main research. In addition to reviewing the interview schedule, questions and protocol, the data collection instrument will be presented to at least three subject experts for further face validation and reliability assessments prior to the commencement of the main study. Additionally, Cronbach's alpha will be used to further assess the internal validity of the interview questions. The researcher will also explore the possibility of

complementing the semi-structure group interviews with interactive methods such as decision matrices or cognitive maps to co-create meaning and manage the diversity of responses. Given the sample size used in undertaking this study and the required reviews to the research methods, tools and processes, the resultant data will not be used in the main study. Only new data collected using the revised tool will be used to test the main study's proposition and to address the research questions.

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CAUSES OF THE EMIGRATION OF SOUTH AFRICA'S CONSTRUCTION INDUSTRY PROFESSIONALS

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Professionals within the South African construction industry are emigrating to developed countries. This is due to globalisation and general construction industry advancement throughout the globe. This paper aims to evolve measures, which could be used within the South African construction industry to mitigate the extent to which professionals emigrate to developed countries. A review of literature was followed by a mixed methods empirical study. Descriptive survey research in the form of a questionnaire was used to collect primary data. The study was conducted within the Nelson Mandela Bay Metropole (NMBM) and data was obtained from a sample of construction managers, construction project managers, as well as quantity surveyors. The findings indicate that: infrastructure investment is important to the advancement of the construction industry; emigration of skilled professionals, including young graduates leads to 'brain drain'; the South African construction industry is not conducive to its employees' growth; incentives as well as growth prospects lead to job satisfaction thus commitment to the organisation, and lastly, emigration of skilled professionals hinders the effective knowledge transfer to the younger generation of the industry. Based on the findings of this paper, it can be concluded that the emigration of industry professionals, results in 'brain drain', furthermore it is caused by organisational dissatisfaction, which ultimately leads to decreased commitment; and this could be mitigated by creating more opportunities for growth. To reduce the effects of emigrating professionals, organisations should consider their employees' satisfaction with the organisation return on its investment in the young graduates.

Keywords: Emigration, Infrastructure, Job Satisfaction, Organisational Commitment, Professionals

INTRODUCTION

The South African construction industry has been envisioned to play a significant role in the country's economic growth, in addition to producing structures that contribute to productivity improvement, as well as quality of life. However, this can hardly be achieved when the rate at which the industry's professionals emigrate is disproportional to the rate at which young professionals are employed within the South African construction industry.

The present situation in the construction industry is that highly skilled employees within the construction industry, as well as young construction graduates are emigrating from South Africa in pursuit of 'first world' construction opportunities. These working opportunities consist of mega construction projects, such as the Dubai International Airport, which play a considerable role in the transformation of a country's infrastructure and overall gross domestic product (GDP) (Kalthoff, 2015).

This study endeavours to contribute to the knowledge base of the South African construction industry by evolving measures to mitigate the extent to which

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professionals within the South African construction industry emigrate. The main objective is therefore to determine why professionals within the South African construction industry are emigrating.

LITERATURE REVIEW

Skills foregone

To understand the impact of emigrating construction industry professionals on South Africa, the skills and experience possessed by emigrating professionals needs to be placed in perspective.

According to the South African Council for the Project and Construction Management Professions (SACPCMP) (2009), the following are categories in which candidates may apply to register with the council. Each category has its own criteria, which must be met by the applicant:

- Professional Construction Project Manager (Pr. CPM);
- Professional Construction Manager (Pr. CM);
- Candidate Construction Manager, and
- Candidate Construction Project Manager.

To register with the South African Council for the Quantity Surveying Profession (SACQSP), as a candidate Quantity Surveyor (QS), a 480-credit university degree coupled with a minimum of three years in training is essential. Having obtained a degree and relevant work experience, professionals are subjected to an Assessment of Professional Competence (APC) interview. Following the interviews, professionals can then undergo Professional Quantity Surveying training.

In developing countries, education is either partially or totally subsidised by the government and emigrants leave before they can repay their debt to society (Docquier, 2014). The emigration rate of professionals far exceeds that of low skilled workers in almost all countries. In receiving countries that experience a shortage of professionals, employers will attract a developing country's professionals by providing job opportunities (Lowell & Findlay, 2002).

Causes of emigrating graduates and professionals

Political factors

According to Brink (2012), highly skilled persons have a high mobility level and may be 'pushed' if they are dissatisfied or disagree with a government policy. A survey conducted by Brink (2012) revealed that 29% of the respondents approved of government performance, meaning that there were low levels of satisfaction, 18% responded that the government could be trusted, and 27% responded that the government was interested in its citizens' opinions. The introduction of affirmative action (AA) into South African legislation resulted in discontentment of highly skilled individuals who then resorted to emigrating from the country (Rasool & Botha, 2011).

Socio-economic factors

The evolution of complex technology, demographics, and social, economic and political factors has brought about an increasingly internationalised interdependence as well as mobility of capital, goods, services, technology, knowledge, and people (Cortina, Taran & Raphael, 2014).

The following factors in a country influence emigration rates:

- GDP per capita in the country;
- Rule of law in the country;
- Effectiveness of the national government;
- Economic freedom that the country provides, and
- Education opportunities available in the country.

Dissatisfaction with and lack of commitment to organisations

Organisational commitment (OC)

On a broader scale, OC refers to the motivation and morale of employees (Panda, 2008). However, a more acute definition of OC is stated by Leveson, Joiner and Bakalis (2010), as a situation in which an individual identifies with the organisation in which they work, as well as its goals and therefore wishes to maintain membership to realise these goals. Individuals who identify with the values and goals of the organisation in which they work have elevated levels of affective commitment, which has a negative relationship with turnover. Because the success of the built environment, specifically the construction industry, which is driven by profitability, it is easy for organisations therein to overlook the importance and impact of OC. Numerous studies have revealed that highly educated individuals identify greater benefits from emigration because they are presented with better career opportunities in developed countries than persons with lower educational levels.

Job satisfaction

Workers who exhibit elevated levels of job satisfaction generally enjoy their job; they perceive the environment in which they work to be just, and that their job provides them with positive features in terms of variety, challenge, remuneration, security, autonomy, as well as pleasant work relationships (Bakotić, 2016). Lack of participation by workers in decision-making is one such example, which may lead to the dissatisfaction of employees in an organisation. According to Hartman (1995), cited by Miller, Haskell and Thatcher (2002), the social integration theory of emigration suggests that the greater a person's involvement in a social institution, the greater the person's attachment to the society in which that institution operates and hence the lower their intention to emigrate. The consequences of job dissatisfaction are adverse and are especially detrimental to the organisation. Notable consequences include absenteeism, turnover intentions, and turnover (Oyewobi, Suleiman & Muhammad-Jamil, 2012). Oyewobi et al. (2012) argue that built environment professionals such as quantity surveyors, are more likely to be satisfied with and motivated by their jobs if they are afforded adequate recognition, and better opportunities for growth within their careers.

Inadequate infrastructure development and construction industry growth

State of infrastructure investment in South Africa

Infrastructure is an important driver and stimulant of a country's economic development (Winters, 2014). This is confirmed by a study conducted by the Accelerated and Shared Growth Initiative South Africa (ASGI-SA), which determined that inadequate infrastructure is amongst the six most important deterrents of growth in South Africa (Fedderke & Garlicky, 2008). The amount the South African government allocates to infrastructure spend is a good determinant of the success of

the country's construction industry (Price Waterhouse & Coopers, 2015). The public sector is a major contributor to infrastructure development, as it is responsible for R150 billion in civil engineering works and R25 billion in non-residential projects annually (cidb, 2012). In his budget speech, the Minister of Finance, Gordhan (2016), stated that there had been a R870 billion allocation to infrastructure spend over the next three years, which is R23 billion more than the R847 billion allocated in 2014. While this is obviously delightful for South Africa, Price Waters and Coopers (2015) states that the tough economic environment experienced by the country is also experienced by the construction industry because of its benefits from infrastructure investments by the public sector.

The state of the South African construction industry

In South Africa, the state of the construction industry is measured using key performance indicators. The Construction Industry Indicators (CIIs) have been developed to inform the country with respect to the status of performance within the industry and are used as a tool to enhance the performance thereof (cidb, 2014).

According to Price Waters and Coopers (2015), the capital expenditure by the public sector increased by 13% in the 2014 fiscal year, having a total expenditure in the year amounting to R255 billion. The new construction work contracted increased by 3% to R125 billion, whereas plant, machinery and equipment purchased increased by 40% to R94 billion. This indicates that the public sector spent less on new construction works. There has been a steady annual increase of 2.3% in the expenditure growth trends since 2010. Furthermore, in the lower economic growth environment, fiscal pressures impacted on discretionary capital expenditure. Therefore, these fiscal pressures will impact on the future expenditure. The challenges experienced by the construction industry have resulted in a decrease in anticipated expenditure.

Mega structures

The Construction Industry Institute Research Team 315 (2015) defines a mega-project as one with the following complexity criteria: considerable number of stakeholders; many interfaces; a provocative project location; an inadequate supply of major resources; unfamiliar technology; difficult regulatory techniques, and extensive infrastructure requirements. The construction of mega-projects requires a peculiar set of skills, especially from a design and managerial point of view, in addition to large-scale investments (Ahmed & Othman, 2013). To mitigate the slow development of mega-projects in developing countries, Ahmed and Othman (2013) recommend that construction enterprises in developing countries offer competitive remuneration packages and work opportunities. In effect, this will attract the relevant professionals as well as graduates who may have emigrated to return and retain those who have not emigrated.

Impact on recruitment practices

Recruitment strategies in organisations vary according to the degree to which skill strategies exist or are abundant. Clarke and Hermann (2007) assert that recruitment difficulties in the construction industry are attributable to: limited applicants with the necessary skill set; too much competition for applicants between employers, and lack of experience, attitude, motivation, and personality in applicants. With increasing construction activity on an international scale, developed countries continue to recruit employees from developing countries, which places substantial pressure on the professional labour market in both the receiving, and the sending countries. While the

manner in terms of which recruitment into the industry affects professionals' decision to emigrate, the emigration of highly skilled professionals affects the state of the labour market of an industry. Unfortunately, the emigration of professionals from South Africa to other countries has a significant impact on the employment and wages of those who have not emigrated.

When the skills shortages in the construction industry are at a peak and training is low, secondary labour markets develop. Such labour markets are dependent on external recruitment markets, which are characterised by employees who lack empowerment, instability of employment, the abuse of managerial power, lack of training and low qualification levels. To the extent that in the short run, the remaining professionals are price makers, skills shortages in the construction industry of the sending country may continue to escalate due to the inability or unwillingness of firms to offer competitive remuneration packages together with attractive working conditions.

Effects of emigration

'Brain drain'

In quantifying the 'brain drain', it has been observed that the highest emigration rates are prevalent in middle income countries, and university graduates from middle income countries are more likely to emigrate in pursuit of working opportunities in developed countries. Emigration is a cost to the government, in that it causes social welfare losses for the home country. The cost of emigration is that highly skilled emigrants do not pay taxes in their home country once they have left. Another negative effect is inducing shortages of human resources in major activities, for example, when professionals emigrate in disproportionately large numbers, which then impedes a country's ability to adopt modern technologies (Docquier, 2015).

Although the impact of emigration is seen to have ramifications such as 'brain drain', a model developed by Agrawal, Kapur, McHale and Oettl (2011) suggests that the access of domestic innovators to knowledge drives innovation. 'Brain drain' has been viewed as unidirectional in nature, and in today's globalised economy, knowledge is multi-directional and hence brain drain has been transformed into 'brain circulation' through diaspora networks. Through such networks, the impact of emigration can be reduced, and as a result, highly skilled emigrants are able to make a meaningful contribution to their countries of origin, via their body of knowledge.

Economy

There are numerous micro and macro-economic factors that result from the exodus of skilled professionals. A concept evolved by Bhorat, Meyer and Mhlatseni (2002) states that because of the general skills shortage in South Africa, there has been an increased demand for highly skilled employees. Naturally, the skills labour market will respond by demanding higher wages. However, with the effect of emigration of the highly skilled individuals on skills shortage, the remaining skills pool demands an even higher wage relative to the exacerbated skills shortage. The obvious consequence of emigrating professionals is the shortage of skills which, as stated by Atoyan, Christiansen, Dizoli, Ebeke, Ilahi, Ilyina, Mehrez, Qu, Raei, Rhee and Zakharova (2016) could result in upward pressure on domestic wages. These outflows of skilled labour could then lower productivity in the presence of human capital externalities, as well as low extent of substitutability between skilled and unskilled labour. This confirms the concept stated by Bhorat et al. (2002). In effect, Atoyan et al. (2016) argue that emigration can exacerbate competitiveness. Although there are positive

linkages to remittances, Atoyan et al. (2016) highlight that remittance inflows could lead to an appreciation of the exchange rate and wage reservation, and reduce the supply of labour.

Maintenance involves a combination of both technical and administrative actions which contribute to the protection and satisfactory operation of an asset (Wahab and Basari, 2013). The wear and tear of building components creates hazards which in turn lead to building failure thus putting lives at risk while subsequently becoming costly to rectify (Hong Kong Buildings Department (2002). Effective building maintenance therefore requires preplanning of all the foreseeable mechanical components that will require maintenance in future and the time the maintenance will be required (Lateef, 2008). There are various forms of maintenance, but this research will focus mainly on preventive maintenance. According to Zulkarnain et al (2011) preventive maintenance is maintenance carried out at predetermined intervals or corresponding to prescribed criteria and intended to reduce the probability of failure or the performance degradation of an item. Preventive planning avoids overworking of building mechanical components beyond their life span (Ishak, Chohan and Ramly, 2007). This helps in the prevention of breakdowns that can lead to undesirable or even fatal situations. The next section reviews building services installation.

Building Services Installations

According to the Hong Kong buildings department (2002), common mechanical components that require regular checking and maintenance within a building include;

a) Water supply

Fault warning signs are usually detected by insufficient water pressure, brownish water and sudden rise in consumption. The probable causes could be related to pipe blockages and or leakages, rusty pipes, and pump(s) failure.

b) Electricity supply

Electrical faults are usually signalled by the stoppage of supply, heating of switches, electric sparks and shocks. These are most likely caused by the failure of a fuse, circuit breaker, overloading, uneven distribution of phases and inadequate earth bonding.

c) Fire services

Fire services are important from a safety perspective and the symptoms of failure are normally detected through inadequate water pressure or no water supply and malfunctioning alarm systems. These faults are probably caused by pipe blockages and leakages, pump failure and defective alarm wiring.

d) Lift and escalator

Stoppage, excessive noise during operation, unstable lifting, doors not closing properly, and occasional overrun are some of the warning signs of defective lifts and escalators. These could be due to ageing of parts, landing misalignment and mechanical failure.

e) Air conditioning/heating

Default warnings are usually detected the system not being cool enough or warm enough, noisiness and poor indoor air quality and are mainly caused by malfunctions.

f) Other installation services that require regular checking and maintenance include, gas supply, solar supply, security systems and telephone signalling systems.

Present day buildings are becoming more complex, making the need for operating and maintaining information vital. Effective maintenance now requires the facilities management team to obtain and integrate diverse facility information including but not limited to building elements, operational costs and maintenance (Arayici, Onyenobi and Egbu, 2012). The next section introduces BIM which is regarded as key in preventive maintenance of buildings. This is since BIM can store all the information of a building and makes it easy for users to retrieve the information when needed.

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Building Information Modelling

Pasarnezhad and Dimyadi (2014) argue that accessibility of information is vital to efficient management and operation of facilities. Without information of the facility, the job of a facilities manager is limited as maintenance to the facility becomes difficult to implement. As a result, high time and monetary costs are experienced by the owners of the facility (Hong Kong Buildings Department, 2002). Most contractors are required to handover drawings and any other documents containing information about the building for ease of reference by the facilities managers (Kassem, 2015). Lee et al (2012), pointed out that about US\$10.6 billion out of US\$15.8 billion losses caused by interoperability inefficiencies are attributed to the operations and maintenance phase of a building. Research has proven that BIM will enable the smooth handover of real time information for example Motamedi et al (2014) noted that the 3D visualisation which comes along with BIM helps facility managers to use their cognitive and perceptual reasoning for problem solving. The availability of information will enable preventive maintenance to be carried out smoothly as all the information about the mechanical components installed as part of the building finishes will be at the disposal of the facilities manager.

The BIM task group (2013) suggested that the adoption of BIM is expected to provide ways for managing information about building operation which can be utilised in future designs. Teicholz (2013) asserts that, BIM brings positive value as it will improve the quality and reliability of data resulting in increased workforce efficiencies. The BIM task group (2013) summarised the benefits as follows: “BIM will provide a fully populated asset data set into computer aided facilities management (CAFM) systems and therefore reducing time wasted in obtaining and populating asset information enabling us to achieve optimum performance quicker, reducing running costs and refine target outcomes”.

Azhar (2011), agrees indeed that, facilities management departments stand to benefit through BIM as it can be used for works such as renovations, space planning and maintenance operations. The importance of BIM can be discovered in the event of say, a maintenance problem such as a leaking pipe. BIM will provide information on the exact location of the problem, how the pipe relates to other pipes within the building, thus making it easier for the team to identify and rectify, save time and money in the process (Arayici et al, 2012). Furthermore, risk management allows facilities managers to balance the operational and economic costs of building protective measures (Stoneburner, Goguen and Feringa, 2002). As noted by Stoneburner et al (2002), risk management is not unique as it permeates across all spectrums of decision making. The following section reviews literature relating to the need for risk assessment in the use of BIM in preventive maintenance.

The Need for Risks Assessment

Risk is an unknown, unexpected, undesirable and unpredictable endeavour (IRM,2002). Risks can be classified as physical, technological, financial and economic and political and environmental (Zavadskas, Turskis and Tamosaitiene, 2010). All projects have some element of risk, be it cost overruns, delays or failure of the building performance to meet expectations (Pryke, 2016). Furthermore, Pryke (2016) is of the view that adopting BIM cannot eradicate all risks but can de-risk most sections throughout the project life cycle. According to case study results carried out

by Pryke (2016), savings of up to 45% on unplanned maintenance activities and 20% on planned maintenance tasks have been achieved using BIM. Pryke further notes that the response rates to problems have also improved by 54% and productivity increased by 50% during planned preventive maintenance tasks.

According to the IRM (2002), risk management gives value and protection to organisations and their stakeholders through; the provision of an organisational structure enabling a consistent and controlled manner of future activities, optimisation of operational efficiency, the development and support of people and the organisation's knowledge base, protection and enhancement of assets and the company image, reduction of volatility in the non-essential areas of business, contributing to more efficient use/allocation of capital and resources within the organisation, improvement in decision making, planning and prioritisation by comprehensive and structured understanding of business activity, volatility and project opportunity or threat.

Zavadskas et al (2010) affirm that, risk analysis involves risk identification which seeks to determine an organisation's exposure to uncertainty. IRM (2002) emphasises that the identification process requires an intimate knowledge of the organisation, the market in which it operates, legal, social, political, and cultural environment in which it exists, as well as the development of a sound understanding of its strategic and operational objectives, including factors critical to its success as well as threats and opportunities related to the achievement of the objectives. Business activities and decisions can be classified in different ways which include but is not limited to strategic, operational, financial, knowledge management and compliance.

Evaluation of risk is critical in decision making about the significance of risks to the organisation and whether each specific risk should be accepted or treated. In fact, risk evaluation is important to compare the estimated risks against the organisation's established risk criteria. Next is risk treatment which is a process of choosing and implementing measures to modify the risk. This includes risk control or mitigation, risk transfer just to mention a few.

RESEARCH METHODOLOGY

Existing literature is used to evaluate the need for research relating to the risks associated with the use of BIM in preventive maintenance of the mechanical components of buildings. This is since some of these publications are written by experts thus resulting in the collection of valid information based on authenticity, representativeness, meaning and credibility (Platt 1981; Scott et al 1990). The literature review method enables the researcher to review the existing knowledge regarding the use of BIM in building maintenance. This helps the researcher to identify strengths and weaknesses of the existing knowledge, which helps the researcher to identify a gap, in this case the gap is the risks associated with the use of BIM in preventive maintenance.

DATA ANALYSIS

Analysis is important in gaining a better understanding of the collected data (Creswell and Clark, 2007). Unquestionably, the remark by Lateef (2008) that, effective building maintenance requires preplanning of all the foreseeable mechanical components that will require maintenance in future and the time the maintenance will be required, is fundamental in understanding the basic need of risk management in building

maintenance. This remark emphasises the need for preplanning in order to maintain the operation of the building at an optimal level.

Lee et al (2012) claims that, about US\$10.6 billion out of US\$15.8 billion losses caused by interoperability inefficiencies are attributed to the operations and maintenance phase of a building. These figures are telling and should thus raise alarm bells for the need to properly manage the building during its operation phase. This calls for intensive research aimed at reducing the claims made by Lee. The research should cover the operation phase including the risks associated with using concepts such as BIM in trying to reduce the maintenance costs. The BIM Task Group (2013) and Teicholz (2013), both agree that BIM brings positive value, but no mention is made on the need for risk management in their research. Thompson and Miner (2007), emphasize that, prior to the full implementation of BIM, the risks associated with its use must not only be identified and assigned, but the cost of implementing it should also be paid for. This clearly shows the need for identifying and dealing with the risks associated with the use of BIM before it is implemented. Without a doubt, the views of Thompson and Miner (2007) provides the motivation for this research which seeks to evaluate the need for assessment of risks associated with the use of BIM in preventive maintenance of mechanical components of buildings.

Thomson and Miner (2010) point out that, regardless of all the savings and efficiencies associated with the use of BIM, it is vital to note that its use is not without risk. Thomson and Miner (2010) emphasise that the inaccuracy of the BIM generated data can be disastrous. Azhar (2011) broadly classifies BIM risks into legal (contractual) and technical. The first risk identified by Azhar (2011) is that of ownership of BIM data. Disputes are most likely going to arise between the Owner of the building and the project team on who owns the BIM data. Obviously, the owner, as the funder of the project would assume ownership whereas the project team, having played a role in the collaboration process, would also want ownership rights of the information. This is also affirmed by Thomson and Miner (2010) who add that; there is a need to determine ownership of the generated BIM data as well as its protection through copyright and other legal frameworks. It is critical to take note of the fact that the realisation of the model's potential must not be affected in spite of these challenges.

The second risk as identified by Azhar (2011) arises from the issue of who is supposed to control data entry. According to Thomson and Miner (2010), taking responsibility for updating BIM data and ensuring its accuracy involves a lot of risk. Considering a scenario where say, the owner of the building sues the project team over a perceived maintenance program error, there is need to know who lies with the responsibility. However, Azhar (2011) suggested that the best way to deal with these risks is to have "collaborative, integrated project delivery contracts in which risks of using BIM are shared among project participants among with rewards." Tomeka and Matejka (2014), reiterate the importance of the topic of risks in BIM by suggesting that the use of BIM creates big impacts on standard risk levels.

Pryke (2016) points out that the adoption of BIM cannot eradicate all risks but can de-risk most sections throughout the project life cycle. What's more important in the work of Pryke (2011) is the fact that there has been an acknowledgement that there are certainly risks associated with the use, the research done by Pryke in 2011, reports that up to 20% savings have been achieved from the use of BIM in maintenance of buildings. This figure is significant considering the fact that lifecycle costs of

buildings are higher during the operation and maintenance stages. Pryke's research also claims that there has roughly been a 54% improvement in response rates to problems through the use of BIM in maintenance of buildings. These statistics clearly show that BIM has some major benefits in maintenance and will likely result in more organisations adopting the concept. The major challenge though is that BIM risks need to be assessed for improved results.

CONCLUSIONS

In conclusion, there are numerous risks that arise in using BIM for better preventive maintenance of building services installations. While risk assessment and management have a potential to improve the use of BIM, no formal research has focused on risk management lately. The fact that maintenance should and can not be circumvented coupled with the benefits of using BIM in preventive maintenance makes it almost impossible not to consider the issue of risk. Extensive research on the risks associated with BIM in preventive maintenance is therefore vital. This should involve the identification of all potential risks and coming up with treatment options for those risks. While this paper looks at the negative risks associated with the use of BIM in preventive maintenance of building services installations, there is a need for further research which looks at the positive risks associated with its use in preventive maintenance as well.

The following recommendations can be made for future studies:

- A proper risk management process for the use of BIM in preventive maintenance of building service installations needs to be implemented.
- With such proper risk management processes, facilities managers can actively consider the use of BIM in preventive maintenance of building services installations.
- Response to the list of available risks for BIM implementation associated with preventive maintenance of building services installation is highly recommended.

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RESOLVING CLIENT LINKED DELAY IN CONSTRUCTION PROJECTS IN INDIA: A CONCEPTUAL SYSTEM DYNAMICS MODELLING APPROACH

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Clients are one of the major stakeholders in construction projects and it is therefore argued that client induced factors contribute to delay in construction. Using a survey research method and conceptual System Dynamics modelling approach, this study identified the influence of various client related factors causing delay in construction projects and evolved mechanisms based on the causal feedback relationships among the various client related factors influencing delay in construction projects which could assist the project stakeholders to comprehend the inter-linkage among the variables that cause delay, and make appropriate policy interventions to resolve the challenges of delay in construction projects in Indian context. It is revealed that delay in progress of payments by owner, slowness in decision making process by owner, change orders by owner during construction, poor communication and coordination by owner and other parties, late in revising and approving the design documents by owner, delay in approving shop drawings and sample materials by the owner, and delay to furnish and deliver the site to the contractor by the owner are the major client/owner related factors, which cause delay. However, conceptual SD model induced mechanisms suggest that timely decision making which can be augmented by the availability of requisite information, and effective communication conjoined with the availability of fund and adequate budget allocation can ensure timely progress in payment that essentially shall able to reduce construction delay.

Keywords: Client, Communication, Construction, Fund, System Dynamics modelling

INTRODUCTION

The construction industry in India contributes significantly to the Indian economy. In last five years it was accounted to 6.0% to 9.0% contributions to the Gross Domestic Product (GDP) of the country. The sector is also generating significant employment consistently, and it is projected that it will grow at a rate of about 8% to 9% per year and will add about 2.5 million jobs per year. However, contrary to this economic potential, the construction industry is faced with the challenges of low productivity, and time and cost overruns, which range from 20-25% in building projects to 50% in other sectors like power, petroleum, railways (Ernst and Young, 2011; Gupta, Gupta, and Netzer, 2009). More importantly, delay is a major cause of concern in majority of the construction projects in India. There are plenty of investigations made on to find the intrinsic factors and causes of delay, which are available in the main stream

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literature of project management and construction management research (Assaf, Al-Khalil, Al-Hazmi, 1995; Assaf and Al-Hejji, 2006; Das, 2015; Olatunji and Das, 2015; Das, and Emuze, 2017; Doloi, Sawhney, and Iyer, 2012; Doloi, Sawhney, Iyer, and Rentala, 2012; Iyer, and Jha, 2005). It is evident from various investigations that availability of quality professionals, quality performance, time, and cost are major challenges faced by the construction industry. Besides, time overrun is the most significant factor that results the cost escalation. Such challenges are emanated from various stakeholders such as clients, contactors, consultants and designers, etc. However, client/owner related factors are argued to be major concerns of delay in addition to other various factors linked to contractor, design, equipment, project management, etc. Evidences from literature suggest that although, the client linked causes and factors that engender delay have been identified, it is argued that most of studies failed to examine that how the identified causes work together in a mechanism and influence the occurrence delay (Doloi, Sawhney, and Iyer, 2012; Doloi, Sawhney, Iyer, and Rentala, 2012). It is therefore argued that area-specific identification of the causes and factors without understanding the collective influence on schedule performance or delay does not provide convincing arguments for preventing delay in the context of Indian construction projects (Doloi, Sawhney, and Iyer, 2012; Doloi, Sawhney, Iyer, and Rentala, 2012). The reason being understanding of the mechanisms and causal relations are pivotal to quantify schedule performance under various scenarios and develop policy interventions to reduce delay and improve schedule performance. So, the main concern remains with non-understanding of the causal relationships among the factors and mechanisms and not foreseeing of the unwarranted events, which cause delay. In the Indian context, it is also observed that investigations on causes of delay because of clients or owner's attributes are limited. Moreover, there have been scarcely any significant research conducted with regards to interlinkage of the various client linked factors, which develop mechanism that engender delay in construction. In other words, investigations relating to development of policy/strategic interventions or mechanisms based on the causal relationships among the client induced factors to resolve the challenges of delay in construction projects in India are observed to be scarce. Therefore, the objectives of the paper are to (1) to identify the influence of various client related factors causing delay in construction projects in Indian context, and (2) to evolve mechanisms based on the causal feedback relationships among the various client related factors influencing delay in construction projects, which could assist the project stakeholders to identify the activities and events, comprehend the inter-linkage among the variables that cause delay, and make appropriate policy interventions to resolve the challenges of delay in construction projects. The investigation was conducted by using survey research methodology and System Dynamics (SD) modelling approach. Findings suggest that delay in progress of payments by owner, slowness in decision making process by owner, change orders by owner during construction, poor communication and coordination by owner and other parties, late in revising and approving the design documents by owner, delay in approving shop drawings and sample materials by the owner, and delay to furnish and deliver the site to the contractor by the owner are the major client/owner related factors, which cause delay. These variables are interlinked with each other and function in causal feedback mechanisms creating a chain of actions, which influence the occurrence of delay. However, a mechanism However, remedial mechanisms involving timely decision making which can be augmented by the availability of requisite information, and effective communication, and availability

of fund and adequate budget allocation can ensure timely progress in payment, which essentially can reduce construction delay in construction projects in India.

RESEARCH METHODOLOGY

A survey research method was employed to collect primary data from the various stakeholders in construction projects in Odisha state of India. The survey was conducted by using a pretested questionnaire. The questionnaire was developed by incorporating most of the key factors under the client attributes causing delay, as observed from various literatures (Awasthi and Thomas, 2013; Desai and Meheta, 2013; Doloi et al., 2012; Odeh and Battaineh, 2002; Lo et al., 2006; Satyanarayana and Iyer, 1996; Semple et al., 1994) and testing and fine tuning it through a pilot survey in the study area.

A total of 120 questionnaires were administered among various professionals and stakeholders, who are selected from 28 large and medium construction projects in Odisha state of India through a random selection process. The respondents were selected based on their engagements in various construction related professional / managerial/ administrative/ ownership engagements and the experiences in the construction industry. Table 1 presents the profile of projects and respondents used for the survey. Various construction projects from which respondents were selected for survey include building (39.2%), roads (21.4%), bridges (14.28%), railway (7.14%), power plants (7.14%), and industrial complex (10.71%) projects. The respondents include project managers (16.67%), architects (10.78%), engineers and designers (13.73%), skilled technicians (8.82%), consultants (11.76%), estimators (Quantity surveyors) (10.78%), contractors (12.75%) and clients/owners (12.75%), were surveyed through semi-structured interview method. From the survey, out of the 120 questionnaires administered 102 responses (approximately 85% response rate) were returned.

Table 1 Profile of respondents

Project characteristics			Characteristics of Respondents			
Type of projects	Number	Per cent	Respondents	Number	Per cent	Average industry experience (range in years)
Buildings	11	39.28	Owners/ Clients	13	12.75	14-22
Roads	6	21.42	Project managers	17	16.67	8-15
Bridges	4	14.29	Consultants	12	11.76	7-18
Railway	2	7.15	Architects	11	10.78	6-15
Power plants	2	7.15	Engineers	14	13.73	13-20
Industrial complexes	3	10.71	Contractors	13	12.75	12-21

Total	28	100.00	Estimators	11	10.78	5-14
			Skilled Technicians	9	8.82	4-16
			Total	102	100	8.6-17.6

The respondents were asked to assess the perceived influence of the measured attributes in the form of an affirmative question by selecting one of the projects in which they had participated. A five point Likert scale (1= not influential, 2 = less influential, 3 = somewhat influential, 4 = significantly influential and 5 = most influential) was adopted for guiding the participants to provide their objective responses with varying degrees of influence of client related factors on construction delay (Doloi, et al, 2012; Gravetter and Wallnau, 2008).

Quantitative descriptive statistics analysis and Cronbach's alpha test of the data collected were conducted to observe the reliability of the data. Likert scale was employed to measure the relative influence of the variables in terms of a delay index (DI) (as obtained from the surveyed data) causing delay. The delay index is the mean score achieved from the responses of the respondents. Followed by, conceptual models by using SD modelling principles (Forrester, 1968; Sterman, 2000) based on the systems thinking process (Von Bertalanffy, 1974) were developed. The construction project was considered as the system or environment while developing the model. The influential variables, their positive and negative influences on the related variables and the causal relationships among them were used to develop the conceptual SD models. The causal relationships among the variables within and across the major parameters were developed based on the evidences observed from the literature, and discussions and experiences of the professionals surveyed. The causal relationships were developed by using a systematic process such as first the variables, such as, information, decision and action and environment (system) variables were identified (Olaya, 2012). Second, the variables were then connected with simple one-way causality in terms of one way linkages of information – decisions – actions – impact on the environment with their influence (i.e., information assisting in evolving decisions (policy interventions), decisions leading to appropriate actions, and actions influencing the environment (system)) (El Halabi, Doolan, Cardew-Hall, 2012; Olaya, 2012; Veniix, 1996). Third, once the one way causalities were established the feedback relationships were checked and established. Fourth, the constructed causal feedback relations were then discussed with the professional and experts in the field to check the veracity of the causal diagrams and relevant modifications with respect to the variable names, their polarity and causal relations as need be were made. Finally, modifications and amendments to the causal relations and conceptual models and validation were made to develop the final causal feedback relations and conceptual model. The valid causal feedback diagrams (causal loop diagrams) were then employed to develop the conceptual SD models.

RESULTS, CONCEPTUAL SD MODELS AND MECHANISMS

Major client related factors causing construction delay

Table 2 presents the client related factors and their level of influence in construction delay. The high Cronbach's α value (0.93) shows the reliability and acceptability of data. It is observed that the standard deviations (SD) are also within the acceptable

ranges, which show that there were low variations on the responses among the respondents. So, the results are considered as acceptable and can be used for further analysis. From the Table 2, it is apparent that delay in progress of payments by owner (DI=4.35), slowness in decision making process by owner (DI=4.20), change orders by owner during construction (DI=4.10), poor communication and coordination by owner and other parties (DI=4.05), late in revising and approving the design documents by owner (DI= 3.95), delay in approving shop drawings and sample materials by the owner (DI=3.85), and delay to furnish and deliver the site to the contractor by the owner (DI= 3.65) are the major client/owner related factors, which cause delay. However, factors such as suspension of work by owner (DI= 3.20) and unavailability of incentives from the client to the contractor for finishing ahead of schedule (DI= 2.85) have lesser impact on delay of construction.

Table 2: Significance of attributes and factors influencing delay in construction

Group/ Attributes	Factors	Delay Index (DI) (Likert scale Mean Score)	SD	Cronb ach'α	Rank in the group	General Rank across the groups
Client/ Owner	Delay in progress payments by owner	4.35	0.34	0.93	1	1
	Delay to furnish and deliver the site to the contractor by the owner	3.65	0.27		7	13
	Change orders by owner during construction	4.10	0.32		3	5
	Late in revising and approving design documents by owner	3.95	0.33		5	7
	Delay in approving shop drawings and sample materials	3.85	0.38		6	9
	Poor communication and coordination by owner and other parties	4.05	0.35		4	6
	Slowness in decision making process by owner	4.20	0.32		2	3
	Unavailability of incentives from the client to contractor for finishing ahead of schedule	2.85	0.26		9	21
	Suspension of work by owner	3.20	0.22		8	19

Conceptual models, understanding of the causal feedback relationships responsible for client induced delay and possible mechanisms for its reduction

Considering the influence of the factors as discussed above conceptual SD models have been developed to comprehend the dynamic causal feedback relationships among factors, which cause delay; and develop the possible mechanisms that can assist in developing policy interventions to reduce or eliminate delay in construction. In the

model, the causal feedback relations (loops), which essentially balance or disrupts the system (construction projects), and consequently augment delay are identified by balancing loops (B). On the other hand, the causal feedback loops, which reinforce the smooth functioning of the system and consequently assist in reducing or eliminating delay, are identified by reinforced loops (R). The causal feedback relationships among the influential factors and the conceptual SD model are presented in the Table 3 and Figure 1 respectively.

Causal feedback relations and conceptual SD model

As mentioned above and seen from Table 2, delay in progress of payments by owner, slowness in decision making process by owner, change orders by owner during construction, poor communication and coordination by owner and other parties, and delay in approving shop drawings and sample materials by the client are the major client/owner related factors, which cause delay although others factors contributes to lesser extent. It is observed that there exists cause and effect relationships among these factors, and they work through a causal feedback mechanism. Figure 1 manifests the conceptual SD model based on such causal feedback relationships. As shown in the Figure 1, slowness in decision making leads to delay in progress in payment, which cause delay and disrupts the system through balancing loop OB1. Also, poor communication leads to slowness in decision making and vice versa through another balancing causal feedback sub loop OB1A. So, sub loop OB1A aggravates the actions of balancing loop OB1. Besides, factors like change in orders during construction, delay in approving the drawing and materials, late approval of revision of designs and delay in furnishing the site delivery by the client are influenced by slowness in decision making and vice versa. On the other hand, effective communication among stakeholders (which can be enhanced by coordination among them) will assist in decision making that will facilitate timely payment and consequently will assist in reducing the construction delay from client's side. However, to achieve this, measures, such as, coordination among stakeholder that would lead to effective communication; availability of requisite information to aid timely decision making, and availability of adequate fund and budget allocation that would allow timely payment are necessary.

Thus, the feedback mechanism involving effective communication, timely decision making and timely payment will reinforce reduction in delay through reinforcing loop OR1. As a result, the disrupting effects of feedback mechanisms (OB1 and OB1A) are balanced or negated by feedback mechanism OR1. So, the causal feedback relationship among communication, decision-making, progress in payment and construction delay is the dynamic hypotheses, which influence delay and need to be attended to develop remedial mechanisms to alleviate the problem.

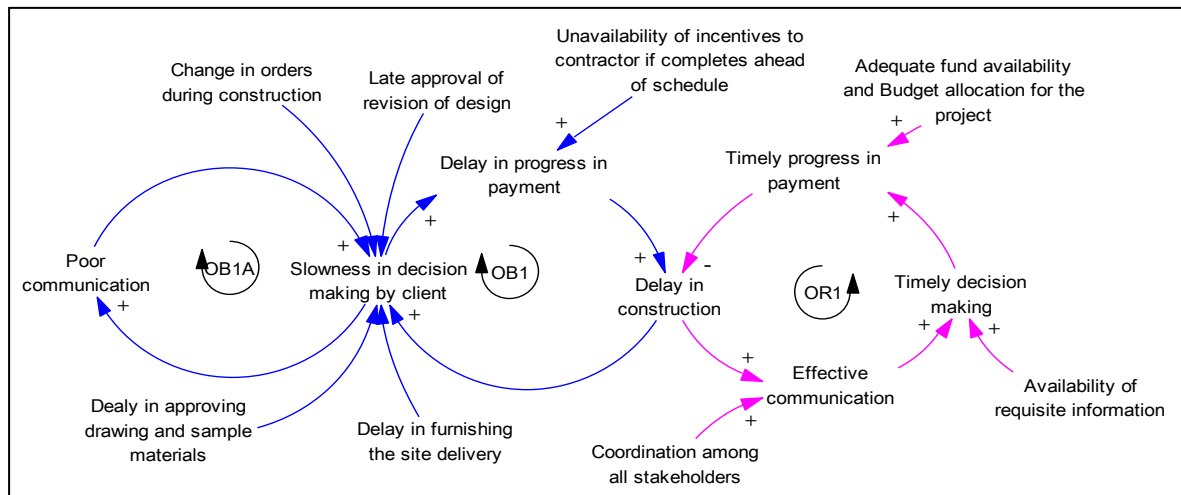


Figure 1: SD model based on causal feedback relations among the client/ owner related factors causing delay

Mechanism for Policy Interventions

Figure 2 presents causal feedback mechanisms derived from the dynamic hypotheses that are obtained from the SD models, based on which policy interventions can be derived. It shows that how construction delays are influenced by various client related factors. First, it is influenced by slowness of the decision making by the client, which is caused by several factors, such as poor communication, change in orders during construction, delay in approving the drawings and materials, late in approval of revised design, and delay in furnishing the site delivery. Second, delay in progress in payment, which is essentially caused by slowness in decision making. These variables are found to be connected in a chain of actions. However, timely decision making which is one of the most significant variables can be augmented with the aid of availability of requisite information, and effective communication. Timely decision making conjoined with the availability of fund and adequate budget allocation will ensure timely progress in payment, which essentially shall be able to reduce construction delay.

The mechanisms as presented in the Figure 2 also indicate that all the factors are linked to each other through a chain of actions actuated by causal relations, and influence each other through appropriate feedback mechanisms. It also clearly manifests how the factors influence each other and how the mechanisms work. So, the mechanisms provide the scope to diagnose the challenges at various stages of the construction work easily based on which timely and appropriate interventions can be taken to address the problem that would assist in reducing delay in construction projects.

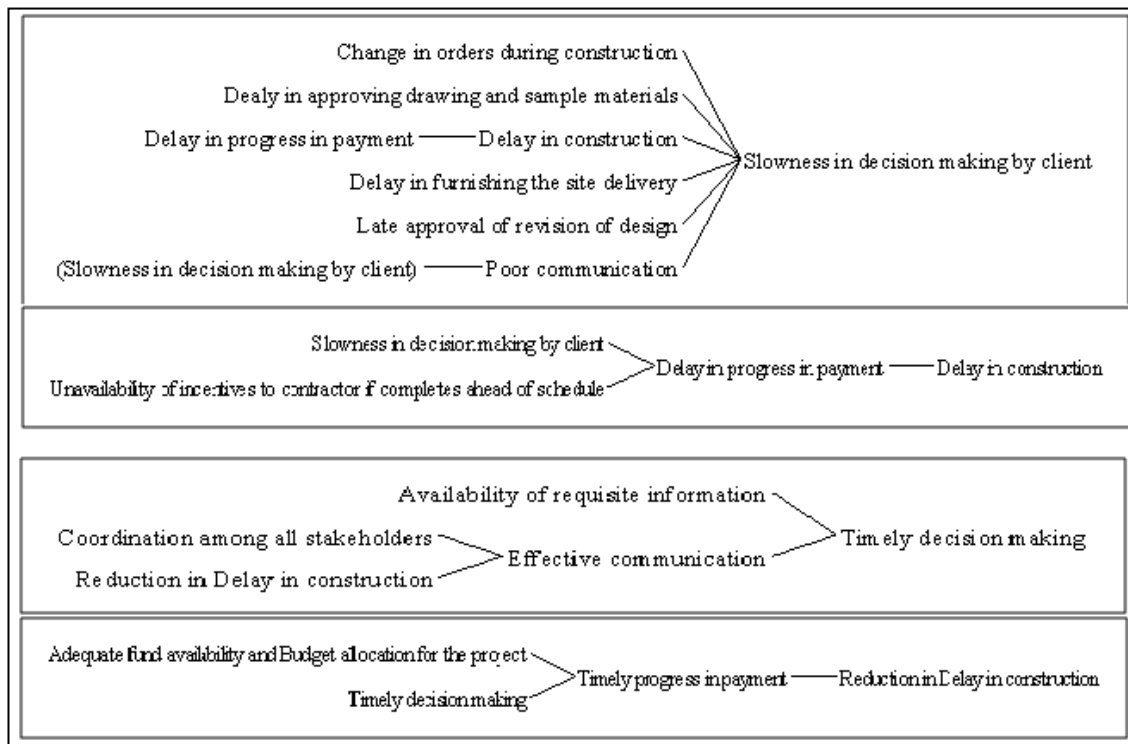


Figure 2: Mechanism to understand client related construction delay and its reduction

CONCLUSIONS

Delay in construction projects is a menace particularly in India. It leads to both appreciable cost and time overruns. Although, there were plenty of studies conducted to investigate the causes of construction delay, which vary depending on contexts, yet there are several causes, which are observed to be common in most of the projects. However, there is sparse literature available regarding the mechanisms, which could aid in developing policy interventions to reduce or eliminate construction delay. This challenge has therefore warranted the investigation. This investigation examined the various client induced factors that influence the occurrence of project delays in construction and evolved mechanisms based on the causal feedback relationships among the various client related factors influencing delay in construction projects. For realisation of these objectives a survey research method was used followed by development of a conceptual SD model. Before the conceptual SD model was developed, an evaluation was conducted based on a delay index developed with the exploratory survey data obtained from construction projects in India. It is revealed that delay in progress of payments by owner, slowness in decision making process by owner, change orders by owner during construction, poor communication and coordination by owner and other parties, late in revising and approving the design documents by owner, delay in approving shop drawings and sample materials by the owner, and delay to furnish and deliver the site to the contractor by the owner are the major client/owner related factors, which cause delay. The mechanisms from the SD model elicit that delay is influenced by slowness of the decision making by the client, which is caused by poor communication, change in orders during construction, delay in approving the drawings and materials, late in approval of revised design, and delay in furnishing the site delivery. Further, delay in progress in payment, which is essentially cause delay in construction, is engendered by slowness in decision making. However, timely decision making which can be augmented by the availability of

requisite information, and effective communication conjoined with the availability of fund and adequate budget allocation can ensure timely progress in payment that essentially shall be able to reduce construction delay.

The major contribution of the paper is that it explicitly shows the causal feedback relationships among the client induced variables causing construction delay, and the mechanisms on which they work in a chain of actions, whose reference in the existing body of literature is scarce. Besides, it goes beyond the identification of causes of delay and their level of influence, and offers ways to develop mechanisms for diagnosing the problems at different stages of construction work and evolve policy interventions to take remedial measures. It also offers a methodological avenue to analyse the construction delay by using SD principles.

The paper has its limitations. The obvious limitations are that the modelling was done conceptually, although the basic premise behind it was to see the challenges of delay in a more critical way. However, there is a need for developing stock flow linkages and quantitative modelling to examine the extent to which construction delay can be reduced or eliminated under different scenarios of strategic/policy interventions based on the dynamic hypotheses derived from the conceptual model, which is the further scope of this research.

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AN EVALUATION OF THE NEED TO ADDRESS SKILLS SHORTAGES IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY THROUGH AUTOMATION

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The construction industry plays a significant and influential role in national and global economies and it makes up to 10% of GDP in developed countries and more than 25 % in developing countries. Since 2008, the South African construction industry contributes an average of 9% of the total employment both formal and informal and around 9% towards the GDP. Despite playing such a significant role in the nation's economy, previous research has shown that the industry is faced with many challenges among them shortages of skilled artisans to do the work. The construction industry which is often used as the measure of the country's level of development, but over the years it has failed to deliver as per expectations owing to skills shortages. The results from a survey carried out by Construction Industry Development Board shows that, over 50% of respondents recorded a severe shortage of skilled labour which cost time and money. A similar survey by Manpower SA, showed an increase from 8% to 31% between 2014 and 2015 by South African Employers having difficulties in filling positions in the construction industry. Previous researches of skills shortages have focused on education and training to remedy skills shortages but this has failed to yield the desired solutions as the skills shortages are still being felt to date despite heavy investments in education and training. As a result a more radical approach is needed if the construction industry is to overcome this challenge. The purpose of this study is therefore to evaluate the need to address skills shortages in the South African construction industry through automation. Robotics and automation which has been the crux of scientific developments for the last century has been playing a major role in all other sectors save for the construction. In order to ascertain this generalisation, existing literature is used in justifying the need for this study. Existing literature from google scholar, articles journals and e-books is scrutinised. Evidence from reviewing the existing body of knowledge show that despite previous efforts to address skills shortages, the problems still exists and there is a need to shift from the current focus on education and training to the use of automation in order to address skills shortages. The significance of this research can be attributed to the fact that, despite the construction industry playing a significant role in many economies globally, there are damning results when it comes to skills shortages. Previous efforts to address skills shortages are not yielding the desired outcomes as far as eradicating skill shortages in the industry is concerned.

Keywords: Skills Shortage, Construction Industry, Automation, Integration

INTRODUCTION

The South African construction industry is divided into three sub-sectors being civil engineering, building construction and materials manufacturing sector. Civil

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engineering involves the construction of structures for use by the general public like roads, bridges, dams and any other structures excluding buildings. The building sub-sector involves erection, completion and renovation of buildings and related structures. The materials manufacturing sector involves the manufacture of materials for both the civil engineering and building sub-sectors. According to the Construction Industry Development Board (CIDB), most work in civil engineering is commissioned by the public sector, and accounts for about 80 % of civil engineering works (Cottle 2014). It is estimated that one million people are employed by the construction sector, of which 424 000 are in the formal employment (Department of Public Works 2012).

The construction industry is faced by a number of challenges among them being, skills shortages, constant late information and design changes, a number of skilled people leaving the industry and collusion by both contractors and consultancy. Traditionally, the construction industry in the past has been viewed as technologically stagnant in comparison with other industries (Zhai et al 2009) but in recent years, it has become one of the most important research areas in the field of service robotics (Balaguer & Abderrahim 2008). The construction industry being a heterogeneous and widely displaced industry and its products do not share the same characteristics, there is a very limited scope for learning curve benefits (de Valance 2010). It can be further noted that, the unstructured nature of the construction work environment makes it difficult for the implementation of Robotics and Automation in Construction (RAC). The current shortage of skilled labour in the South African construction industry has resulted in inequitable delivery of infrastructure among South African communities (Sorinolu 2014). The previous focus on education and training failing to attain the desired results as evidenced by a high unemployment rate among the graduates. This research is therefore driven by the need to find an alternative solution to the current shortage of skilled labour in the South African construction industry. In the next section existing literature on skills shortages will be explored to highlight the existence of skill shortages in the construction industry.

LITERATURE REVIEW

This section a review of the existing body of knowledge recorded on skills shortages in the construction industry locally and globally, what has been done in addressing these shortages and what still needs to be done in order to effectively address this shortage.

The South African Construction Industry

The SA government considers the construction sector as part of the country's economic fibre, the sector is confronted with major delivery challenges (SA Government 2013). During the draft of the Government Gazette notice 380 of 2014, the Department of Higher Education and Training (DHET) in conjunction with the Joint Initiative on Priority Skills Acquisition (JIPSA) identified five priority areas that needed immediate attention. Of these five areas, three were linked to the construction and infrastructural development (Government Gazette 380 of 2014). This goes to show the government's committed efforts in delivering quality infrastructure projects amidst high skills shortages.

In 2005 the government announced large infrastructure spending programme. This programme includes the construction of the Gautrain Rapid Rail Link and provision of infrastructure for the 2010 FIFA Soccer World Cup. At that time, the general shortage of skills was highlighted. This highlight necessitated timely interventions to ensure the

delivery of a number of infrastructure development projects be delivered on time without delays (SA government 2005). In response to the need for timeous delivery of the 2010 FIFA World Cup Projects, the CIDB in conjunction with the National Department of Public Works commissioned a commission of enquiry to quantify the current skills base in the construction industry at that time, the estimate of the anticipated skills required to meet this ambitious investment programme and lastly, estimate the shortfall and identify interventions for addressing the skills problem (CIDB 2007).

The shortage of skills was considered so serious as it has the potential to sabotage the Accelerated and Shared Growth for SA (ASGSA) initiative (CIDB 2007). The then Deputy President Mlambo-Ngcuka who was driving this ASGSA alluded to this saying, “government's R372m infrastructure investment between now and 2009 is expected to stretch the country's skills pool to the limit”. In 2012, the presidency released its yearly Development Indicators Report revealing a worrying shortage of skills particularly in the engineering sector. In that report, the Minister in the Presidency for Performance Monitoring and Evaluation C. Chabane indicated that the skills shortage was a major concern given the need to roll out the massive infrastructure programme including the National Development Plan 2030 Vision (SA Government 2012).

The effects of skills shortages

The shortage of skills in the construction industry slows down progress in the design and construction of the major mega projects and also the maintenance of the existing infrastructure. The concern about scarce skills shortage is heightened by the fact that, apart from the planned mega-projects (Vision 2030), existing construction and engineering operations are working to capacity owing to the expansion of the industry in the past five years (CIDB 2007). This acute shortage has resulted in rising construction costs and has had an impact on quality of projects (Tshele & Agumba 2014). On the critical skills, there is a significant shortage of experienced managers, engineers, supervisors and qualified artisans that is threatening to stall service delivery unless ameliorated delivery systems are instituted in concert with supporting interventions which can assist in bridging the current gaps (CIDB 2007). It is one thing to create employment through infrastructure development, but if the country does not have the skills in its pool to execute those projects, unemployment will remain high and the economy will continue to deteriorate (Dialogue 2017). As a result, the country needs to strike a balance between sustainable employment and skills shortage and economic growth on the other hand.

Causes of skills shortages and the current focus on education and training

Despite high unemployment rate in the country, the construction industry continues to experience skills shortages (Tshele & Agumba 2014) mainly due to skills mismatch. This was also echoed during the Infrastructure Dialogue 2017 that the high unemployment rate in South Africa can be directly linked to, among other things, the lack of skills as there is a serious mismatch between the skills available and the skills in demand. To elaborate on this, in 2011, just 9 193 of the 160 300 university graduates graduated in the engineering field a huge shortfall from the anticipated 15 000 engineering graduates required per year if the country is to meet its engineering professional requirements (Engineering News SA 2013). The structure and admission policies of institutes of higher learning also contributes to this shortfall as promoting student access into higher education is still a perennial challenge (Insight 2011).

To highlight this skills mismatch, as of January 2014, 470 000 vacancies were open for skilled people in the country. Despite these huge vacant jobs, SA simultaneously possesses a surplus of unemployed graduates estimated at 344 000 for the same period (Adcorp 2014). By 2016, the figure for unfilled positions has rose to 829 800 (Adcorp Employment Index 2016). There is also a serious problem of lack of skills planning which must respond to the needs of the labour market and society. For an effective and efficient labour market, skills of the workforce should match those required by the employers and the type of skills produced should be in line with the market demands especially the unemployed (Insight 2011). While in most cases skilled workers need hands-on experience rather than just supervisory experience, today's youth have no preference for hands-on labour and would rather work with computers (Mukora, 2008). This has resulted in the construction industry failing to attract the younger generation. Most young people do not pursue a career in the construction industry as it is unattractive and perceived to be of low status and hence skills shortage (Tejankar 2015, Ellator 2008) In order to address the skills shortages and restore the pipeline of skills shortages for the future in the construction industry, the CIDB and Department of Public Works proposed the following:

- Increasing the number of mathematics and science graduates at Grade 12 level requires ongoing interventions by the Department of Education
- Improving the attractiveness of the industry requires ongoing interventions by the Department of Public Works, as well as by industry and professional associations
- Improving the quality and relevance of current training programmes (particularly learner ships and FET college programmes)
- Strengthening funding mechanisms for learner ships that support experiential training that is of sufficient duration to meet qualifications criteria for artisans requires direct interventions
- Increased and diversified funding to contribute to improved skills development.
- Restoring the experiential learning system to create a skills supply pipeline

The need for automation

Automation may be defined as the use of control systems and information technologies thereby reducing human intervention to the minimum. In the construction industry, automation makes sense due to the controlled, highly virtualised environment (Quartz 2017).

The evolution of 4-D models on which modern construction jobs are mapped makes automation a whole lot easier as the automated equipment and computer software will already have the detailed plan for the required task. The project based nature of the construction industry implies the periodic mobilisation of the construction equipment, materials, supplies, personnel and temporary facilities at the start of every construction project. Shortages of skilled labour due to economic fluctuations or geographical considerations make the adoption to project based means and techniques even more challenging, therefore the possibility of automating construction processes for overcoming the transition to project based demands (Nof 2009).

Automation brings about safety in workplace. Causes of accidents on construction sites may be attributed to human error, unsafe behaviour, the interaction of humans with materials and tools and environmental factors. The unsafe working conditions on

site is the main reason the industry is failing to attract and retain workforce resulting in a few people willing to pursue a career in the construction industry and hence skill shortages (Elattor 2008, Tejankar 2015). The South African construction industry has the third highest fatality rate after the fishing and transport sectors (Stats South Africa 2016). These high proportion of construction injuries and fatalities may indicate that the industry needs new approaches in-order to improve safety environments for workers on site. Some of these efforts advocate on the use of machines to complete repetitive, hard physical and monotonous tasks. Due to ergonomic, automation can be used in improving work environments as conventional manual work is reduced to a minimum and workers are relieved from uncomfortable work position (Ellator 2008).

The application of automation in the construction industry may be useful to planners who conceive the project and prepare preliminary reports as well as to those who correct designs and revise estimates (World Economic Forum 2016). Because most projects in the initial planning stage involve a lot of rework and adjustments to suit the client needs and budget by different professionals. Automation can be useful in integrating different contributions by the professionals working on the project via visualised models and making adjustments to the models before the actual project kicks on site. Automation is also useful for those who deal with tenders as well as working on a large number of similar projects.

RESEARCH METHODOLOGY

In carrying out this research, existing literature was used to evaluate the need to address construction skills shortages in the South African construction industry through automation. . According to Vosloo (2014), research is based on a perceived assumption that the researcher has and a research is therefore carried out to develop the body knowledge and add on to the body of knowledge before a conclusion can be made on the initial assumption. The purpose of carrying out a research will be

therefore to prove or disapprove that underlying assumption about an area of study (Cooper & Schindler 2014). The choice of investigating the need to use automation in addressing skills shortage in the South African construction industry through the use of literature review is to assess qualitatively what measures have been done to alleviate this problem and what can still be done to eradicate the problem. Existing literature through internet sources in the form of research papers, books and construction industry journals published in the past ten years were used in gathering data to on what has been done in the past to address construction skills shortage. A research gap in the form of using automation to address skills shortage was then identified.

Because of the need to uncover the general and perceived thoughts of skills shortage in the construction industry a qualitative analysis of literature is done. This is so because qualitative research provides and insight into the research problem and helps in developing ideas and test the hypothesis (Saunders et al 2016). For this research, existing literature published in the last ten years from renowned publications like journals and scholars is used to evaluate the need to address skills shortages in the construction industry through automation. An analysis of the existing body of knowledge was done in order to identify the shortfall on the current focus on addressing these shortages and what can still be done if this problem is to be eradicated completely.

In carrying out a research, either quantitative or qualitative data collection method is used. Quantitative research quantifies data that is to say information gathered can be measured and written down with numbers. Qualitative research is suitable for gaining in-depth understanding of underlying reasons and insights into the problem. The data collected is then analysed in the next section in order to get a better understanding of the data collected.

DATA ANALYSIS

From the findings of the literature review it shows that shortages of skilled labour is the biggest constraint on construction growth with project and contract managers, tradesman and engineers cited as the scarcest of all skills (Makhane & Thwala 2009). In the US, the skills shortage has stretched for over three decades, (Business Round Table 1983) and the future still not promising (Makhane & Thwala 2009, Tshele & Agumba 2014). The future of the construction industry is uncertain when it comes to curbing the challenge of skills shortage. This is mainly because of the failure by the industry to attract new labour into the market and at the same time experiencing an aging population (Mukora 2008). The focus on skills shortage should not be on the quantity but on the quality of the skilled workforce as well. While in most cases skilled workers need hands-on experience rather than just supervisory experience, today's youth have no preference for hands-on labour and would rather work with computers (Mukora, 2008). Currently the construction industry is undergoing a rapid digital transformation through disruptive technologies such as Building Information Modelling (BIM), wireless sensing, big data and analytics, 3D printing, and autonomous equipment (World Economic Forum 2016). These can be fused in the current curriculum to improve the attractiveness of the construction industry and help attract fresh blood who are so fond of working with computers.

The problems associated with construction work like decreasing quality of work, skills shortage and safety of labour and working conditions of projects can be overcome by new innovative technologies like automation which has the potential of improving the quality, safety and productivity in the construction industry (Tejankar 2015). Locally the construction industry is perceived to be a job of low social standing and lacks in attractiveness due to its physical demands. This can be highlighted by the fact that, despite high unemployment rate in the country, the construction industry continues to experience skills shortages (Tshele & Agumba 2014) mainly due to skills mismatch (Amrop 2012, Nyatumba 2017).

Researches in the past years has focused on education and training in addressing skills shortages. But regardless of heavy investments in education and training, the industry is still grappling with an acute shortage of skilled labour (Tshele & Agumba 2014). This is mainly due to work in the construction industry being perceived as lowly, unattractive and risky. The adoption and encouragement to replace most works at heights by some form of machinery and robotics may help in alleviating these negative perceptions. Selvakumaran (2016) highlighted that, using automation and artificial intelligence to undertake routine functions could help free up the supply of skilled labour for more creative tasks making the industry more attractive and appealing.

In order to survive and remain competitive in the market, construction companies need to embrace innovation and new technologies (World Economic Forum 2016, Albertyn 2017). According to McKinsey Report (2016), productivity in the manufacturing, retail and agriculture has grown by more than 1 500 % since 1945,

while it has barely gone up in the construction industry. The reason for this increase in productivity is directly linked to the level of automation in these industries. In multi million rand industry like construction, even a slight increase in efficiency could result in huge savings.

With construction sites covering vast areas of land and buildings now shooting stories high into the sky, site inspection by foot can take days to complete. But with automation (drones), the same task can be done by one pilot in a few hours (Recode's Code 2017). Because of the many challenges faced with the construction industry, automation and robotic application presents opportunities to solve such issues (Kim et al 2015). And according to Senthilkumar et al (2010) in order to address the complex task of planning and managing the design and construction, many processes have been automated. While in most developed counties and some developing countries there are advocating for automation as a measure to curb skills shortages, this may be different for South Africa. There is a common perception that businesses should not opt for automation at the detrimental of the poor and unemployed. Rather than opting for automation, business and government should continue to seek creative solutions to solve the issues (Dialogue 2017). EPWP with the support of the ILO promotes lour intensive construction as a way of continuously create employment among the unemployed youths. We have to employ people in order to skill them.

From the literature review and data analysis carried out, there are contradictions between different authors as to whether automation can be a solution to curb skills shortages in the construction industry. This is mainly due to the fact that automating construction activities goes against the SA government and the International Labour Organisation polices on poverty eradication and employment creation. Below is a summary of the publications used in the research which supports automation and those that oppose the idea of automation.

Table 1: Summary of the publications used for and against construction automation.

Article Name	Country of Publish & Year	Author	Supports Construction automation	Reasons for supporting or not supporting
Is the term "Construction industry outdated"	United Kingdom (2016)	Selvakumaran S.	Yes	Automation helps free up skilled labour supply for more creative tasks making the industry attractive
Imagining construction's digital Future	United Kingdom (2016)	McKinsey Report	Yes	Boost productivity as is the case with other industries like manufacturing and automotive
The construction industry is	United States of America	Recode's Code	Yes	Efficiency and easy of carrying out tasks

short on human workers and is ripe for a robotic takeover	(2017)			
Investigating the causes of skills shortage in SA construction industry	South Africa (2014)	Tshele L and Agumba J.N.	Yes	Automation presents an opportunity to solve many problems in the construction industry
Handbook of automation	United States of America (2009)	Nof S.Y.	Yes	Automation helps address complex tasks of planning and managing design and construction processes
Shaping the future of construction industry: Inspiring innovators redefine the industry	Canada (2016)	World Economic Forum	Yes	Automation makes sense due to the controlled, highly virtualised environment especially as it avoids reworks in the design phase
Seizing opportunities: employment in and through Infrastructure in the context of South Africa's job crises	South Africa (2017)	Infrastructure Dialogue	No	Automation is detrimental to government policies on employment creation (EPWP) which promotes labour intensive construction as a way of continuous employment creation
Innovation, Procurement and Construction Industry development.	Australia (2010)	de Valance	No	Uniqueness of projects in that they do not present the same set of problems across all sites
An	Australia	Mahbub	No	High costs and

Investigation into the Barriers to the Implementation of Automation and Robotic Technology in the Construction Industry	2012			financial commitment in acquiring and maintaining technology

CONCLUSIONS

As concluding remarks, unlike in the other industries where automation has been a success, it will be expensive using traditional automation technology to establish a fully mature automation system which can solve the problems highlighted earlier as being faced by the construction industry (Ding et al 2014). The construction industry in most cases offers customised products with unique characteristics and a high risk of failure. There is very little direct repetition as projects are built to meet a special requirement. The design and process skills though they may be commonly be used the output differs and this affects and impacts heavily on the efficiency and economies of scale of the construction process which in turn influence significantly on the innovation and technological development (de Valance 2010). The low level of automation in the construction industry is mainly due to the following; automation is not suitable for large scale construction products; automation is not compatible with the conventional design approach, compared with other industries, the amount of the final product is rather less and the types are fewer; there is limitation on material selection as not all construction materials can be used with automation machines; expensive automation equipment makes the automation technology less attractive; the introduction of automation will make an impact on the traditional project management (Ding et al 2014).

In SA automation is met with resistance due to high unemployment rates and strikes. The government support labour intensity construction methods as a way of creating employment and eradicate poverty among the population. As is one of the barriers of construction automation, the different work cultures between the countries plays a major role in impeding the implementation of construction automation. It is not wise to compare SA with the Western World when it comes to construction automation as SA faces different challenges unique to the Western Countries. SA cannot pursue automation at the detriment of labour. The solution will be to employ more labour in labour intensive operations rather than making the decision to automate (Dialogue 2017).

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THE EFFECT OF PROJECT SUCCESS FACTORS ON PROJECT SUCCESS CRITERIA

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Various studies on Project Success Factors (PSFs) and Project Success Criteria (PSC) have been conducted within the construction industry. However, studies on the influence that Project Success Factors (PSFs) may have on Project Success Criteria (PSC) in construction industry still remains elusive. A survey of UK construction professionals in management roles was undertaken in order to rank 15 PSFs in terms of their perceived influence on four key PSC: time performance; cost performance; quality; and customer satisfaction. Results indicate that nine of the 15 investigated PSFs were ranked as influential on time performance with six of the PSFs ranked as influential on quality performance. On the other hand, construction project cost performance was found to be influenced mainly by six of the PSFs while eight of the investigated PSFs have influence on customer satisfaction. Project managers and other project participants seeking to maximise the attainment of cost, time and quality performance as well as customer satisfaction would therefore need to pay attention to the specific PSFs that are relevant to the attainment of these PSC.

Keywords: success, project, performance, delivery, UK.

INTRODUCTION

The importance of project success factors (PSFs) and project success criteria (PSC) has drawn attention of many researchers (Martens et al., 2018; Joslin and Müller, 2016; Todorović et al., 2015; De Carvalho et al., 2015). One of the first models linking project success criteria and critical success factors was Westerveld's (2003), Project Excellence Model (PEM). The PEM model shows a relationship between key PSFs (related to project organisational and management characteristics) and PSC (project results and broad stakeholder satisfaction areas). Chan and Chan's (2004) research suggests that PSFs can be split into categories including: human-related factors; project-related factors; project procedures; project management actions; and external environment. Additionally, success factors in one project may be the failure factors in another as different types of projects may require different approaches to management (Gunathilaka et al., 2013). Despite the existence of these studies in the wider project management discourse, there are few studies that have explored the phenomenon within construction. In this study, PSFs are critically analysed in order to understand their relative influence on specific PSC. In the following sections, a review on PSFs and PSC is presented. This is followed by an outline of the research design, findings and discussion, and conclusions.

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PROJECT SUCCESS CRITERIA

Project success criteria are the measures by which we judge the successful outcome of a project (Muller and Turner, 2007). Determining whether a project is a success or failure is intricate and sometimes ambiguous (Nguyen et al., 2004). Cooke-Davies (2002) and De Wit (1988) clarified that project success should be measured against the overall and broader objectives of the project's delivery. It is a question of whether the deliverables from a project undertaken by an organisation produce the desired outcomes and expectations (Camilleri, 2011). A productive evaluation of project success should not only address project efficiency and the fulfilment of project aims, but it should also examine project effectiveness (Cserhati and Szabo, 2014). Williams (2016) agrees with Cserhati and Szabo (2014), suggesting that projects including the Sydney Opera House and the Scottish Parliament, famously over budget and late, might be considered unsuccessful in efficiency but effective, in line with Westerveld's (2003) project excellence model. While some different suggestions about what is project management have been made, the criteria for success, namely cost, time and quality remain the main description of success in most projects (Atkinson, 1999). Most project managers refer to this as the 'iron triangle'. Subsequently, several researchers have proposed different sets of success evaluation criteria in addition to the 'iron triangle' (Westerveld, 2003; Jha and Iyer, 2007). Muller and Turner (2010), state that different success criteria are relevant for different types of projects or for projects from different industries. Understanding that projects have different success criteria helps create a wider range of PSFs. Naturally, some projects must have time and/or cost as the prime objective(s), however, all project managers have the challenging task of identifying the factors which affect both time and cost (Atkinson, 1999). Therefore, project success should be something much more important than simply meeting cost, schedule and performance specifications (Chan et al., 2002; Westerveld, 2003).

PROJECT SUCCESS FACTORS

The success factors of a project are the elements or activities required in ensuring the success criteria of the project is achieved. The effects PSFs have on PSC is recognised and the overall influence they have on a project is explained. As stated by Gunduz and Yahya (2015), the construction industry often underperforms especially in meeting deadlines and budget. Further research by Camilleri (2011) shows that 85 to 90 percent of projects fail to deliver on time, on budget and to the quality expected. However, Camilleri (2011) also states that using a reasonably mature project management system improves productivity by 20 to 30 percent. Camilleri (2011) suggests that using proven methods increases productivity meaning PSC such as completion on time can be achieved more easily. He suggests that poor productivity, time performance and quality performance are attributable to poor collaboration between the parties involved. Thus some studies have established causal links between PSFs and PSC, making similar studies within the construction industry context worthwhile.

RESEARCH METHODOLOGY

The purpose of the research was to understand the extent to which different Project Success Factors (PSFs) affect Project Success Criteria (PSC). The following four PSC; Completion on Time, Quality Performance, Budget/Finance/Cost Performance and Customer Satisfaction were the key focus of the study. Data was collected through a questionnaire survey. Respondents were asked to rate on a five-point scale (1 = No

impact, 2 = Low impact, 3 = Medium impact, 4 = High impact, 5 = Very high impact) the extent to which 15 PSFs can positively affect the achievement of PSC. The PSFs derived from extensive literature review were: Effective Project Team Formation, Effective Communication, Top Management Support, Allocation of Sufficient Resources, The Level of Technology, Project Managers Competence, Project Monitoring and Feedback, Clients Consultation and Involvement, Clear and Detailed Procurement Process, Project Risk Management, Project Plans and Schedules, Frequent Progress Meetings, Commitment to the Project, Effective Quality Assurance. The target sample size was 480 respondents based on recommendations from Mahamadu (2017) on minimum sample size for surveys of UK construction professionals. In total, 43 usable surveys were returned representing 9% response rate which is also typical of construction management surveys in the UK (Ankrah, 2007; Mahamadu, 2017). In addition to snowball techniques, online surveys were launched with invitations sent to various online professional groups including the Chartered Institute of Building (CIOB) and Royal Institution of Chartered Surveyors (RICS). In relation to professional backgrounds of respondents, 29 out of 43 respondents were project managers (67.4%), 18.6% were site managers and 2.3% were construction managers. Over half of the participants (51.2%) had more than 10 years' experience in their current role while 27.9% of the respondents had 5- 10 years' experience.

FINDINGS AND DISCUSSIONS

The one sample t-test was run to compare the PSF mean scores to a test value of 3.5. Results of one-sample T-test showing critical success factors for each success criteria are shown above the dashed line in Tables showing results below. In Table 1, the success factors shown are critical for completion on time with 9 out of 15 success factors perceived to be critical by survey respondents. These were: commitment to the project, effective communication, allocation of sufficient resources, project managers' competence, financial stability and adequate funding, project plans and schedules, effective project team formation, frequent progress meetings and project risk management.

Table 1: Critical Success Factors for Completion on Time

Critical Success Factors	N	Mean	Rank by Mean	Std. Deviation	Std. Error Mean	One sample t-Test (Test Value = 3.5)						
						t	df	Sig. (2- tailed)	Sig. (1- tailed)	Mean Difference	95% Confidence Interval of the Mean	
											Lower	Upper
Commitment to the Project	43	4.4651	1	.735	.112	8.609	42	.000	.000	.965	.74	1.19
Effective Communication	43	4.3953	2	.541	.082	10.858	42	.000	.000	.895	.73	1.06
Allocation of Sufficient Resources	43	4.2326	3	.527	.080	9.111	42	.000	.000	.733	.57	.89
Project Managers Competence	43	4.1395	4	.516	.079	8.135	42	.000	.000	.640	.48	.80
Financial stability & adequate funding	43	4.0000	5	.655	.100	5.008	42	.000	.000	.500	.30	.70
Project Plans and Schedules	43	3.9302	6	.669	.102	4.218	42	.000	.000	.430	.22	.64
Effective Project Team Formation	43	3.9070	7	.684	.104	3.904	42	.000	.000	.407	.20	.62
Frequent Progress Meetings	43	3.8837	8	.697	.106	3.609	42	.001	.000	.384	.17	.60
Project Risk Management	43	3.7209	9	.797	.121	1.819	42	.076	.038	.221	-.02	.47
Top Management Support	43	3.4651	10	.909	.139	-.252	42	.803	.401	-.035	-.31	.24
Clear and Detailed Procurement Process	43	3.4651	10	1.054	.161	-.217	42	.829	.415	-.035	-.36	.29
Project Monitoring and Feedback	43	3.4419	12	.908	.138	-.420	42	.677	.338	-.058	-.34	.22
Clients Consultation and Involvement	43	3.4419	12	.854	.130	-.447	42	.657	.329	-.058	-.32	.20
Effective Quality Assurance Programme	43	3.2558	14	.875	.133	-1.829	42	.074	.037	-.244	-.51	.03
The Level of Technology	43	2.7907	15	.861	.131	-5.404	42	.000	.000	-.709	-.97	-.44

Note: Scale: 1 = no impact; 2 = low impact; 3 = medium impact; 4 = high impact; 5 = very high impact

For critical success factors above the dashed line, Mean is significantly greater than the test value of 3.5

Results of one-sample T-test showing critical success factors for quality performance are shown in Table 2. Six success factors were emerged as critical in the opinion of

respondents. These are: effective quality assurance programme, commitment to the project, allocation of sufficient resources, effective communication, project managers' competence and financial stability and adequate funding.

Table 2: Critical Success Factors for Quality Performance

Critical Success Factors	N	Mean	Rank by Mean	Std. Deviation	Std. Error Mean	One sample t-Test (Test Value = 3.5)						
						t	df	Sig. (2-tailed)	Sig. (1-tailed)	Mean Difference	95% Confidence Interval of the Difference	
											Lower	Upper
Effective Quality Assurance Programme	43	4.3256	1	.808	.123	6.697	42	.000	.000	.826	.58	1.07
Commitment to the Project	43	4.2093	2	.514	.078	9.041	42	.000	.000	.709	.55	.87
Allocation of Sufficient Resources	43	4.0930	3	.648	.099	6.002	42	.000	.000	.593	.39	.79
Effective Communication	43	4.0000	4	.724	.110	4.530	42	.000	.000	.500	.28	.72
Project Managers Competence	43	3.9535	5	.615	.094	4.832	42	.000	.000	.453	.26	.64
Financial stability & adequate funding	43	3.9070	6	.648	.099	4.119	42	.000	.000	.407	.21	.61
Effective Project Team Formation	43	3.6744	7	.892	.136	1.282	42	.207	.103	.174	-.10	.45
Project Monitoring and Feedback	43	3.6512	8	.973	.148	1.019	42	.314	.157	.151	-.15	.45
Project Plans and Schedules	43	3.6047	9	.903	.138	.760	42	.452	.226	.105	-.17	.38
Frequent Progress Meetings	43	3.5349	10	.797	.122	.287	42	.776	.388	.035	-.21	.28
Project Risk Management	43	3.4851	11	.767	.117	-.298	42	.767	.383	-.035	-.27	.20
The Level of Technology	43	3.3023	12	.964	.147	-1.344	42	.186	.093	-.198	-.49	.10
Top Management Support	43	3.2558	13	.978	.149	-1.637	42	.109	.055	-.244	-.55	.06
Clients Consultation and Involvement	43	3.1628	14	.924	.141	-2.393	42	.021	.011	-.337	-.62	-.05
Clear and Detailed Procurement Process	43	2.9767	15	1.080	.165	-3.177	42	.003	.001	-.523	-.86	-.19

Note: Scale: 1 = no impact; 2 = low impact; 3 = medium impact; 4 = high impact; 5 = very high impact
For critical success factors above the dashed line, Mean is significantly greater than the test value of 3.5

Results of one-sample T-test showing critical success factors for cost performance are shown in Table 3. Six out of 15 success factors emerged as critical. These were: allocation of sufficient resources, financial stability and adequate funding, commitment to the project, effective communication, project managers' competence and project risk management.

Table 3: Critical Success Factors for Cost Performance

Critical Success Factors	N	Mean	Rank by Mean	Std. Deviation	Std. Error Mean	Test Value = 3.5						
						t	df	Sig. (2-tailed)	Sig. (1-tailed)	Mean Difference	95% Confidence Interval of the Difference	
											Lower	Upper
Allocation of Sufficient Resources	43	4.5349	1	.631	.096	10.763	42	.000	.000	1.035	.84	1.23
Financial stability & adequate funding	43	4.4651	2	.767	.117	8.253	42	.000	.000	.965	.73	1.20
Commitment to the Project	43	4.0930	3	.570	.087	6.827	42	.000	.000	.593	.42	.77
Effective Communication	43	4.0465	4	.785	.120	4.563	42	.000	.000	.547	.30	.79
Project Managers Competence	43	3.8837	5	.662	.101	3.800	42	.000	.000	.384	.18	.59
Project Risk Management	43	3.8372	6	.721	.110	3.065	42	.004	.002	.337	.12	.56
Effective Project Team Formation	43	3.7209	7	.934	.142	1.551	42	.128	.064	.221	-.07	.51
Frequent Progress Meetings	43	3.6279	8	.757	.115	1.108	42	.274	.137	.128	-.10	.36
Clear and Detailed Procurement Process	43	3.5814	9	1.096	.167	.487	42	.629	.314	.081	-.26	.42
Project Plans and Schedules	43	3.5349	10	.935	.143	.245	42	.808	.404	.035	-.25	.32
Clients Consultation and Involvement	43	3.4651	11	1.008	.154	-.227	42	.822	.411	-.035	-.35	.28
Top Management Support	43	3.4419	12	.881	.134	-.433	42	.667	.334	-.058	-.33	.21
Project Monitoring and Feedback	43	3.3721	13	.900	.137	-.932	42	.357	.178	-.128	-.40	.15
Effective Quality Assurance Programme	43	3.3488	14	1.021	.156	-.971	42	.337	.169	-.151	-.47	.16
The Level of Technology	43	2.9535	15	.872	.133	-4.112	42	.000	.000	-.547	-.81	-.28

Note: Scale: 1 = no impact; 2 = low impact; 3 = medium impact; 4 = high impact; 5 = very high impact
For critical success factors above the dashed line, Mean is significantly greater than the test value of 3.5

Results of one-sample T-test showing critical success factors for customer satisfaction as shown in Table 4. Eight out of 15 factors (53%) emerged as critical. The 3 most critical with a Mean ratings over 4 were: effective communication, clients' consultation and involvement and commitment to the project.

Table 4: Critical Success Factors for Customer Satisfaction

Table xxx: Critical success factors for customer satisfaction												
Critical Success Factors	N	Mean	Rank by Mean	Std. Deviation	Std. Error Mean	One sample t-Test (Test Value = 3.5)						
						t	df	Sig. (2-tailed)	Sig. (1-tailed)	Mean Difference	95% Confidence	
											Lower	Upper
Commitment to the Project	43	4.4186	1	.626	.095	9.621	42	.000	.000	.919	.73	1.11
Clients Consultation and Involvement	43	4.3721	2	.655	.100	8.724	42	.000	.000	.872	.67	1.07
Effective Communication	43	4.2791	3	.734	.112	6.956	42	.000	.000	.779	.55	1.01
Frequent Progress Meetings	43	3.9767	4	.771	.118	4.054	42	.000	.000	.477	.24	.71
Project Managers Competence	43	3.8837	5	.879	.134	2.864	42	.007	.003	.384	.11	.65
Allocation of Sufficient Resources	43	3.8605	6	.774	.118	3.054	42	.004	.002	.360	.12	.60
Financial stability & adequate funding	43	3.8140	7	.699	.107	2.946	42	.005	.003	.314	.10	.53
Project Monitoring and Feedback	43	3.7674	8	.782	.119	2.243	42	.030	.015	.267	.03	.51
Top Management Support	43	3.6512	9	1.021	.156	.971	42	.337	.169	.151	-.16	.47
Project Risk Management	43	3.6512	9	.752	.115	1.318	42	.195	.097	.151	-.08	.38
Effective Project Team Formation	43	3.6047	11	.903	.138	.760	42	.452	.226	.105	-.17	.38
Project Plans and Schedules	43	3.5581	12	.796	.121	.479	42	.634	.317	.058	-.19	.30
Effective Quality Assurance Programme	43	3.4419	13	1.181	.180	-.323	42	.748	.374	-.058	-.42	.31
Clear and Detailed Procurement Process	43	3.0233	14	.963	.147	-3.245	42	.002	.001	-.477	-.77	-.18
The Level of Technology	43	2.9302	15	.936	.143	-3.992	42	.000	.000	-.570	-.86	-.28
Note: Scale: 1 = no impact; 2 = low impact; 3 = medium impact; 4 = high impact; 5 = very high impact												
For critical success factors above the dashed line, Mean is significantly greater than the test value of 3.5												

Project Success Factors for Completion on Time: Previous research from Camilleri (2011), Gunathilaka et al. (2013) shows similarities with the findings from this study with factors such as poor collaboration between parties, the project managers' competence, insufficient budget allocation and allocation of sufficient resources similarly emerging as the most critical to completion on time.

Project Success Factors for Quality Performance: Interestingly, the ranking of important success factors as shown in Gunathilaka et al.'s (2013) work are different when compared to the findings of this study. Having an effective quality assurance programme emerged as the most critical affecting quality and frequent progress meetings also had a high positive impact on quality performance. Whereas in Gunathilaka et al.'s (2013) work ranked having an effective quality assurance programme 11 out of 21 and frequent progress meetings ranked 18 out of 21. These findings reveal that in addition to effective quality assurance programmes more meetings between project team members is critical to achieving quality performance.

Project Success Factors for Cost Performance: As previously discussed, the allocation of sufficient resources and communication can impact time performance as shown by its rank of 1 in Table 4. This is reflective of findings in previous studies where availability of resources often affect budget (Gunathilaka et al., 2013). Most importantly, communication is critical to minimising changes which often leads to significant cost overruns (Ahiaga-Dagbui and Smith, 2014).

Project Success Factors for Customer Satisfaction: Hussein (2013), Jraisat et al. (2016) and Williams et al. (2015) suggests that customer satisfaction can be hard to identify but its widely acknowledged as essential success criteria. Commitment to the project as discussed previously again ranked as the most critical factor contributing to the attainment of customer satisfaction as shown in Table 4 and this reflects Gunathilaka et al. (2013) findings and also consistent with views of Egan (1999). These findings show that the clients' involvement has always been most critical and the less involved they are, the less likely they will be satisfied.

CONCLUSION

This study examined the role of 15 PSFs on the achievement of four of the most cited PSC: cost; time; quality; and customer satisfaction. Whilst in broad sense the study has shown that PSFs are vital to the achievement of important PSC, more importantly it has shown that not all PSFs are key to the achievement of cost, time, quality, or customer satisfaction respectively. For instance, a PSF that may be key to the achievement of quality or cost performance, may not be vital to the achievement of time performance. This implies project managers and other project participants need to pay attention to the right PSFs that are needed for the delivery of specific PSC on projects. A limitation of the study is the sample size ($n = 43$) as well as scope which covered only UK professionals. This limits the generalisability of the findings and therefore calls for similar studies in other contexts including developing countries in order to ascertain differences and parallels. Future studies could consider other PSC relevant to the contexts of their scope. Nonetheless, the findings provides useful insights, which contribute to the discourse on PSFs and their relative impact on various PSC. Additionally, the findings highlight the need for practitioners to understand and focus on the right PSFs needed to achieve particular PSC. Further studies involving larger sample size and in other country contexts would also help to consolidate the results offered by this study.

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COMPETENCIES NEEDED BY CONSTRUCTION PROJECT MANAGERS FOR BIM-ENABLED PROJECTS

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Construction project manager (CPM) competency has been common place discussions over the years with the recognition of the importance of skills and knowledge to project success. With recent advancements in the application of digital technologies such as Building Information Modelling (BIM), it is imperative that CPMs develop new competencies that enable effective delivery of projects. The lack of clarity of the specific competencies needed by CPMs to deliver BIM-enabled projects, makes it important that the competencies required by CPMs for effective BIM-enabled project delivery be ascertained, such that this study addresses this gap. A sequential exploratory mixed method study is adopted to identify these competencies needed to effectively deliver BIM projects as well as validate the competencies of great value to BIM project delivery. Six key competency groups were identified as pertinent to BIM project delivery namely: Managerial and administrative; Strategic; Functional and operational; Leadership and people management; Technical and implementation; and Innate qualities. Overall, managerial and administrative competencies as well as leadership and people management competencies were regarded as being more crucial to the role of the CPM in BIM-enabled project delivery. This study provides useful guidance for development of training programmes as well as performance assessment systems for CPMs in the era of BIM based on the prioritisation of areas of competence.

Keywords: Building Information Modelling (BIM), Knowledge, Competency, and Skills.

INTRODUCTION

The construction industry is important to every economy as a result of its role in the development and maintenance of the built environment as well as critical infrastructure (HM Government, 2013). The industry is, however, fraught with many challenges which in recent times are generally being alleviated with the uptake of technology driven innovation such as Building Information Modelling (BIM). In order to fully exploit the potential of BIM, all construction industry professionals need to develop competencies in its usage to facilitate effective implementation. This includes construction project managers (CPMs) whose services are critical to project delivery. It, however, remains unclear the specific competencies needed by CPMs in order to operate in a BIM-enabled project environment.

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LITERATURE REVIEW

Lucia and Lepsinger (1999) define competency as “a cluster of related knowledge, skills and attitudes that affects a major part of one’s job (a role or responsibility), that correlates with performance on the job, that can be measured against well-accepted standards and that can be improved via training and development”. Competency is widely regarded as critical to human resource management processes, including the development of robust selection and succession planning models as well as training and performance management (Dainty et al. 2005). Some studies have focussed on CPMs competencies which is often regarded as broad and multifarious with several categorisations of the various CPM competency sets. One of the notable classifications of project management competencies are communication, organisational, teambuilding, leadership, coping, and technological skills (Dainty et al. 2005). A comprehensive set of performance criteria summarised within nine-factor groups are also presented by Dainty et al. (2005) including team building, leadership, decision making, mutuality and approachability, honesty and integrity, communication, understanding and application, self-motivation and external relations.

According to Edum-Fotwe and McCaffer (2000), construction project management (CPMgt) competency is acquired from knowledge gained through training and the skills developed through experience as well as the application of the knowledge gained. CPMs are however confronted by several issues including undertaking roles traditionally not part of their responsibilities (Edum-Fotwe and McCaffer, 2000). There are arguments from some quarters that the role of CPMs must be supplemented by non-traditional CPMgt knowledge and skills to meet today’s professional demands and in order for CPMs to effectively adapt to the current climate of digitisation (Fewings, 2013). One of the areas of focus is Building Information Modelling (BIM). BIM is defined as a “digital representation of physical and functional characteristics of a facility, which serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onwards” (Barlish and Sullivan, 2012). With BIM, there is increased integration of the roles of all stakeholders whose involvement has traditionally been coordinated by CPMs. BIM thus provides an opportunity for a new approach to CPMgt.

Several countries have developed BIM standards and strategies to guide its use based on its increasing adoption (Smith, 2014). A mandate for the implementation of 3D BIM as a minimum by 2016 on all government project was issued, aimed at achieving 20% savings in cost (Cabinet Office 2011). This initiative of government places a demand on construction professionals including CPM with roles very pivotal and key to the successful delivery of BIM on projects. With this demand placed on CPMs, it is imperative that CPMs develop competencies requisite for BIM execution on projects. There is, however, limited academic literature on CPM BIM competency. The studies available are focussed on traditional CPMgt functions (see Ahadzie et al 2008), while some other recent studies have generically focussed on BIM competencies with no specific consideration of peculiar competencies pertaining to CPMs (see Succar et al., 2013; Succar and Sher, 2014; Rahmana, et al., 2016). Succar and Sher (2014) discussed BIM competencies extensively, where individual BIM competencies are “the personal traits, professional knowledge and technical abilities required to perform a BIM activity or deliver a BIM related outcome by an individual”. They also presented a BIM competency taxonomy in three complementary tiers namely; core, domain and execution. Other BIM competencies classification as presented by Succar and Sher (2014) are generic and specialised, with the generic BIM competencies

described as those that find relevance across all disciplines, specialities and roles. The specialised BIM competencies only pertain to specific roles and specialities. This study seeks to ascertain the specialised BIM competencies for CPMs with due consideration of the value of their role in successful BIM project delivery.

METHODOLOGY

This research was conducted using the sequential exploratory mixed research method (Watkins and Gioia, 2015) hinged on both positivist and interpretive philosophies. In view of the method adopted, interviews were conducted with CPMgt and BIM experts (n=3), and finding from these experts were cross-validated with competencies identified from literature and analysed thematically. These experts had an average of 21 construction projects experience and 3 BIM enabled project experience. They either had expert knowledge in CPMgt or BIM implementation or expertise in BIM competency assessment and research. A survey of construction professionals (n = 47) with CPMgt BIM knowledge and experience was used to ascertain the relative importance of CPMgt BIM competencies identified from literature. The respondents were asked to rate the extent to which each competency was needed for effective execution of CPM duties on BIM enabled projects based on a five-point Likert scale (ranging from 1 = “not needed” to 5 = “greatly needed”). The majority of the survey participants had more than 6 years (i.e. 45% > 6 years and 32% > 10 years) of construction experience and at least participated in a BIM project or currently studying BIM at post graduate level. Their professional backgrounds were architecture, quantity surveying, BIM management, engineering (mechanical and civil) and project management. In relation to educational qualification, 66% of participants had Bachelor’s degree while 23% had a master’s degree as their highest qualification. 6% hold a Doctorate degree in the areas of BIM and CPMgt.

FINDINGS

The finding of this study is classified into qualitative and quantitative. The qualitative findings were arrived at from the thematic analysis of interviews conducted to validate a list of competencies generated from literature review. The quantitative findings on the other hand are determined from the computation of the Relative Importance Index (RII) (Babatunde et al., 2010) of each of the competencies presented in the survey.

Qualitative Findings: Table 1 below includes the qualitative findings. Six (6) key competencies and fifty-three (53) sub-competencies were identified as core CPM BIM competencies. The 6 areas of competencies are: Managerial and Administrative; Strategic competencies; Functional and Operational; Leadership and People Management; Technical and Implementation; and Innate Qualities. Key provided shows reference to interviewees and literature which was used as part of thematic analysis for identification of competency areas and sub competencies. From the literature and interviews the following definitions emerged.

Managerial and administrative competencies refer to skills required by CPMs to deal with or control things and people, as well as the day-to-day running of business with the aim of achieving their strategic goal, and this competency is very critical to CPMs for effective BIM project delivery [Interviewee 1,2,3]. Strategic competencies describe skill and knowledge areas related to the identification of overall and long-term aims and goals and how BIM can help to achieve them [Interviewee 1,2,3]. Functional and operational competencies refer to those competencies needed to perform BIM related activities [Interviewee 1,2,3]. They are basically concerned with

the facilitation of operation and effective use of CPMgt BIM software, systems or tools. Leadership and people management is concerned with influencing and coordinating people such that the ability of CPMs to harness their potential will aid favourable BIM project outcomes [Interviewee 1,2,3]. Technical and implementation are the primary and core IT skills required by CPMs to manage all BIM related software, systems and tools as well as their practical use and how they affect the execution of BIM enabled projects [Interviewee 1,2,3]. Innate qualities refer to the personality driven qualities that make it easy to lead on BIM enabled projects overall [Interviewee 1,2,3].

Quantitative Findings: The quantitative findings reported are based on the computation of the relative importance index (RII) of the respective sub-competencies. The RII is computed using this formula $RII = \frac{\sum W}{(A \times N)}$; where RII=relative importance index of the competencies; W=weighting given to each factor by respondents (ranging from 1-5); A=highest weight (i.e., 5 in this case); and N=the total number of participants. Table 1 shows the RII for the six key competencies and their sub-competencies (Babatunde et al, 2010).

The higher the value of the RII of the competency, the more they are perceived as needed by CPMs for BIM-enabled project management as presented below and summarised in Table 1 and 2. Managerial and Administrative (RII=0.7844) emerged as the most important area of competency required by CPMs for BIM-enabled project management, with most of the sub-competencies having high RII scores. This included collaboration (RII=0.9064, mean=4.5319 and Std. D=.85595), Information flow management (RII=0.8298, mean=4.1489, Std. D=.90838). Leadership and people management (RII=0.7792) emerged as the second most important area of CPMgt BIM competency. The high RII scores in this group are from sub-competencies such as communication (RII=0.8979, mean=4.4894, Std. D=.90583) and teamwork and cooperation (RII=0.8936, mean=4.4681, Std. D=.85595). Innate qualities (RII=0.7723) were the third most important group of CPMgt BIM competencies with the following RII scores for the most required sub-competencies: Flexibility and adaptability (RII=0.8213, mean=4.0851, Std. D=1.03902), Information seeking (RII=0.8170, mean=4.0851, Std. D=.97423) and Goal orientation (RII=0.7745, mean=3.8723, Std. D= 1.05536).

Strategic competencies (RII=0.7175) follow next as the fourth important competency group. The high RII scores for the sub-competencies in this group are Strategic planning (RII=0.7872, mean=3.9362, Std. D=.96469) and organizational management (RII=0.7660, mean=3.8298, Std. D=1.08986). Functional and operational (RII=0.6894) emerged as the fifth important competency group based on the RII computation. The high RII scores for the sub-competencies in this group are BIM management (RII=0.8426, mean=4.2128, Std. D=.93102), BIM coordination (RII=0.8255, mean=4.1277, Std. D=.99164), and common data appreciation (RII=0.8043, mean=4.0213, Std. D=.98884).

Table 1: Key competencies and their Relative Importance Indices for CPMs on BIM-enabled projects

Competency		RII	Rank
Managerial and Administrative ^{1,2,3,8}	Document control ²	0.7745	17
	Human resource management ^{5,7}	0.6298	49
	Collaboration ^{4,6}	0.9064	1
	Technical training ⁸	0.7787	16
	Team/Workflow management ⁷	0.8170	10
	Information flow appreciation ²	0.8128	12
	Information flow management ²	0.8298	6
	Information flow coordination ²	0.8213	8
Strategic Competency ^{1,2,3,8}	IT support ^{3,8}	0.6894	35
	Strategic planning ^{1,7}	0.7872	15
	Organisational management ^{4,7}	0.7660	21
	Component development ⁸	0.6426	48
	Analytical Thinking ^{4,6}	0.7149	31
Functional and Operational ^{1,2,3,8}	Conceptual thinking ^{4,6}	0.6766	38
	BIM coordination ³	0.8255	7
	BIM management ³	0.8426	5
	Common data environment appreciation ³	0.8043	13
	BIM tool (e.g. Revit) manipulation ³	0.6681	41
	Design and conceptualizing ^{2,8}	0.6468	47
	Software and web development ⁸	0.5404	52
	Software related trouble shooting ⁸	0.5320	53
Leadership and People Management ^{1,2,3,8}	BIM PM tool (e.g. Navisworks) appreciation ²	0.6553	44
	Impact and influence ^{4,6}	0.7617	23
	Leadership ^{1,4,5,6,7,8}	0.7915	14
	Teaching and coaching ⁸	0.6809	37
	Facilitation ⁷	0.7234	29
	Initiative ^{4,6}	0.7574	26
	Developing others ⁶	0.6979	33
	Negotiation ^{1,5}	0.7277	28
Technical and Implementation ^{1,2,3,8}	Communication ^{2,4,6}	0.8979	2
	Team work and cooperation ^{4,6,7}	0.8936	3
	Team leadership ^{4,6}	0.8596	4
	Software coordination ³	0.6766	38
	Software management ³	0.6681	41
	IT awareness ^{1,3}	0.6894	35
	IT appreciation ³	0.6511	45
	BIM Tool (e.g. Revit) appreciation ^{1,2,3}	0.6766	38
	General computing appreciation ³	0.6979	33
	Analysing and simulating ⁸	0.6638	43
Innate Qualities ^{1,2,3,8}	Quantifying and estimating ⁸	0.6255	51
	Modelling and drafting ⁸	0.6298	49
	Documentation and detailing ⁸	0.7064	32
	Model management ⁸	0.6511	45
	Goal orientation ²	0.7745	17
	Change orientation ²	0.7574	26
	Decisiveness and assertiveness ^{2,4,6}	0.7617	23
	Flexibility and adaptability ^{2,3,4,6}	0.8213	8
	Patience ³	0.7702	19
	Accommodating ^{3,4}	0.7234	29
	Achievement orientation ⁶	0.7617	23
	Self-confidence ²	0.7660	21
	Information seeking ⁴	0.8170	10
	Composure ⁶	0.7702	19

Key: *superscript: 1 = Interviewee 1, 2=Interviewee 2, 3=Interviewee 3, 4= Literature 1; Dainty et al., (2005), 5=Edum-Fotwe and McCaffer (2000), 6=Dainty et al., (2004), 7= Succar and Sher (2014), 8=Succar et al., (2013).

The sub-competencies with the least RII scores are software related troubleshooting (RII=0.5320, mean=2.6596, Std. D=1.22077), software and web development (RII=0.5404, mean=2.7021, Std. D=1.33376), and design and conceptualising (RII=0.6468, mean=3.2340, Std. D=1.21964). Technical and implementation (RII=0.6670) was regarded as the least needed competency group from the RII analysis. Documentation and detailing (RII=0.7064, mean=3.5319, Std. D=1.23096), General computing appreciation (RII=0.6979, mean=3.4894, Std. D=.95262) and IT awareness (RII=0.6894, mean=3.4468, Std. D=1.07962) are the sub-competencies with high RII scores. On the other hand, those with low scores are quantifying and estimating (RII=0.6255, mean=3.1277, Std. D=1.26176), modelling and drafting (RII=0.6298, mean=3.1489, Std. D=1.30182), IT appreciation (RII=0.6511, mean=3.2553, Std. D=1.05229) and model management (RII=0.6511, mean=3.5745, Std. D=1.17482).

Table 2: Relative Importance of Main CPM competency areas for BIM-enabled projects

Competency Group	RII	Rank
Managerial and Administrative	0.7844	1
Leadership and People Management	0.7792	2
Innate Qualities	0.7723	3
Strategic competency	0.7175	4
Functional and Operational	0.6894	5
Technical and Implementation	0.6670	6

From table 1 above we find the key competency groups as well as the sub competencies under them, while table 2 presents the Main competency groups and their relative important index as well as their ranks with regards to it. Given the high technological component that makes up for the BIM process, the assumptions from the finding would have been that Technical and implementation, and Functional and operational would have been the most valuable BIM competency requisite for BIM-enabled project delivery. Contrary to this assumption, the findings show that Managerial and Administrative, Leadership and people management and Innate qualities were more important to CPMs for BIM-enabled project delivery. This is justified by the findings from literatures on general PMs competences. Furthermore, a look at the sub competencies of great relevant to effective BIM project delivery, show that sub competencies under leadership and people management were more significant, while the sub competencies under functional and operational, technical and operational were the least import for effective BIM-enabled project delivery. This is as shown in table 3. Table 3 presents the five (5) most critical sub-competencies as well as the five (5) least critical sub-competencies for BIM project implementation.

Table 3: Most needed and least needed CPM BIM Competencies

S/N	5 Most critical competencies needed by PMs for BIM project Implementation	Competency group	RII	Rank	Mean	SD
1.	Collaboration	Managerial/Administrative	0.9064	1	4.5319	.85595
2.	Communication	Leadership/People mgt.	0.8979	2	4.4894	.90583
3.	Teamwork and cooperation	Leadership/People mgt.	0.8936	3	4.4681	.85595
4.	Team leadership	Leadership/People mgt.	0.8596	4	4.2979	.97613
5	BIM management	Functional/Operational	0.8426	5	4.2128	.93102
S/N	5 least critical competencies needed by PMs for BIM project Implementation	Competency group	RII	Rank	Mean	SD
1.	Software related trouble shooting	Functional/Operational	0.5320	53	2.6596	1.2207
2.	Software and Web development	Functional/Operational	0.5404	52	2.7021	1.3337
3.	Quantifying and Estimating	Technical/Implementation	0.6255	51	3.1277	1.2617
4.	Human Resource Management	Managerial/Administrative	0.6298	49	3.1489	1.2154
5.	Modelling and drafting	Technical/Implementation	0.6298	49	3.1489	1.3018

DISCUSSION

There were varying views from research participants. However, the finding revealed by the study indicate that the competencies needed by CPMs for operating in a BIM-enabled environment are distinct when compared with the competencies required in traditional CPMgt functions. This is buttressed by the findings of Succar et al. (2013) who highlighted the need for identification of speciality-specific competency classifications. Whereas it is unsurprising that more technical and operational BIM competencies are regarded as less important to CPMs, the findings are interesting because CPMs have been found in recent times to highlight their technical BIM competencies more from a review of professional profiles of CPMs (Rahmana, et al., 2016). From the findings of this study, however, such technical and hard skills are less important to the PM's ability to successfully perform on BIM-enabled projects. The findings underscore the lesser expectations for CPMs to directly use BIM related tools themselves when compared with BIM-specific duty holders such as BIM managers and coordinators (Rahmana, et al., 2016). The findings further highlight the leadership role of CPMs given the high level of importance placed on administrative, strategic and managerial competencies. This highlights the importance of facilitation and provision of resources such as finance for BIM project success (Succar et al., 2013; Succar and Sher, 2014, Mahamadu et al., 2017). Several competencies that relate to people and collaboration issues emerged as important to the CPMs. This underscores the important role of the CPM in ensuring that the BIM tools and processes can lead to attainment of collaboration which often requires soft skills (Smith, 2014). In summary, despite acknowledging the importance of hard IT-centric skills to CPMs in BIM project delivery, the findings overwhelming support the need for people and managerial skill sets for CPMs in order to deliver BIM projects. This accords with wider CPM competency literature where people, managerial and organisational strategy related skills are often prioritised over task-centric technical know-how for attainment of superior performance (Edum-Fotwe and McCaffer, 2000; Dainty et al., 2005; Ahadzie et al., 2008).

CONCLUSION

The findings from this study have implications for training and development of CPMs competencies for BIM-enabled project execution. The study has highlighted the importance of collaboration and communication competencies of CPMs on BIM projects and overall the greater need for managerial, administrative and leadership competencies compared to technical skills related to the use of BIM tools.

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THE NEED FOR CHANGE MANAGEMENT CONCEPT IN CONSTRUCTION PROJECT COST CONTROL

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Controlling construction cost is one of the most difficult task in cost management. The application of change management concepts improves project cost performance, however there appears to be a lack of its concept in the existing frameworks of the practice of construction project cost control over its composition and more significantly its measurable attributes. This paper demonstrates the need for change management principles in construction cost control by revealing the appropriate constructs for defining change management to enable its measurement and to examine how they relate to cost control practice in construction project. Paper employs the descriptive survey. It relied on only the secondary form of data collection where literature review was used as methodology and draws on models of change management and construction cost control culture to achieve the objectives of the paper. Findings reveal that the change management principles enhance cost performance. Projects with change management principles perform better in cost performance than those without change management. The paper demonstrates the role change management plays in construction project cost control and propose its incorporation in the existing frameworks for the practice of cost control. Theories of change management can be adopted and adapted to generate constructs for measuring change management issues in construction cost management. Project cost managers can therefore use change management constructs to control construction project cost in the construction industry.

Keywords: Change Management, Cost Control, Cost Management, Construction Industry

INTRODUCTION

Construction project cost control practice is a prerequisite management method for successful managing of construction project cost (Bahaudin et al. 2012). Cost control practice is a process whereby the cost of the construction project is monitored, evaluated and compares the planned budgeted cost with the actual site cost for decisions to be made to bring the cost on track (Cleland and Ireland 2002). The concept of cost control principle has six main functions which are estimating, budgeting, monitoring, analysing, reporting, and corrective action (Charoenngam and Sriprasert, 2001).

At the predetermined stage of the construction project, the quantity surveyor or cost engineer needs to check the status of the construction project cost by auditing or collecting information about the project cost. Calculations are conducted leading to the graphical representation of the project cost. The 'S' curve is widely used to calculate the project cost as illustrated in figure 1 below.

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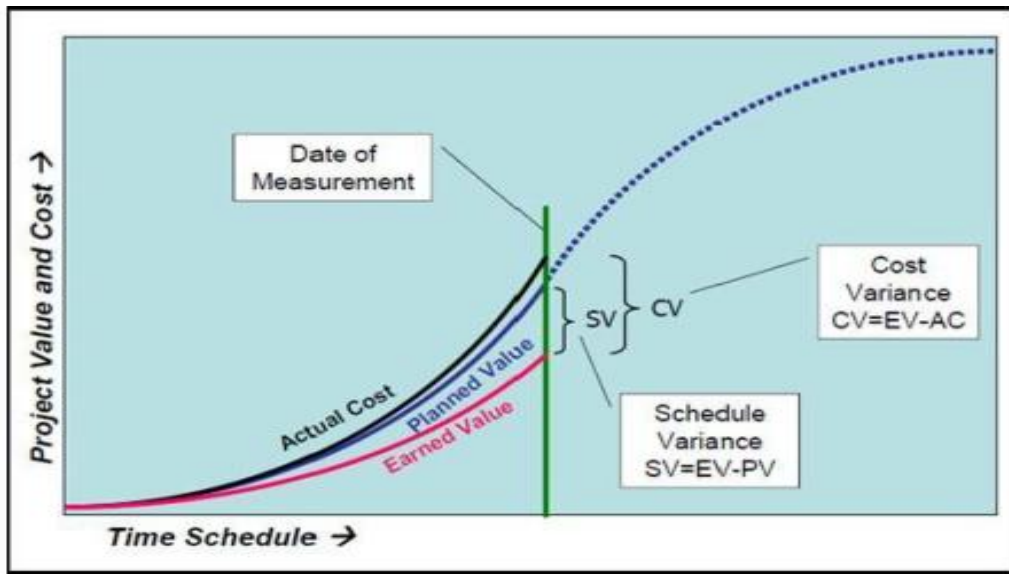


Figure 1: Standard Earned Value Analysis Graph (Adapted from Subramani et al, 2014)

The calculations are made in three main areas thus; actual cost, planned value and earned value. There could be a deviation of the actual cost from the budgeted cost. This situation is referred to as cost variance. A variance in project management is the differences between the two values usually the differences between two expenditures; thus, planned and actual (Ansah and Boamfo-Adjei, 2012).

The variance is to offer early warning system, notices of likely budget problems at predetermine time for corrective measures to be undertaken to reduce or overcome the variances. The project quantity surveyor or the cost engineer requires to apply the cost control practice to develop a series of possibilities for the best option that can fit within the approved budget limit (Adjei et al, 2017; Khamidi et al., 2011; Dikko 2002). Corrective measures are therefore considered as a decision-making concept to be used to solve the variances that occur in the construction cost (Adjei et al, 2017).

In the construction industry, the controlling of the cost is done by effective decision making but less attention is given to how to incorporate change management concept in cost control. Thus, the existing cost control frameworks lack change management concept. According to Zou and Lee, (2008) construction projects with change management principles accomplish better in cost performance than those lacking that. Zou and Lee, (2008) in their studies also added that change management is one of the best and important practice in project management but this is less seen in construction cost control. Implementing change initiatives in organisation may fail, nevertheless, organisations need to be mindful of major changes that occur in construction cost in order to achieve the project objectives (Higgs and Rowland, 2005; Higgs and Rowland, 2000).

Previous studies have been conducted in the construction industry relating to change management concepts and its impact on construction project cost performance. Zou and Lee, (2008) investigated the impact of change management practices on project change cost performance. Owusu (2015) identified the impact of change management practices on construction project performance. Many researches are conducted on change management framework/model and concepts for the construction industry (Gharaee Moghaddam, 2012; Sun et al., 2006; Erdogan et al, 2005; Al-Sedairy, 2001).

This paper therefore demonstrates the need for change management principles in construction project cost control by revealing the appropriate constructs for defining change management to enable its measurement and to examine how they relate to cost control practice in construction projects

CHANGE MANAGEMENT SYSTEM

Definition of change management

Change management is a structured and strategic approach to initiate and manage the change process in the organization structure and culture as well as the individual's/team's behavior and attitude towards the change transition in the field of the business processes, technology implementation or any other policies of an enterprise. Change management is about modifying or transforming organizations in order to maintain or improve their effectiveness (Hayes, 2007).

Lazarus and Clifton (2001) and Erdogan et al., (2005) defined change in a construction project in six different directions namely: 1) The scope of the project; 2) The capital cost, whole-life cost or value of the project; 3) The time required to design or construct the project; 4) The project team relationships and appointments; 5) Project-associated risk allocation or scope; and 6) The form of procurement.

Change management process: theories and frameworks

According to Motawa et al, (2007), Owusu (2015) change management system has five principles which are; 1) promote a balanced change culture; 2) recognize the changes; 3) evaluate the change; 4) Implement the change and 5) continuously improve from experience. Jaworski and Scharmer (2000) also identified the core practices for successful change process which are: 1) observing: seeing reality with new eyes, 2) sensing: turning the observed reality into emerging patterns that inform future possibilities, 3) envisioning: crystallizing vision and intent. and 4) executing: acting in an instant to capitalize on new opportunities.

For the change management process to be effective the project management team must identify the changes in the project and future possible changes (Gharaee Moghaddam, 2012). Then change should be reviewed and responsibilities assigned to members for the task to be done. The change should be communicated to the other members of the organisation, thus, various disciplines who are going to see to the change process (Gharaee Moghaddam, 2012). Matkó et al., (2015) also added that for a successful change management, the top management team support is critical and it is required. The team should be assigned with the task and given all the powers for the change process. The team then outlines the visions and strategies for the change. The team then implements it in the organisation (Matkó et al., 2015). More change management process from four different authors are presented and summarized (see Table 1).

Table 1: Summary of change management process

Jacobsen, 2013	Kotter, 2012	Motawa et al, 2007	Jaworski and Scharmer, 2000

(1) Diagnosis: realizing that there is a need for change	(1) Create a sense of urgency	(1) Anticipate change;	(1) Observing: seeing reality with new eyes.
(2) Solution: realizing what needs to be accomplished and create a plan	(2) Create coalition (the size of team to power change)	(2) Recognize changes;	(2) Sensing: turning the observed reality into emerging patterns that inform future possibilities.
(3) Implementation: performing the plan	(3) Formulate a compelling vision	(3) Evaluate change;	(3) Envisioning: crystallizing vision and intent.
(4) Evaluation: evaluate if the change was successful	(4) Expand the vision more widely	(4) Resolve change; and	(4) Executing: acting in an instant to capitalize on new opportunities.
	(5) Allow employees to achieve vision	(5) Learn from change.	
	(6) Design and build a short-term success plan		
	(7) Consolidate the results, planning future changes		
	(8) Institutionalizing new approaches		

Source: Literature review

LEADERSHIP IN CHANGE MANAGEMENT

A leader in change management concept is the one who is solely responsible for making the change process to be as smooth as possible (Rosén, 2014)

Leadership styles required for change management

Several leadership styles are there for managers practicing change management to adopt. These include charismatic, operational, Theory E, Theory O, combination of Theories E & O and transformational leadership (Rosén, 2014; Dessler et al., 2004; Landrum et al., 2000). In charismatic leadership, the leader combines three core elements for successful leadership. These are vision, inspiration and empowerment of people (Dessler et al., 2004). The leader most at time communicate the vision and gather the momentum needed for improvement in the change management process (Landrum et al., 2000). For an operational leader to be effective, planning, organizing and controlling are also the core elements for the change management process (Dessler et al., 2004). Both charismatic and operational leadership styles are natural and forms of transformational leader (Rosén, 2014; Dessler et al., 2004). Studies by Beer and Nohria (2000), and Rosén, (2014) presented a detailed leadership styles of theories E, O and its combination (See table 2). Theory E's success in change management is best seen in the use of shareholders' value, managing change at the top management team level with very little to do with the lower level management team. The theory O considered employee engagement to manage change.

The theory encourages individuals of the organisation to take initiatives and solve problems at lower levels of the organisation. The combination theories use both hard and soft leadership style

Table 2: leadership styles for the dimensions of change

Dimensions of change	Theory E	Theory O	Theories E and O combination
Goals	Maximum shareholder value	Develop organisational capabilities	Explicitly embrace the paradox between economic value and organisational capabilities
Leadership	Manage change from the top down	Encourage participation from bottom up	Set directions from the top and engage the people below
Focus	Emphasize structure and systems	Build up corporate culture: employees' behaviour and attitude	Focus simultaneously on the hard (structure and systems) and soft (corporate culture)
Process	Plan and establish programs	Experience and gradual development	Plan for spontaneity
Reward systems	Motivate through financial incentives	Motivate through commitment – use pay as fair exchange	Use incentives to reinforce change but not to drive it
Use of consultants	Consultants manages problems and shape solutions	Consultants support management in shaping their own solution	Consultants are expert resources which empower employees

Source (Beer & Nohria 2000; Rosén, 2014)

Leader's role in change management

Higgs and Rowland, (2000) identified leader's role and behaviour in the change process in five broad areas as:

- (1) Creating the situation for change: effectively engaging others in recognizing the need for change.
- (2) Creating structural change: ensuring that the change is built on depth of understanding of the matters and supported with a constant set of tools and processes.
- (3) Engaging others in the whole change process and building commitment.
- (4) Implementing and sustaining changes: developing effective plans and ensuing good monitoring and review practices are developed.
- (5) Facilitating and developing capability: ensuring that people are challenged to find their own answers and that they are supported in doing this.

Higgs and Rowland, (2000) & Denzin and Lincoln, (2000) further explored leadership behaviours with very detailed emerging themes relating to change management. The nine categories came out to be essential for leaders to perform in change management operations. These are:

- (1) What leaders say and do: The communication and actions of leaders related directly to the change.
- (2) Making others accountable for the change.
- (3) Thinking about the change.
- (4) Using an individual focus.
- (5) Establishing 'starting points' for the change.
- (6) Designing and managing the change journey.
- (7) Communicating guiding principles for the change.
- (8) Creating individual and organizational capabilities.
- (9) Communicating and creating connections.

MOTIVATING STAFF FOR CHANGE

According to Korbi (2015), motivating staff for change is to influence the employees in an organisation to eradicate their resistance to change, motivation is efficient and provide the necessary vigor to conquer all anticipated challenges. Employees expect from the leader, a vision, and motivation to fulfil the vision. The motivation will assist and inspire the employees to achieve the change objectives within the organisation (Duluc, 2000).

THE NEED FOR CHANGE MANAGEMENT CONCEPT IN COST CONTROL PRACTICE

Cost control is the process of monitoring; evaluating and comparing planned results with actual results to determine the status of the project cost, schedule and technical performance objectives Cleland and Ireland (2002). It is vital for the contractors to operate an effective cost control procedure during the post contract stage of project to keep the cost of the scheme within the building budget (Sanni and Hashim, 2013).

According to Al-jibouri, (2003) during the construction stage, divergences from the initial plan of cost will occur, notwithstanding that fact, construction project should have a control cycle as follows with the aim of completing project within acceptable time and budget:

Make a plan

Implement the plan

Monitor the actual output and record it.

Report the actual, the planned parameters and their variations.

Take corrective action on the variation

Existing framework on cost control has six main functions for cost control which are budgeting, monitoring, analysing, reporting, corrective action, and post-evaluating (Charoenngam and Sriprasert, 2001). The details of the various sub constructs for the

main functions are presented and summarized (see Table 2). This indicates that cost control framework is well managed by taking good decisions which act as a corrective measure in order to bring the cost on track.

Researchers like Adjei et al, (2017) Khamidi et al., (2011) Al-jibouri, (2003), Dikko, (2002) have all agreed to the fact that, there is the likelihood of cost variances thus changes to occur within the original budgeted cost. Therefore, the changes in the construction project cost could be also managed with change management concept. Hafez et al, (2015) buttressed the fact that, project cost control system should estimation, monitoring, project reporting, forecasting, as well as change management process which encompasses assessing the impact of change, reporting on the change decision and implementing the change into the scope of the work. Zou and Lee, (2008) also supported that, construction projects with change management principles accomplish better in cost performance than those lacking that. Zou and Lee, (2008) also show that, change management is one of the best and important practices in project management but this is less seen in construction cost control. There is therefore the need for change management concept to be fused into construction project cost control principles

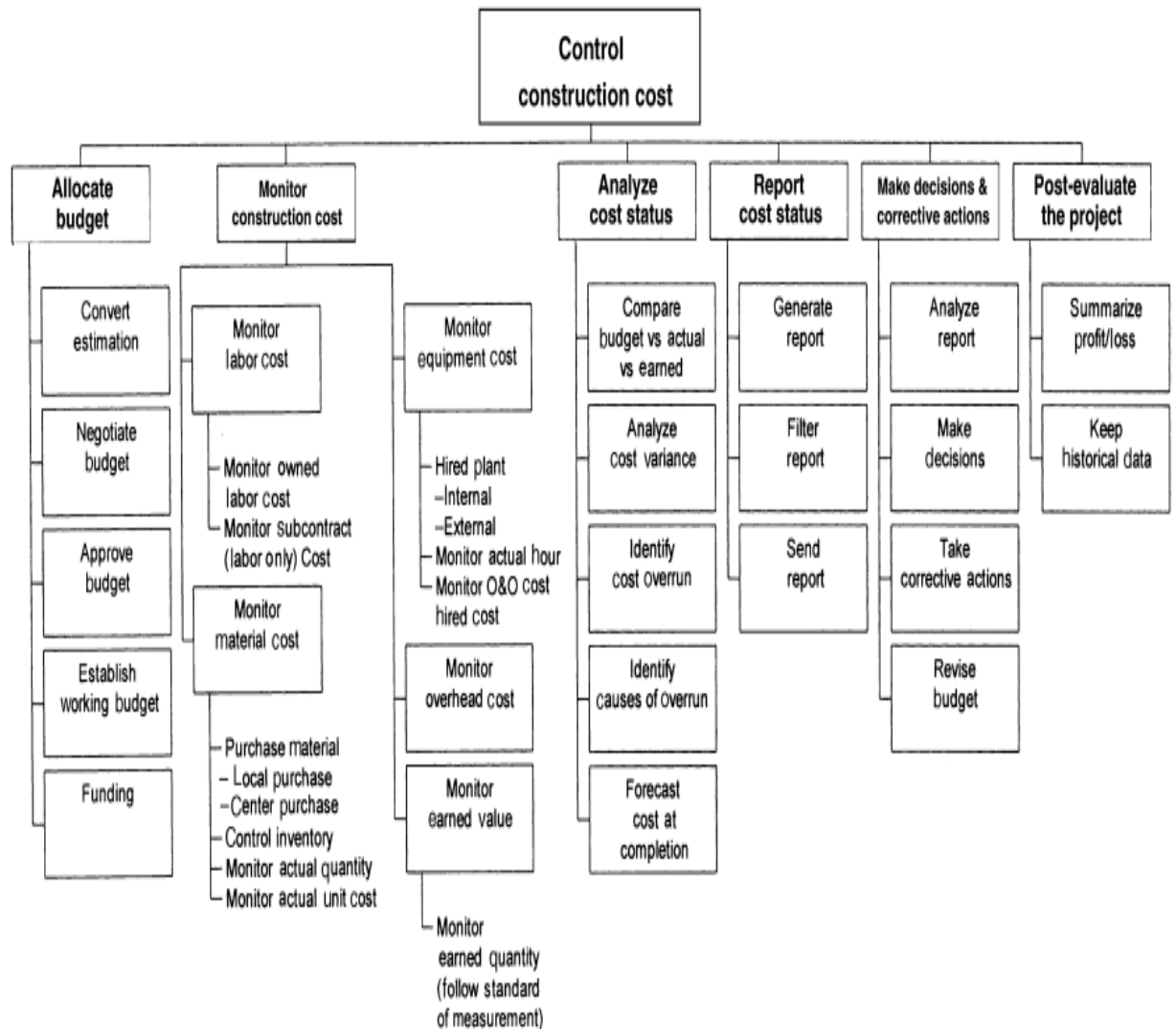


Figure 2: Cost control function breakdown structure (Adapted from Charoenngam and Sriprasert, 2001)

RESEARCH METHODOLOGY

This study was conducted using research papers from the literature search and successively processing and analyzing the papers gotten. Familiar texts relating to cost control and other cited publications in referred journals but limited to papers that relates to issues focusing on the change management concept for cost control were also assessed.

The following steps were used:

- (1) Finding out from titles, keywords and abstracts with words like ‘change management’, managing changes in cost’ ‘change management in construction industry’, ‘cost control’, ‘cost management’ through the electronic databases since such platform has a lot of collection of texts and therefore provides an extensive coverage of texts than of individual journals. The electronic databases used includes Google scholar, Google search engine, Ebscohost ASCE, Emeralds, Taylor and Francis, Sage, Wiley online library, DOAJ, AJOL, Science Direct. Different papers identified were scanned with the above-mentioned keywords.
- (2) A review of the abstracts of these papers were conducted to sieve out the less related papers. This was attained by means of selecting technical papers and reviews, eliminating duplicate articles, and doing away with papers which were not directly related with the topic of the study.
- (3) All the outstanding papers were read, analyzed and numerous descriptive words were identified. The part of the paper that relate to challenges of cost control were singled out for further examination for the purpose of this study.

PROPOSED CONSTRUCTS FOR CHANGE MANAGEMENT FOR COST CONTROL

The following constructs are proposed for its incorporation in construction project cost control framework. The summary has thirteen (13) different presentations in Table 3

Table 3: proposed change management constructs for cost control.

S/No	Change Management Constructs for Cost Control
1	Establishing the sense of urgency for change
2	Developing a vision for cost change
3	Developing strategies for cost change
4	Design short term success plan
5	Promote a balance change
6	Implement the change
7	Evaluate the change
8	Continuously improve from lessons learnt
9	Communicating guiding principles for the change.
10	Empowering others to act on the vision

-
11	Selecting appropriate leadership style
12	Motivating staff for change
13	Creating individual and organizational capabilities
-

CONCLUSIONS

Changes are always inevitable in construction. It occurs in two different areas, this is within the organisation and construction projects. Changes are likely to occur in the budgeted cost of construction projects. This is because construction cost is dynamic during the execution of the project.

It is therefore essential that change management concept is added to the existing theories of construction project cost control. Thirteen (13) sub constructs were proposed for it further examination and measurement. These are: establishing the sense of urgency for change, developing a vision for cost change, developing strategies for cost change, design short term success plan, promote a balance change, implement the change, evaluate the change, continuously improve from lessons learnt, communicating guiding principles for the change, empowering others to act on the vision, selecting appropriate leadership style, and motivating staff for change, creating individual and organizational capabilities.

A new cost control framework is needed to be developed to reflect the current or modern trends of controlling of construction project cost. Thus, it will be better to consider how to fix change management concept in cost control of construction projects.

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FACTORS RESPONSIBLE FOR POOR SAFETY PERFORMANCE OF SMALL AND MEDIUM CONSTRUCTION CONTRACTING FIRMS IN NIGERIA

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Even with the immense contribution of the construction industry to economic growth, the frequency and severity of accidents and ill health pose a great concern to stakeholders. The construction industry has been known for its notoriety regarding hazardous and dangerous nature because of the high incidence of accidents and deaths that occur on the construction site around the world. This research examines factors responsible for poor health and safety performance of small and medium sized construction firms in Nigeria. The study also looked into strategies to improve H&S performance. The study adopted a quantitative research method where one hundred and fifty questionnaires were randomly distributed among small and medium sized construction contracting firms in Abuja, Kaduna and Kano state of Nigeria. Findings from the study revealed that low budget provision for health and safety, low awareness of health and safety issue among workers, non-implementation of existing legislation on health and safety, casual nature of construction workers employment and apathy of stakeholders are the responsible for the poor safety performance of construction SME's. The current paper seeks to provide additional insight into causes and strategies to enhance poor health and safety performance of Small and Medium scale construction contracting firms who are the most affected by health and safety challenges.

Keywords: Health and Safety, Performance, SME's

INTRODUCTION

The construction industry is strategically important in the provision of building and infrastructure (buildings, roads, dams, airports, power plants, stadia, and ports) which are construction products on which all sectors of the economy depend on. A country's development is hinged on the performance of the construction industry. Even with the positive contribution of the industry, the accident, injury and illness rate has tainted the image of the industry. The construction industry has been classified as one of the most hazardous sector which is highly susceptible to accidents, injuries and illness (Abdul Tharim et al 2011; Eaves et al., 2013; Ajayi and Thwala 2015; Huang and Hung 2015). HSE (2000), ILO (2005), Agwu and Oledede (2014) assert that the construction industry globally experiences accident and injury rate that is five (5) times higher than other industries. According to Loiselle and Werna (2014) the risk associated with construction work is estimated to be three to six times greater in developing countries and around 4% of the world's gross domestic product is lost to cost of injury, death and disease through absence from work, sickness treatment, disability and survivor benefits.

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No matter how automated the construction process goes, the need for human effort can never be eliminated in developing countries like Nigeria where labour is readily available (Fellows et al., 2002; Matiko 2013). This depicts why safety of construction workers has to be put at the forefront. Preventing occupational injuries and illness should be a primary concern for all stakeholders in the industry including the government. It is no longer acceptable for large number of construction workers to get injured or even killed on construction sites. Fellows et al., (2002) linked the causes of accidents on construction site to organisational issues such as lack of adherence to standard health and safety laws, lack or poor communication within the company and lack of implementation of the health and safety laws.

The current state of health and safety in the Nigerian construction industry is not encouraging. According to Waziri (2015) health and safety practices on construction sites in Nigeria is poor. Okoye et al., (2016) adds that there is low level of compliance of health and safety practices by construction workers in Nigeria. It is has been generally agreed that employers takes responsibility regarding the safety of the employee even though other stakeholders have their own role and responsibility. Therefore the constructor (construction firms) should be held responsible for these poor performances. That is why this study focuses on the construction firms

Shittu et al., (2015) tried to make a case for researches to focus more on SME's. The study asserted that health and safety researches in developing countries, especially in Nigeria, have been ineffective in addressing the challenges of health and safety in the Nigerian construction sector because it have been largely generalised without considering size and operation of players in the industry.

According to Kheni et al., (2006) health and safety performance of construction sites under SME's are poor. They suggested further research to explore factors contributing to low health and safety performance of SME in the construction sector. It is in this vein that this research seeks to assess the factors militating against the implementation of health and safety practices on construction sites among small and medium construction firms in the Nigerian. The research also intend to find strategies to overcome constraints in health and safety management and pave a way of improving health and safety performance of SME in the construction industry.

LITERATURE REVIEW

Occupational health and safety

Occupational health and safety (OHS) encapsulates the mental, emotional and physical well-being of the worker in relation to the conduct of his work. OHS puts the human life at the centre of all productive activities, which must not be compromised at any cost. Appreciation of the concept of occupational health and safety has become imperative to the success of any organisation.

Organisations can no longer afford to lose experienced and committed employees through ill-health caused by unhealthy working conditions (Amponsah-Tawiah and Dartey-Baah 2010). The cost of recruiting, selecting, developing, motivating and retaining new employees lost through work related ill-health could be enormous. Despite significant improvements in health and safety in many parts of the world over the past several decades, the global challenge of providing for worker health and safety is ever greater today (Loiselle and Werna 2014).

Health and safety in construction industry

Construction workers are the most important asset in the industry. Their performance determines the success or failure of a project. These workers carry out their activities at the expense of their health and safety. The high rate of injuries and fatalities in the industry is a source of concerns to all stakeholders. This has led to deliberations on ways of ensuring a safe and healthy working environment especially for workers who are usually at the receiving end when these incidents occur (Agwu and Olele 2014). Mahmoudi, et al., (2015) posits that construction companies need to improve their conditions with respect to occupational health and safety. According to Obiegu (2015) most construction projects in Nigeria do not achieve safety and quality. He further stated that clients are still not satisfied regarding task preparation, lack of workers protection and poor safety culture resulting in accidents on construction sites.

Small and medium scale Construction firms in the construction industry

Small and medium scale enterprises are important to the development of any nation. The importance of small and medium sized firms in the construction industry cannot be overemphasised. The construction sector especially in developing countries is dominated by small and medium sized contractors (Kheni et al., 2006). According to AbdulHafeez et al., (2016) over 80% of construction contracting firms in Nigeria are within the micro, small and medium scale enterprises. The figure is even higher in developed countries. Lia and Yao (2008) posit that 99% of enterprises in the construction industry belong to the medium and small scale businesses in China. Using the Commission of the European Community's classification, Miller et al., (1999) observed that 99% of firms in the UK are SME's. In tackling health and safety issues in construction small and medium sized construction contracting firms should be the focus not just because they constitute the highest number of firms but because they also employ the large number of employees.

RESEARCH METHODOLOGY

The research adopted a quantitative research method. Questionnaires were administered to small and medium sized construction firms within Kaduna, Abuja and Kano states of Nigeria. These states were chosen because of the high rate of construction activities and firms. The study adopted random sampling in distributing questionnaires.

Preliminary study was carried out prior to the main research with the aim of securing relevant data for the study. Fellow and Lui (2007) suggested that all questionnaires should initially be piloted, completed by a small sample of respondents in order to have an opportunity for testing the prepared questionnaire before decision are taken on the final version.

A total of One hundred and fifty questionnaires were randomly distributed among small and medium sized firms. The most senior personnel in charge of construction were asked to fill the questionnaire. The questionnaires were hand delivered and retrieved the same way. One hundred and eight questionnaires were returned, giving a response rate of 72%. The significance of the factors was measured on a 5-point likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The data was analysed using mean.

Interpretations of the mean values are as follows:

Mean < 3.00, item is assessed to have low rating.

$3.00 \leq RII < 4.00$, item assessed to have high rating.

$RII \geq 4.00$, item assessed to have very high rating

RESULTS AND DISCUSSION

The profession/designation of respondents who filled the questionnaire on behalf of the construction firm is presented in Table 1. 12% of respondents are Architects, 34% are Builders/ Construction manager, 21% are Quantity surveyors, 26% are Civil Engineers and 8% are project managers. This shows that respondents are all professionals in the construction industry in Nigeria.

Table 1: Profession of Respondents

Profession	Frequency (Nr)	Percentage (%)
Architects	13	12
Builders/Construction Manager	37	34
Quantity surveyors	23	21
Civil Engineers	27	25
Project Manager	8	8
Total	108	100

Table 2 shows the years of experience of respondents. Majority (83%) of respondents have working experience of between 6-15 years in construction. 11% have 0-5 years experience while the least 6% have working experience of above 15 years. It can be concluded that respondents firms have adequate working experience in the construction industry.

Table 2: Profession of Respondents

Years of experience	Frequency (Nr)	Percentage (%)
0-5 years	12	11.1
6-10 years	46	42.5
11-15 years	44	40.7
Above 15 years	6	5.6
Total	108	100

Table 3. shows the area of specialization of the firms. 51% of the firms specialize in building works, 23% specialise in civil works while 26% are involved in both civil and building works. It shows that responding firms are only into the construction work which basically comprises of building and civil works.

Table 3: Area(s) of operation or specialization of firms

Area	Frequency (Nr)	Percentage (%)
Building	55	51
Civil works	25	23

Civil and building works	28	26
Total	108	100

Regarding the size of the firms, 51% are small construction firms and 39% are medium sized. None of the response was from large construction firms (see Table 4). The classification of the size of the firms is based on Small and Medium Scale Enterprise of Nigeria (SMEDAN) classification.

Table 4: Company size

Area	Frequency (Nr)	Percentage (%)
Small (less than 50 employees)	66	61
Medium (51-199 employees)	42	39
Large (over 200 employees)	0	0
Total	108	100

The study assessed the availability of a health and safety manual used in developing a project specific health and safety plan. As seen in Table 5, very few (13%) have a health and safety manual. This shows that most small and medium sized construction firms do not have a formal health and safety plan. It also shows they don't plan for safety. Like the saying goes if you fail to plan you are planning to fail.

A health and safety log book shows records of accidents and injuries including near misses. It also depicts a company's commitment to health and safety. Findings show that 86% of firm do not have a safety logbook, therefore they do not keep health and safety records. This could be one of the reasons for the poor statistics on accident and ill health in the Nigerian construction industry. Most construction firms keep records of financial transaction but do not keep health and safety records. This might be because according to Smallwood (2011) most firms are preoccupied with cost, quality and time. They do not appreciate and understand the synergistic role of health and safety. It also shows that most firms do not see safety as a measure for project success.

Table 5: Health and safety manual, record and budgeting

	Option	Frequency	Percentage (%)
Availability of a health and safety policy and manual	Available	14	13
	Not-available	86	87
	Total	108	100
Records on health and safety/ Logbook	Available	7	6
	Not-Available	86	93
	Total	108	100

The research looked into the personnel saddled with the responsibility for managing health and safety on the construction sites of these firms (see Table 6). 57.40%

(majority) of SME's do not assign anyone to oversee issues relating to health and safety on site. Very few (2.77%) companies have health and safety officer on site. Usually other professionals (site managers and construction manager) are given the responsibility of managing safety in addition to their primary roles. This shows why health and safety issues are not put at the forefront on most construction sites because safety professionals are not in place. This according to Diugu et al., (2012) could be because the safety regulation in Nigeria do not stipulate the appointment of a safety officer on the construction site.

Table 6: Personnel in charge of Health and safety on site

Personnel	Frequency (Nr)	Percentage (%)
Health and safety officer	3	2.77
Ergonomist	0	0
Site Manager	34	31.50
Construction Manager	9	7.40
No one	62	57.40
Total	108	100

Table 7. shows the motivation or benefits of implementing health and safety. Preventing injuries and death ($x=4.48$), increase productivity and staff morale ($x=4.33$), reduced insurance premiums and compensation claims ($x=4.11$) were the most significant benefits from implementing health and safety in construction. Complying with safety regulation ($x=3.94$) and reduced staff turnover ($x=3.68$) were ranked significant by respondents.

Preventing injuries and death is a moral, legal and financial argument for promoting health and safety (H&S) on construction site according to Huges and Ferret (2008). Finding from this study also reveals that firms are beginning to link health and safety to increase productivity, which is a step in the right direction in promoting health and safety. Firms also see insurance premiums and compensation claims as a treat to their profitability. No firm wants to pay compensation or insurance premiums due to accidents. This finding is also similar to Dodge (2017) on factors that influence contractors to H&S which include; concern about workers safety; insurance cost, liability cost and fulfilling regulatory requirement.

Table 7: Motivation for implementing health and safety

Motivation	5	4	3	2	1	$\sum f$	$\sum fx$	Mean
Preventing injuries and death	68	32	-	7	2	108	484	4.48
Increase productivity and staff moral	52	31	18	12	5	108	467	4.33
Avoiding insurance premiums and compensation	51	40	3	6	8	108	444	4.11

claims

Complying with safety regulation	40	46	5	9	8	108	425	3.94
Reduced staff turnover	30	51	12	5	10	108	389	3.68
Reduce absenteeism	10	47	15	32	4	108	351	3.25
Sound reputation	19	26	19	27	17	108	327	3.03

Health and safety regulations, requirements and provisions were identified from review of literature. These regulations are welfare, health, and safety provisions from the Laws of the Federal republic of Nigeria. Result from Table 8. reveal that the most implemented health and safety laws are health, safety & welfare provisions in workmen's compensation Act (68%), health, safety & welfare provisions in conditions of contract (65%), health, safety & welfare provisions in factory's Act 1990 (60%) and health, safety & welfare provisions in labour safety and welfare law (58%). There were low compliance with Health, safety & welfare provisions in National Environmental Standards & Regulations Enforcement Agency (NESREA) Act and public health Act 1990

Table 8: Health and safety law implemented

Health and safety provision	Frequency (Nr)	Percentage (%)
Health, safety & welfare provisions in Workmen's Compensation Act 2012	68	63
Health, safety & welfare provisions in conditions of contract	65	60
Health, safety & welfare provisions in Factory's Act 1990	60	56
Health, safety & welfare provisions in Labour Safety and Welfare Law 2012	58	54
Health, safety & welfare provisions in National Environmental Standards & Regulations Enforcement Agency (NESREA) Act, 2007	44	41
Health, safety & welfare provisions in Public Health Act 1990	40	37

The study assessed the factors contributing to poor safety performance of SME's, the result is presented in Table 9. Low budget provision for health and safety ($x=4.38$), low awareness of health and safety issues among workers ($x=4.29$), non-implementation of existing legislation on H&S ($x=4.12$), temporary nature of construction workers employment ($x=4.05$), apathy of stakeholders ($x=4.03$) and lack of regulatory framework ($x=3.86$) were the most highly ranked challenges.

Inadequate or low budget for health and safety is a major factor contributing to low performance in health and safety management on construction sites. According to Idoro (2011) Nigerian contractors allocate little or no fund for health and safety management. Health and safety cost are usually under provisional sum in contracts. Contractors see the provisional sum as an area to make more profit. Muhammad, et al., (2014) observed that most craftsmen in Nigeria were trained informally and rarely undergo training after their initial training. They are mostly employed on project basis or are mostly on daily pay. Their major concern is the money rather than health and safety issues. Construction firms sometimes exploit this and ignore health and safety practices.

There is no law in Nigeria currently enforcing health and safety in construction so contractors use their discretion in managing health and safety issues. Low level of awareness especially among craftsmen has made firms escape from providing safety equipment. The craftsmen do not understand that it is mandatory their employers ensures their safety and also provide them a safe working environment hence, they do not demand for it. The factory act and workers compensation act are the laws regulating health and safety in Nigeria. Even though it is not adequate for the industry, implementing it would have gone a long way in improving the poor health and safety performance of the industry.

Because Nigerian firm rarely keep, report, or release accurate records of accidents and injuries occurring on construction sites, the number of injuries, accident and death cannot be accurately determined so the extent of the problem is still unknown. Many construction operatives are employed on casual basis and therefore the employment conditions are not properly defined. Employers can afford not to train or provide the necessary PPE because of the short duration of employment.

Table 9: Factors contributing to poor health and safety performance of SME's

Factors	5	4	3	2	1	$\sum f$	$\sum fx$	Mean
Inadequate or low budget for health and safety	61	30	15	1	1	108	473	4.38
Low awareness of health and safety issues among construction workers	53	39	10	6	-	108	463	4.29
Non-implementation of existing legislation on H&S	57	25	10	14	2	108	445	4.12
Temporary nature of construction workers employment	36	49	17	4	2	108	437	4.05
Apathy of stakeholders	45	38	12	10	3	108	436	4.03
Lack of regulatory framework	24	57	14	10	3	108	413	3.82
Unavailable health and safety policy among construction firms	27	49	16	12	4	108	407	3.77
Lack of reliable data on injuries and death in Nigerian construction industry	39	34	6	24	5	108	402	3.72
Shortage of health and safety personnel	39	28	15	20	6	108	384	3.56

Large number of workforce in the informal sector	14	39	36	10	9	108	363	3.36
Availability of cheap labour	10	36	24	16	24	322	108	2.98

Table 10 presents strategies to improved implementation of health and safety practices. Developing an industry specific health and safety Law for construction (x=4.16), including health and safety plan to contract document (x=4.15), funding agencies to insisting on good OSH through contract (x=4.03) increasing awareness among stakeholders (x=4.03) were ranked to be very significant by respondents. Increasing the number of inspectors with construction background in regulatory agencies (x=3.73) and legislation to enforce implementation could have significant impact according to respondents.

The construction industry in Nigeria needs her own health and safety policy just as it is obtainable in other developed countries because hazards and risks differ in each industry. Nigeria lacks requisite statutory regulations on health and safety. The Factory Act, is not specific to practices in the construction industry. Idoro (2004) observed that the definition of a factory as given in Article 87 of the Factory Act technically excludes construction sites and associated activities from the coverage of the Act. Making health and safety plan a contract document would mean that contractors would plan for safety before actual construction takes place which is good.

Funding agencies (clients) should also insist on good OHS, instructions could be issued to the contractor or it could be stated in the contract. There is need for increased awareness and training on health and safety, through effective education and training in occupational health and safety at all level of training in the industry. This will make firms and workers aware of hazard and risk which will make them more conscious of health and safety, which could in turn enhance implementation. Legislation could force firms to comply. As seen in Table 7. Complying with statutory requirement is a motivator for implementing health and safety. Enforcement of the law by inspectors is also very important

Table 10: Strategies to improved health and safety performance among SME's

Strategies	5	4	3	2	1	Σf	Σfx	Mean
Development of a specific health and safety law/policy for construction	46	43	11	6	2	108	449	4.16
Including health and safety plan to contract documents	50	32	20	4	2	108	448	4.15
Clients/Owners insisting on good OSH through contract	50	27	20	7	3	108	435	4.03
Increasing awareness among stakeholders	42	37	10	16	3	108	423	3.91
Increasing the number of health and safety professional with construction background in regulatory agencies	32	41	6	12	17	108	382	3.55

Reviewing OHS institutional and regulatory framework in Nigeria	14	39	36	10	9	108	363	3.36

CONCLUSIONS

The importance of health and safety in any industry cannot be over emphasised especially in construction. There is also the need to seek ways to improve health and safety management on the construction site and the industry as a whole because the image of the industry of being dangerous and risky might scare potential workers who the industry needs. It is also important to protect the current stock of tradesmen and workers which the industry is lacking both in quantity and quality. The research set out to study the challenges responsible for the poor performance of small and medium construction contracting firms in construction. The study concludes that inadequate or low budget provision for health and safety by SME's, low awareness of health and safety issues among workers, non-implementation of existing legislation on H&S, temporary nature of construction workers employment and apathy of stakeholders are the responsible for the poor performance of construction SME's. The study recommends development of a health and safety policy for construction, making health and safety plan part of contract documents and increasing safety awareness among all stakeholders. This study advocates that all stakeholders especially construction firms to consider health and safety performance as a parameter to measure project success including time, quality and cost.

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THE UNDER-REPRESENTATION OF WOMEN IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

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Previous research and statistical reports have indicated that women are significantly under-represented in the South African construction industry and that scholars face barriers that deter them from engaging in construction practice. This research examines the female perception of barriers women in construction and by extend the barriers female school learners face. The research adopted the use of an online questionnaire which was promoted by South African construction industry related organizations and councils by inviting their members to participate in the research. Furthermore, the participants were asked to use their social network to distribute the questionnaire further. A total of 103 responses were received from which 95 valid questionnaires were analysed using descriptive statistics. The research delimitations defined the sample as women working in the South African construction industry. The data received from male respondents or respondents who chose not to disclose their gender was discarded. The majority of responses were received by women who hold a Quantity Surveying degree, followed Construction Management with the minority who hold an Architecture or Engineering related degree. Women with construction related degrees concur that the career selection factors contribute the most to the under-representation of women in the construction industry. Female school learners do not know what the construction industry entails, career guidance counsellors in high school, female role models from the construction industry as well as the cultural upbringing lack support and guidance of female school learners to consider a career in the construction industry. The concurrence of the other barriers, grouped under the image and the discrimination, were considered to affect the under-representation of women in the South African construction industry with exception of maternity leave acting as a career obstacle.

Keywords: Construction, Women, Challenges, Barriers, Representation, Image, Discrimination, Career Selection

INTRODUCTION

The publication of this paper coincides with the 100 years anniversary of British women gaining the right to vote (Sky News, 2018) and 25 years after the South Africa Parliament passed an interim Constitution which established universal and non-racial suffrage (Albertyn, 1994). In light of these historical key events, this research draws attention to the fact that the construction industry remains one of the most male-dominated industries with women being under-represented in all construction occupations and professions (Sang and Powell, 2012). The gender composition of the South African construction industry is no exception. According to Statistics South Africa (Stats SA, 2017), 11.6% of the South African construction labour force are women although almost half (44%) of the labour force population is female.

In a job interview for a senior managing position on a large civil construction project, the hiring managing director confided in one of the authors that, in his experience, gender-mixed construction teams perform better. Menches and Abraham (2007)

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support this perception by claiming that the synergy between the different genders increases the production and effectiveness of the team. Gender-balanced teams “harness the full range of skills, training, experience, and understanding from different perspectives” (Menches and Abraham, 2007). Yet, Sangweni (2015) highlights that “...women continue to be under-represented in most sectors of the economy, with the construction industry being one of the oppressors when it comes to this phenomenon. Time and again, discrimination has come up as one of the reasons why women are still under-represented”. It seems nothing has changed since Fielden et al., (2000) reported that the construction continues to be the most male-dominated industrial sector although there is a wide range of South African and international legislation since the late 1990s to support women (Mathur-Helm, 2005).

The aim of the study was to determine the female perception of the barriers which leads to female under-represented in the South African construction industry. To achieve this aim, the objectives of the study are to determine the level of agreement amongst female professionals whether the poor image of the construction industry, gender-discrimination, as well as factors referring to career selection, contribute to the under-representation of women in the construction industry.

THE SOUTH AFRICAN CONSTRUCTION INDUSTRY AND THE UNDER-REPRESENTATION OF WOMEN

The construction industry in South Africa is one of the largest sectors contributing to the economy (Madikizela, 2008). This industry is sub-divided into three main sub-sectors: civil engineering, building, and materials manufacturing sector. Each sector of the construction industry plays a significant role in the development of South Africa, hence the construction industry is a core contributor to the economy (Dlamini, 2012). Since 2008, the construction industry has contributed approximately 9% towards the Gross Domestic Product (GDP) of the country (cidb, 2015). In 2014, the private and business sector is the largest contributor to the income of the construction industry with 83% and the remainder of 17% is generated by the government sector (Stats SA, 2016).

WOMEN IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

Within the South African context, previous studies relating to women in the workplace show that women have made progress in joining the working population. The Department of Women (2015) reports a rapid growth of 2.5% per annum in employment amongst women compared to men (2.2% per annum) across all sectors for the period of 2010 to 2015. The same report points out that during the same period the employment within the construction industry increased from 8% to 8.5% of the employment across all sectors which could have contributed to that trend. Nevertheless, the Department of Women (2015) reported 43.4% of the total labour force to be female, while Stats SA (2017) reported 44% of the employment population are women. Considering that women constitute nearly half (44%) of the labour force only 11.6% are employed in the construction sector, which equates to just 1.0% of the South African labour force being women in the construction industry (Stats SA, 2017).

In South Africa, Madikizela (2008) citing the Industrial Conciliation Act of 1956 points out that historically job discrimination was legal and recognised by law. These laws were abolished as they constituted unfair labour practices (RSA, 1988).

Corporate organisations lag significantly behind in the achieving gender equity while South African government offices and its public sector organisations made progress (Mathur-Helm, 2005). Despite the progress made women continue to experience discrimination and have been continuously subjected to discrimination in the work environment solely based on their gender Sangweni (2015).

BARRIERS TO WOMEN IN CONSTRUCTION

The literature survey identified several barriers cited by numerous international authors as contributing factors towards the under-representation of women in the construction industry. These barriers are two-fold, firstly women are under-represented when entering the construction industry and secondly women are not retained in the construction industry. Based on those two components, the authors grouped the barriers identified in the literature review to (1) poor image, (2) discrimination, and (3) career selection.

Image of the construction industry

The image of the construction industry is often portrayed and associated with a hostile, aggressive and male-dominated industry (Agapiou, 2002; Menches & Abraham, 2007). Menches & Abraham (2007) report that the image of the construction industry is often associated with an industry which requires “brute strength and tolerance for outdoor conditions, and bad language”. In addition, it is seen as an industry that promotes “adversarial business relationships, poor working practices, environmental insensitivity, and a reputation for under-performance” (Cib, 1996). Menches & Abraham (2007) claim that the existence of male dominance and the negative image of the industry can be intimidating for women. The negative image of the South African construction industry often portrayed throughout the media platforms makes it almost impossible for women to consider being part of the construction industry (English & Le Jeune, 2012).

Discrimination against women in the construction industry

As mentioned before, in South Africa, job discrimination was legal and recognized by law (Madikizela, 2008). These laws were abolished as they constituted unfair labour practices (RSA, 1988). Despite changes made to the law aimed at promoting equality and fair labour practices in the workplace, women continue to experience discrimination. Women have continuously been subjected to discrimination in the work environment solely based on their gender. Toor & Ofori (2011) state that gender-related occupational segregation is prevalent in the construction industry. Women’s potential to advance in traditionally male-dominated career fields has been greatly hindered by discriminatory practices. Discrimination against women occurs in various forms such as biased recruitment processes, unequal promotion opportunities, unequal salaries, and denial to further one's skills through training opportunities (Kolade & Kehinde, 2013; Kumar, 2013). When investigating the gender composition on recruitment panels it becomes clear that males hold an overwhelming majority, which leads to men having the power to select fellow men instead of women (Thayaparan, Amaratunga & Haigh, 2010).

Navarro-Astor et al. (2017) conducted a structured literature review (SLR) on the main barriers to women's career development in the construction industry across 15 years. The review shows that the majority of literature examined the conflict women face to balance personal life with work. Women with families face the greatest challenge to fulfil multiple roles and are obliged to take career breaks due to their

family responsibilities (Navarro-Astor, Román-Onsalo and Infante-Perea, 2017). In fact, Navarro-Astor et al. (2017, citing Caven and Navarro-Astor, 2013; Navarro-Astor, 2011, and De Graft-Johnson et al., 2005) women feel they “still need to choose between family and they fear to lose their jobs or being demoted because they have children or that they will fall behind in their career development when returning to work”.

Career selection

A report by Graves et al. (2014) attributes the under-representation of women in construction to discrimination that starts in education programs right up to the work environment. Various factors have an influence on the career choice made by school learners. Fatoki (2014) identifies some of those as funding, culture, gender, family involvement, personality type, and financial reward. The construction industry is considered one of the least likely career paths to be selected by females making career choices during school. According to Madikizela (2008), there is still a lot to be done in order to promote the construction industry as a viable career option for girls. Haupt & Harinarain (2016) further concur that young people lack the necessary knowledge about career opportunities available in construction. Furthermore receive school learners gender biased careers advice (Le Jeune, 2009).

RESEARCH METHODOLOGY

The research method used for this study was the quantitative approach utilising descriptive statistics and purposeful sampling focused only on the female professionals in the South African construction industry.

The researcher approached the construction industry related organizations and councils to collaborate in the research by inviting participants who are associated with or members of to complete the survey online. Furthermore, snowball sampling was applied using network websites in order to broaden the population and receive more responses. The organizations and councils approached were,

- The Council for the Built Environment (CBE);
- The South African Council of Project and Construction Management Professions (SACPCMP);
- The South African Council for the Quantity Surveying Profession (SACQSP);
- The South African Council for the Architectural Profession (SACAP);
- The Institute of Municipal Engineering of Southern Africa (IMESA) and;
- The Chartered Institute of Building (CIOB).

The statements in the questionnaire were formulated by reviewing related literature and previous studies done. In addition, the statement of the problem, the related sub-problems, hypotheses, and objectives were used as a guideline to formulate applicable questions that cover the focal point of the study. A pilot study was not utilised. Instead, expert consultation was used to identify any errors or ambiguous statements in the questionnaire. This was completed by an experienced female working in the South African construction industry. Once feedback was received and final changes made the questionnaire was distributed via email linking to Google Forms.

The questionnaire consisted of five sections: namely the barriers relating to image, discrimination and careers selection, followed by a section for general comments and

concluding with the demographic information of the respondent. The barriers were split into 24 statements with a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) which are listed in Table 1, Table 2 and Table 3. The questionnaire concluding with 6 questions pertaining age, gender, the field of study, working status and which organization referred to the questionnaire. In total 103 completed questionnaires were received from which 95 were used for the data analysis. The research delimitations defined the sample as women working in the South African construction industry. The data received from male respondents or respondents who chose not to disclose their gender was discarded. The responses were analysed using descriptive statistics. The mean score and standard deviation were determined. Lastly, the mean score was categorized into the following continuums,

≥ 1.00 to ≤ 1.80	strongly disagree to disagree
> 1.80 to ≤ 2.60	strongly disagree to disagree/ disagree
> 2.60 to ≤ 3.40	disagree to neutral/ neutral
> 3.40 to ≤ 4.20	neutral to agree/ agree
> 4.20 to ≤ 5.00	agree to strongly agree/ strongly agree.

DISCUSSION OF RESULTS

Women in this study concur that the career selection constitutes the greatest barrier to women working in construction whereas the poor image and gender discrimination contribute to a lesser extent to the female under-representation in the South African construction industry. The exception of the later is the perception that maternity leave acts as an obstacle to promotion.

Demographic

Figure 1 shows the distribution of work experience responding women held at the time of the survey. The majority (65.3%) of the respondents reported to work in the construction industry at the top end of the experience range (7 years and more), followed by 17.9% stating to have work experience at the low end of the range (1-3 years), trailed (16.8%) by the mid-range (4-6 years) work experience in the construction industry

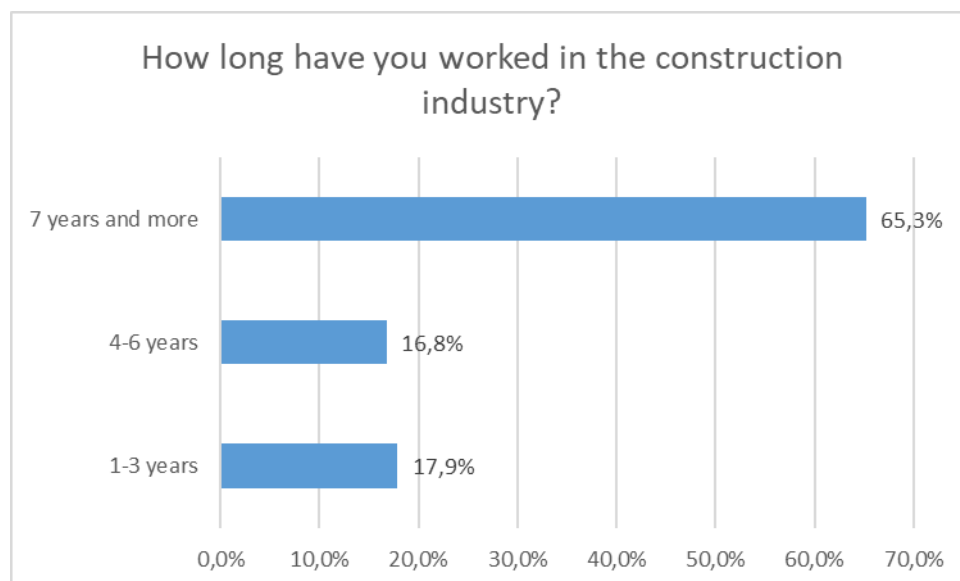


Figure 1: Work Experience of respondents

Women with a Quantity Surveying degree made the bulk (77.9%) of the respondents, followed by 8.4% respondents with Construction Management education. The remainder (13.7%) were respondents with Architecture, Engineering related or other degrees

Results relating to the image of the construction industry

Table 1 shows the respondents' perception of each factor's evidence within the group of the construction industry's poor image. Responding women concur that the following three (3) barriers contributed to the under-representation of women in the South African construction industry,

- Male dominance in the construction industry is intimidating for women;
- The construction industry is a hostile work environment where females are not taken seriously; and
- Lack of female role models within South Africa's construction industry is a dilemma.

Table 1: Means and Standard deviation for image factors

Statement	Continuum	Mean ($\bar{x}$)
The existence of male dominance in the construction industry which can be intimidating for women.	agree	3.65
A hostile work environment for women where their opinions are not taken seriously by men.	agree	3.60
A general lack of female role models within South Africa's construction industry.	agree	3.52
The aggressive nature in which business is conducted in the construction industry.	neutral	3.14
The physically demanding, dirty, and dangerous nature of work involved on construction sites.	neutral	3.02
Poor working practices.	neutral	2.96
Low Professionalism and skills among workers and staff.	neutral	2.89
The insensitivity of the construction industry towards the natural environment, e.g. noise, pollution, etc.	neutral	2.71
The low quality, time and cost overruns of construction work achieved by the construction industry.	neutral	2.67
The negative media coverage received by the industry.	disagree	2.54
Overall	neutral	3.07

Based on the overall mean score ($\bar{x}$)=3.07 (neutral), the respondents do not conclusively agree on the poor image of the construction industry being a contributing factor to the under-representation of women in South Africa's construction industry. This finding contradicts local research by Haupt & Harinarain (2016) as well as international research by Amaratunga et al. (2006) which report that the poor image of the construction industry, deters women from selecting careers in construction. However, the finding with regard to the lack of female role models within the South African construction industry is supported by previous research. "With few women in management generally—and fewer in construction—there has not been a positive image of achievers to ... women [inspiring to join the construction industry]" (English and Le Jeune, 2012). This means that male-dominance in the industry will continue.

Results relating to gender discrimination

It is notable from Table 2 that the respondents agreed on the following four (4) barriers being main contributors to the under-representation of women in the South African construction industry, within the discrimination element,

- Family responsibilities/ Maternity leave acts as career barrier;
- Unequal, gender-discriminating promotion opportunities
- Payment of women in the construction industry is lower than that of their male equals;
- The construction industry is gender discriminating.

Table 2: Means and Standard deviation for discrimination factors

Statement	Continuum	Mean ($\bar{x}$)
The perception that maternity leave acts as a limitation towards a woman receiving a promotion within the construction industry.	agree	3.75
The existence of unequal promotion opportunities for women to progress in the industry.	agree	3.71
Unequal salary between men and women in the construction industry doing the same/similar type of work.	agree	3.66
Discrimination solely based on gender.	agree	3.52
Recruitment processes that are biased towards women.	neutral	3.20
The lack of women on recruitment panels during the recruitment process.	neutral	3.15
Unequal skills development opportunities for women to advance their skills within the construction industry.	neutral	3.01
Overall	agree	3.43

Based on the overall mean score ($\bar{x}$)=3.43 (neutral), the respondents do not conclusively agree that discrimination against women in construction contributes to the under-representation of women in South Africa's construction industry. However, four (4) barriers within this grouping show concurrence with mean scores ($\bar{x}$) $\geq$ 3.5 (agree). Thirty-two (32) studies identified by Navarro-Astor et al. (2017) in a structured literature survey entitled "Women's career development in the construction industry across 15 years: main barriers" named "Work-family balance and multiple role conflict" as the top career barrier supporting the findings of this study. Gender-bias promotion opportunities are ranked fourth in the same research with 24 studies identifying it as career barrier whereas 11 studies identified unequal remuneration as the main barrier for career advancement of women in construction (Navarro-Astor, Román-Onsalo and Infante-Perea, 2017). Sangweni (2015) highlights in a South African study that "...women continue to be under-represented in most sectors of the economy, with the construction industry being one of the oppressors when it comes to this phenomenon. Time and again, discrimination has come up as one of the reasons why women are still under-represented". A report on the USA construction industry by Graves et al. (2014) takes it one step further and claims that the under-representation of women in construction is attributed to the gender discrimination which starts in education programs, covered in the next section of this paper.

Results relating to career selection

Table 3 reports on the results of the career selection factors. The respondents concur that the following six (6) barriers within this grouping contribute to the under-representation of women in the South African construction industry,

- School learners lack knowledge about the construction industry;
- Career counsellors in high school do not promote construction to girls;
- The cultural upbringing discourages a construction career for female school learners;
- Female role models from the construction industry do not support girls to select construction for their career;
- Parents discourage their children to choose construction as career;
- Female school learners lack knowledge about the required skills for a career in construction

Table 3: Means and standard deviations for career selection factors

Statement	Continuum	Mean ($\bar{x}$)
Lack of knowledge about what the construction industry entails.	agree	4.14
Lack of career guidance from career counsellors in high school.	agree	3.84
Cultural upbringing of female scholars which influences their career choices in construction.	agree	3.74
Lack of support in career selection from female role models working in the construction industry.	agree	3.73

Parents influence on the career choices of their children.	agree	3.63
Female scholars are unfamiliar with the skills required to work in the construction industry.	agree	3.59
Women tend to avoid construction and stick to the conventional careers such as nursing.	neutral	3.02
Female scholars lack interest in technical subjects such as mathematics which is a requirement to pursue construction related courses.	neutral	2.77
Overall	agree	3.56

Linking to what was said in the introduction of this paper, respondents agree (mean score ($\bar{x}$)=3.56) that career selection acts as a barrier to school learners joining construction related education and by that contribute to the under-representation of women in South Africa's construction industry which is supported by Graves et al. (2014) as mentioned in the previous section. The under-representation of women in construction is attributed to the gender discrimination which "starts in education programs and continue all the way up the employment chain" (Graves et al., 2014). Adogbo et al. (2015) discovered that undergraduates in construction related university programs perceived that construction practice to be synonymous with site activities. Extending this poor knowledge about the construction industry, no wonder that high school girls and career guidance counsellors do not know what the construction industry entails. The poor image of the construction industry deters females from selecting careers in construction (Haupt and Harinarain, 2016), which can be seen in the concurrence of parents discouraging their kids to choose a construction career. Furthermore, Agapiou reported already in 2002 that "unlike men, recent female entrants to the industry in the United Kingdom were unlikely to have been advised to join the construction industry by same-sex role models". Nothing has changed since based on the findings of this study

CONCLUSIONS

Under-representation of women within the South African construction industry does exist. The findings of the study revealed that the respondents of this study do not entirely agree that the poor image of the construction industry and discrimination against women contribute to the under-representation of women within the South African construction industry. However, the respondents in this study concur that the career selection constitutes the greatest barrier to women working in the construction industry. Lack of knowledge of school learners and the lack of guidance by career counsellors in high school contribute to the under-representation of girls in construction related education programs which results in fewer females entering the construction industry. Discrimination continues during employment. Balancing work and family life, slow career progression and, unequal pay are very discouraging for women to continue their career in the construction industry.

Some limitations of this study must be pointed out. Although much effort was employed the sample size was relatively small (95) and the results are skewed towards

the Quantity Profession (77.9% of respondents belong to that group). It must also be noted that the aim of the study was not to research an exhaustive list of barriers which could result to the under-presentation of women in the South African construction industry.

RECOMMENDATIONS

The recommendations are aimed at attracting more female graduates in construction related education programs. These recommendations are “small steps” which are implementable immediately. Changing the “culture of construction” will take time, but women entering the construction industry will be able to initiate that cultural change of the industry over time.

- A framework that addresses gender issues in attracting and retaining graduates in the construction practice must be developed to help women plan their career in the construction industry. Particular attention should be given to prepare, reduce and police work and family life balancing issues;
- Female mentorship programs must be established, structured, intensify and widened. Actively mentoring girls interested in the sector at high-school level throughout their tertiary education will make the construction industry (a) more attractive and (b) support success rate of female graduates and help with the transition entering the industry. It is suggested that the professional bodies “spearhead” those mentorship programs funnelling it down to the organizations;
- Active marketing the construction industry at high-school level for guidance counsellors, parents and schoolers will increase knowledge about the industry and change the perception that “construction industry” is synonymous with “construction site”.

FURTHER RESEARCH

Based on the literature review the researchers suggest that more research is needed focusing on (practical and implementable) solutions to the under-representation of women in the South African construction industry, concentrate on specific interventions and measures to attract, retain and develop women in the industry. The authors realized after finalizing the literature review that much research has been done with regards to career barrier investigations, but the career selection problem has been researched to a lesser extent. In South Africa, with academics complaining about the quality of students they are faced with, further research is necessary whether the poor STEM (Science, Technology, Engineering, and Mathematics) orientated education in school contributes to the under-representation of women in the South African construction industry. Additionally, research could explore how the advancing of mechanization within the construction industry could attract more women into the construction industry. Since this advancement may reduce the labour-intensive nature of the industry.

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URBAN REGENERATION IN SOUTH AFRICA

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The purpose of this paper is to demonstrate the necessity for regeneration in the central business district (CBD) of major cities and towns; to identify effective regeneration framework strategies incorporated to ensure successful implementation within South African cities; and to identify an effective regeneration strategy, which can be incorporated within the inner city of Bloemfontein. Qualitative data was collected by means of a literature study on property development and urban regeneration. A case study approach was followed to obtain data from newly regenerated CBDs in South Africa; particularly in Johannesburg, Cape Town and Durban. The case studies will be analysed to determine the strategies required for the regeneration of the Bloemfontein CBD, and to compare the municipality's ongoing efforts and their effective implementation thereof. Quantitative data was collected by means of structured interviews with academics and professionals in Bloemfontein and a case study on the current condition of Bloemfontein's city centre. An all-inclusive programme is essential to direct effective methodologies with regards to urban regeneration in South African cities. The effective combination of both incorporating the Urban Development Zones (UDZs), City Improvement Districts (CIDs) and Public-Private Partnerships (PPPs) within the city centre is a fundamental requirement to attract and increase private sector investment and rejuvenation within these decaying areas, as highlighted in Johannesburg, Cape Town and Durban. The analysis serves as a basis for how Bloemfontein can rejuvenate their CBDs to ensure unceasing progression and urban vitality. The outcome of the renewed areas results in increased public unity and safety, ensure continuous development, renew growth, promote trade and improve living and public involvement as well as environmental sustainability. An effective urban regeneration strategy will ensure continuous growth for the city of Bloemfontein.

Keywords: CBD, property development, sustainability, urban regeneration.

INTRODUCTION

Regeneration globally creates and utilizes new approaches and techniques which is established in order to resolve problems in deteriorating urban areas in a coordinated way through property development (Eren, 2014). Keeping and Shiers (2004) summarises that the principal value of an urban regeneration strategy is founded upon the values of sustainable development, and endeavours to inspire citizens to live in cities and cease relocating from them.

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URBAN REGENERATION

Roberts, Sykes, and Granger (2000) define urban regeneration as:

“A comprehensive and integrated vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical, social and environmental condition of an area that has been subject to change.”

The world is experiencing greater urbanisation and changing demographics (Cook and Porter, 2015). The author notes that presently 54% of the world's population lives in cities; however, that number will increase to 66% by 2050.

The Department of Co-operative Governance and Traditional Affairs (2016) mentions that South Africa is no exception where more than 60% of South Africans will live in urban areas and is projected to increase to approximately 71,3% and 80% by 2030 and 2050 respectively.

Cities are the central point of social, economic, and environmental interests to form a connected framework cooperating in a specific area (Healey, 2013). The author further mentions that regeneration developments are an effective approach utilised by stakeholders (generally governments) to maintain a constant quest of transformation within a city. It is essential that public and private sectors function collectively in order to guarantee successful regeneration implementation (Keeping et al., 2004).

As a result, Macdonald and Cheong (2014) conveys that the function of the public-private partnership (PPP) is to combine the skills and resources of both partners to produce a public service or goods for public utilisation by offering incentives for both the public and private sectors.

The World Bank highlights that each city necessitates different approaches to combat urban decay (Creamer, 2016). Furthermore, the author mentions that strong political leadership is necessary to enable an urban regeneration process and that the success of such policy is dependent on the available urban planning and finance tools, well-enforced zoning and property tax system. The case studies focus on the development of urban regeneration and the public-private partnership models that

have contributed to its success. It aims at exploring regeneration outcomes in a comparative perspective using evidence from several urban centres in South African cities such as Johannesburg, Cape Town and Durban.

Urban regeneration in Johannesburg

The City of Johannesburg has experienced severe deterioration due to suburbanisation, inadequate public transportation, deficient administration of state owned properties, ineffective management of the urban environment and minimum parking facilities (Bethlehem, 2013).

The Johannesburg Development Agency (JDA) (2009) is an agency launched by the City of Johannesburg which encourages area-based development initiatives where the model is to restore public sector investment by means of urban infrastructure improvements and appealing tax incentives for private investors in deteriorating areas. The author notes that these upgrades will reassure private sector investment and re-investment into these areas. The JDA projects are divided into two phases; the first phase involves projects directed to act as a catalyst to the process of regeneration and

the second on initiatives aimed at supporting private sector investments by means of tax incentives - such as the urban development zones (UDZ), demarcated city improvement districts (CID), infrastructure upgrades and the renovation of public spaces within the inner city (Bethlehem, 2013).

The UDZ is defined as a tax incentive intended to incite inner city regeneration within South Africa by the South African Revenue Service; it is a tax allowance covering an accelerated depreciation of investment made in either the renewal of existing property or the construction of new developments within the inner city over a period of time (NASHO, 2013). However, the JDA (2009) released a report analysing the impact of the area-based regeneration projects on private sector investments. The report found that UDZs within identified zones did not appeal to property investors as a substantial factor in attracting investment in the inner city. The incentive lead to minimum profit increases and mainly aided to increase revenue for large property owners rather than unlocking substantial new property investments. The core outcome for investment has been the rising market demand combined with noticeable urban management improvements.

The establishment of a CID within the inner-city lead to the private sector providing security, cleaning, advertising, green areas, park supervision and additional assistance to improve and protect the area (Bethlehem, 2013). These developments fundamentally changed the lives of the city's inhabitants and encouraged private investors to invest in the inner city; transforming dilapidated buildings and districts into spaces where society live and work in comfort and security (JDA, 2015).

The most distinctive feature of regeneration of Johannesburg was the combination of the public and private sector (World Bank, 2015). The Johannesburg inner-city regeneration demonstrated that it is achievable for such an extensive range of stakeholders to co-operate and participate through the numerous connected processes and frameworks (Creamer, 2016). Furthermore, the authors report that the private sector invested R18-million into the inner city for every R1-million invested by the JDA since 2001; property assets and infrastructure assets resulted from this effective partnership to the value of R600-million and R3,1-billion respectively.

Urban regeneration in Cape Town

The Cape Town Central City (CTCC) confronted continuing deterioration due to the rise of dilapidated buildings, crime and the collapse of municipal systems; therefore, the Cape Town Partnership was established to prevent further decay and economic withdrawal (Boraine, 2009). The Cape Town Partnership (2013) earliest undertaking was to establish a business improvement district (BID) to manage urban issues; known as the Central City Improvement District (CCID).

The CCID (2015) covers an area of 1.6km² and is divided into four precincts with functioning objectives, which is a PPP established to convert the Cape Town CBD to a safe and clean environment. The CCID (2016a) is divided into four departments to support urban regeneration initiatives; safety and security, urban management, social development and communications. The safety and security department patrol the CCID. The urban management department provide a clean, attractive and risk-reduced urban environment (CCID, 2016). The social development department focusses on aiding underprivileged people within the city centre (CCID, 2016). The

communication department informs the public about the CCIDs efforts within the Central City in addition to managing overall reputation (CCID, 2016d).

The CCID (2015) Annual Report for 2015 indicates both businesses and residential population increased due to the regeneration framework. Dentlinger (2016) added that infrastructure and business developments in the Cape Town CBD is outperforming other South African metros; fourteen key CBD buildings are being renovated, expanded or demolished and constructed from the ground up. The value of property in the CBD is now valued at R24-billion, four times as much as decade ago. The author summarises that the success is as a result of public and private sectors collaborating collectively to increase investments confidence in the CBD.

Cape Town leads the way in terms of urban regeneration which is the only city in Africa that has an all-inclusive regeneration framework for its inner city (CCID, 2011). The success of regeneration policies is dependent on a clean, safe and functioning CBD where infrastructures are sustained and continually developed to accelerate progress and employment opportunities (CCID, 2016e). The CTCC is South Africa's most energetic and safest CBD (CCID, 2015). Furthermore, the CCID and its partners in both the public and private sectors are responsible for the regeneration accomplishments within CTCC; a strong PPP has ensured the development and reinvigoration of the Central City.

Urban regeneration in Durban

The eThekweni Municipal regeneration strategies are spearheaded by iTrump (Inner City eThekweni Regeneration and Urban Management Programme), a directive within the municipality (NASHO, 2013). The eThekweni Municipality (2016) identified the Inner City as the urban core of Durban.

The inner city has been subjected to decline and trade disinvestment from privately and publically held residential and commercial companies due to poorly coordinated public interventions (eThekweni Municipality, 2015). The key component of the plan inner-city regeneration is to unlock projects within the CBD to enable economic growth and the creation of a safe after-hours environment (Teke, 2014).

The overall objective of inner city revitalisation should be to create a 24-hour inner city which is safe, clean and is a centre for working, living, entertainment and culture (eThekweni Municipality, 2014).

To combat inner city deterioration, the Municipality recognised the advantages of a demarcated UDZ. Developers and investors can capitalise on this tax deduction for construction or refurbishment costs of commercial properties within the UDZ precincts (Diener, 2015). The eThekweni Municipality (2011) regards the reinvestments and redevelopments within the inner city as the overall success of the UDZ incentive by which the city has attracted investment valued at R1.7-billion since the inception of the scheme in 2004.

The UDZ incentive scheme has proved most successful and beneficial to Durban (Pam Golding Properties, 2008). Furthermore, the UDZ zone was extended in Durban; the additional zones will increase investment and development in the inner city and prevent the movement of capital from the inner city to the outer suburbs (eThekweni Municipality, 2011).

The municipality has invested over R5-billion in the inner city to improve public infrastructure and implement flagship projects (Naidoo, 2011). The investments will go towards preventing the decay of Durban's inner city and contributing to the restoration of the city's business and residential areas, thus changing the appearance of Durban's CBD (Mtongana, 2008).

The eThekweni Municipality (2016) comprehends that revitalisation is necessary within the Inner City and that new investments is a key requirement. Furthermore, the author mentions that by utilising the regeneration programmes developed, successful implementation would be possible.

METHODOLOGY

The methodology for the research combined qualitative and quantitative processes. A literature analysis was conducted to bring the academic views of both property development and urban regeneration together. The development of a systematic structure for the research and the selection of conceptually appropriate case studies will result from the evaluation of secondary sources with relevant information on the topic by means of consultations with professionals operating in the field of urban regeneration and property development. The selection process was based upon both academic and professionals within the industry. The case study would allow the assessment of a suitable regeneration framework directed on the social, economic, environmental and physical difficulties within Bloemfontein.

The methodology approach followed is to obtain functional verification for the hypotheses concluded by a comprehensive evaluation of the literature that interprets and examines current information on the subject being research; followed by an empirical review to evaluate these frameworks with regards to urban regeneration execution within the CBD of Bloemfontein. The case studies conducted in Johannesburg, Cape Town and Durban will be assessed in order to find a suitable approach for the application of inner-city regeneration strategies in Bloemfontein. The selection of Bloemfontein as a case study and interview topic for this treatise reveals an understanding of three factors; the economic significance of South Africa's urban zones, the development challenges they confront, and the understatement of secondary cities in research. Secondary cities are defined as important urban areas below the population threshold of one million which efficient involvement for metropolitan status (Bernstein, McCarthy and Johnston, 2005). Through the combination of a case study and structured interviews with professionals will aim to reveal opinions, insights and understandings regarding the deterioration and rejuvenation within the CBD of Bloemfontein.

Target population

The structured interviews consist of fifteen questions and discussion points regarding property development and the necessity for urban regeneration within South African cities, particularly in Bloemfontein. The aim of the interviews is to reveal opinions, insights and understanding of the deterioration and predictions of rejuvenation within the CBD of Bloemfontein. An academic and two professionals within the construction and urban planning industry were selected for interviews in Bloemfontein. The interviewees are specialists and shareholders in the current era of reconstruction and development in South Africa.

The interviews were at the respective respondent's workplace around Bloemfontein. Previous research has approached businesses, entities and citizens within the CBD of Bloemfontein; the focus in this study will shift from the business perspective to the professionals and academics with specific knowledge regarding urban regeneration.

Sampling method

Two sampling methods will be utilised; a case study and interviews with relevant professionals and academics. A case study will be conducted on current regeneration policies in the CBD of Bloemfontein and its effectiveness with regards the execution of such framework.

The study will examine external and internal reports and development frameworks. The second method involves the researcher conducting structured interviews. This interview framework is a set of open-ended questions. The interviewer will read the question exactly as written and in the same order to all interviewees (Johnson and Christensen, 2011).

The interviews are regarded as a personal form of research as opposed to questionnaires (Valenzuela and Shrivastava, 2008). Qualitative research interview pursues to reveal both a factual and meaningful parallel (Kvale, 1996). The questions raised to the interviewees will be assessed in relation to the research conducted concerning property development and urban regeneration. The responses by the interviewees will form the basis for the case study regarding the implementation of urban regeneration within the CBD of Bloemfontein.

Research design

The research design of a paper relates to the overall approach that the researcher decides on to incorporate the diverse constituents of the study in a logical and analytical technique to effectually report on the research problem (Labaree, 2009).

The first phase of this research paper emphasized on the literature regarding property development, urban regeneration and the implementation thereof in cities such as Johannesburg, Cape Town and Durban.

In an attempt to test the hypothesis, the second phase will involve the use of both a case study and open-ended questions regarding the effectiveness of urban regeneration in the inner city of Bloemfontein. The information collected will be evaluated to determine the various reasons for the CBD degeneration and the renewal initiatives being undertaken.

In summary, the researcher will employ qualitative methodology to test the hypothesis. The focus will be placed on urban regeneration framework and policies utilised in the inner city of Bloemfontein through the use of a case study approach. The case study will evaluate the success and challenges faced by the CBD. Furthermore, the data will be complemented by structured interviews to enhance the findings regarding the implementation of urban regeneration in the CBD of Bloemfontein.

FINDINGS AND RESULTS

Urban regeneration in Bloemfontein: Current Condition of the CBD

A report by Bernstein et al. (2005) identified strategies established back in a 2005 to combat urban decay and deterioration within the CBD of Bloemfontein. Primary causes for concern was the lack of co-operation between the public and private sector;

the instability of public sector aptitude; the limitations of private sector investors as functional, operational commercial companies enhanced by weak public-sector competence; the dissimilar urgencies of public and private sectors, and the lack of a mutual understanding between these two sectors to combine their resources (Ibid., 2005). The report further identified that there is no collective concept of development or an agreed programme between the public and private sector within the inner city. Ineffectiveness is complemented by limitations of business organisations and lack of effective collaboration from the provincial and national government. The main strategic requisite is to affiliate the strengths of regional public and private sectors into corresponding development methodologies (Bernstein et al., 2005).

The pattern of development towards the west of the CBD is leading to broaden sprawl of the city and forming an accumulation in the provision of land, amenities, community and commercial facilities to these rapidly developing areas. However, the numerous services and facilities within the CBD are underutilised. The current development patterns are uneconomical and detrimental to prevailing economic and social culture of the CBD (Mangaung Metropolitan Municipality, 2010).

The Mangaung Metropolitan Municipality (MMM) mentioned that the spatial configuration of an inner city necessitates strengthening to promote urban integration and ensure comparatively quick distances between all residential areas and the inner city. The reinforcement of the CBD would correspondingly encourage the future capability of public and non-motorised transport as well as city centre parking provisions and requirements. The Bloemfontein inner city could be further enhanced if transport linkages are developed and progress in the western areas halted. The importance of the CBD should be intensified through regeneration in order to shape the city to increase integration to the benefit of all residents of the city (MMM, 2015; MMM, 2010). The MMM (2015; 2010) cites that by promoting and supporting urban regeneration of the CBD, a coherent and cohesive inner city should be established by means of introducing a Central Improvement District (CID) within the Bloemfontein CBD. Moreover, increasing the residential density within the CBD will escalate the effects of urban regeneration (MMM, 2015; MMM, 2010). Transport efficiency within the CBD is highlighted as a key element to promote and attract citizens; the designing of an integrated public transport system to service the CBD (MMM, 2015). The most fundamental constituent in regenerating deteriorating urban areas is by means of private sector involvement (Creamer, 2016) and the MMM has failed in attracting the private sector to redevelop within the CBD. A study by Hoogendoorn et al. (2008) revealed that the main obstacles in the rejuvenation of the CBD is the lack of basic municipal services within Bloemfontein. Furthermore, the author noted that there is a lack of understanding of the significant role provincial governments play in the local economy within the CBD (Ibid., 2016).

Urban regeneration in Bloemfontein: Interviews

With regards to the interviews, the broad consensus between all interviewees is that property development is necessary to promote, initiate and support urban regeneration and without property, the implementation thereof would be unfeasible. When asked whether a regeneration strategy is viable to implement within the inner city of Bloemfontein, the three respondents has stated that such strategy would be possible to implement. They cautioned that the CBD should produce a new purpose to warrant successful urban regeneration. The overall understanding between the three respondents indicated that their attentiveness to projects in Bloemfontein varies

regarding urban regeneration projects. It could be said that local and national governments should promote and publicise projects to attract possible developers and investors.

The respondents mutually agreed that PPPs is fundamental for urban regeneration. Their reactions conjointly validate Keeping and Shiers (2004) statement that public and private sectors function collectively by means of a public-private partnership in order to guarantee successful regeneration implementation. The respondents collectively regarded a combination of a PPP, UDZ and CID as the most suitable policy to successfully execute urban regeneration.

The case studies conducted on urban regeneration frameworks utilised in Johannesburg, Cape Town and Durban indicated that the combination of one or more strategies produced positive outcomes. Furthermore, it was identified by the respondents that urban regeneration within the CBD is essential to combat decay and urban sprawl of a city and that they regard urban regeneration as a capable policy to ensure a commercial and social revitalisation within the CBD of Bloemfontein.

CONCLUSION

The significance of regeneration as a process to rejuvenate the physical, social and economic environment of a specific area were highlighted and rejuvenation assisted in the promotion and maintaining private investments in the inner city. The outcome of urban regeneration assists in improving the capability and infrastructure of cities to meet the standards that creative economies require. Urban regeneration can be considered as the answer to the prospects and problems presented by social, economic, physical and environmental changes. The concept of urban regeneration is an effective approach to restructure the cities in South Africa.

The case studies from newly regenerated CBDs in South Africa; particularly in Johannesburg, Cape Town and Durban signified that an all-inclusive programme is essential to direct effective methodologies about the successful implementation of urban regeneration in South African cities. The effective combination of both incorporating the UDZs, CIDs and PPPs within the city centre is fundamental requirement to attract and increase private sector investment and rejuvenation within these decaying areas. The analysis serves as a basis for how cities in other parts of South Africa can rejuvenate their CBDs to ensure unceasing progression and urban vitality. Evidently, each city necessitates different approaches to combat urban decay and strong political leadership is necessary to enable an urban regeneration process. The success is dependent on the available urban planning and finance tools, well-enforced zoning and property tax systems available.

It was found that there is still a lack of municipal leadership, deficiency of public-private partnership and lethargic implementation of urban regeneration initiatives within Bloemfontein. In addition to the case study, interviews with professionals highlighted that strong legislation is needed by the municipality and government to prevent urban decay. Furthermore, they regard urban regeneration as a capable policy to ensure a commercial and social revitalisation within the CBD of Bloemfontein.

RECOMMENDATIONS

With regards to regeneration policies in the CBD of Bloemfontein and its effectiveness to execute such framework, the following suggestions will prove valuable to policy makers on the successful implementation thereof. By evaluating the

methods, strategies and frameworks adopted in Cape Town, Johannesburg and Durban could improve the outcome of regeneration strategies in Bloemfontein. The current condition and challenges faced within the inner city of Bloemfontein will be addressed when the following recommendations are implemented:

To establish an autonomous agency to effectively combine the various strategies, plans and projects under one organisation to ensure an effectual collaboration between local, provincial and national government. The creation of a CID to support urban regeneration and to create public-private partnerships with local businesses in an effort to deal with crime via infrastructure investment and upgrades. To create a national convention centre within the CBD to attract private sector investment and redevelopment. Effective promotion of the UDZ to encourage private investment within the CBD of Bloemfontein. Encourage private investment to develop and improve residential complexes within the CBD by providing incentives such as the UDZ. Initiatives to encourage PPP within the inner city. The construction of a BRT system to attract private investment. Significant urban management improvement and infrastructure upgrades by the MMM will ensure influx of private investment. Strong political leadership is necessary to reduce fraud and corruption with regards to the public sector. To redefine the function of the CBD; the municipality in conjunction with the private sector, should assist in the creation of a new function in the CBD.

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REGULATORY POLICY AND PROCESS IMPACT ON LOW INCOME HOUSING DEVELOPMENT BY THE PRIVATE SECTOR IN SOUTH AFRICA: CONCEPTUAL FRAMEWORK.

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The existence of housing backlogs indicate that the efforts of government to meet the housing needs of South Africans overtime still remain daunting, hence the active participation of the private sector has been highly encouraged. Scholarly literature on low income housing in South Africa is predominantly focused on regulatory non-compliance and their adverse effects with little attention paid to the factors that cause noncompliance. The main regulatory factors that act as constraints that could deter private sectors' active involvement in low income housing development in South is less studied and the extent to which regulatory policy and their approval processes, affect construction cost, price and supply largely unknown. This study is a descriptive one that aims to develop a conceptual framework to analyse policy and process regarding low income housing development by the private. The research builds on existing literature and contributes to knowledge about the shortfalls of the present regulatory policy and processes. The study identifies gaps in literature and draws out the implications for empirical research arising from the conceptual frameworks.

Keywords: Low income housing, Private sector, Process, Reengineering, Regulatory policy

INTRODUCTION

The built industry is a deeply regulated industry in which developers are subject to regulatory requirements, established by law. Regulation according to Berg, (2017) is a social practice in which businesses, organisations and individuals activities are in governments' control. Regulation as defined by Yee, (2014) is a legal means of specifying actions that are required to protect public welfare and Weaver, (2009) agreed that regulation provides the instruments with which standards are maintained. These regulations in the built industry come in the form of building codes and planning regulations. Though many use these terms interchangeably but they mean different things. Building codes are regulations with stated purpose of assuring safety and sanitation of homes and limiting negative externalities associated with low-quality construction (Gyourko & Molloy, 2014). They are regulations guiding the design and construction of the building structure.

Planning regulations, are regulations that rather guide the land (zone) the structure is built on. Both types of regulations are meant to protect public's safety and the overall quality and value of the society. They seek the greater good over individual. The South Africa's built industry is regulated by National Building Regulations and Building Standards (NBRBS) Act, 103 of 1977 and are implemented through different approval processes. South African developers are thus subjects to these regulations

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and their accompanying approval processes. The aim of this paper therefore is to develop a conceptual framework for analysing the impact of regulatory policies and processes that affect low income housing provision by the private. Section 2 speaks to some contextual issues through literature review from which Section 3 presents a proposed conceptual problem as a methodology from analyses of the current regulatory situation and continued by way of articulating a research agenda which is development of a proposed conceptual framework based on gaps in reviewed literature. Section 4 is research findings and Section 5 concludes with the implications of this research.

LITERATURE REVIEW

Overview of Housing in South Africa

Adequate housing is recognised globally as a basic human right (Le Roux, 2011). The Universal Declaration of Human Rights states in Article 17 that everyone has the right to own property alone as well as in association with others (United Nations, 1948). The drive towards homeownership has therefore become a common practice in many parts of the world (McGee, 2012). Subsequently, the South African constitution (section 26 (1) of Act 108 in 1996) states that everyone has the right to have access to adequate housing and low-income housing provision became a major focus in post-apartheid urban South Africa governance (Allison, 2007). The post-apartheid government responded to the demand for low income housing with large-scale housing initiatives via the White Paper on Housing, such as Reconstruction and Development Programme (RDP) that was later improved into Breaking New Ground (BNG), and some financial institutions were established to support this initiatives. The Government also created a Housing Development Agency to among other things act as a housing projects developer. These were some of government's attempt to eliminate housing backlogs and ensure better living conditions for the poor. Despite this sustained efforts, there still exists housing backlog from an estimated 1.5 million to 2.3 million units (Le Roux, 2011), the National Housing Department agreed in 1997 that the number of families without adequate housing was 2.2 million and Fuller Housing Centre Report, (2014) also affirmed that there is a severe housing shortage in South Africa.

According to the report, a massive housing backlog still exist with at least 2.1million housing units still to be built and that this figure increased by about 204 000 every year mainly as a result of rapid informal urbanisation due to population growth. What has contributed to this among other things the report highlighted include: Fragmented housing policy, administrative systems, inappropriate standards and inadequate land. Human Settlements Committee, (2015) opined that there is a growing crisis in the provision of housing: outputs are declining, costs are rising, procurement processes are bogged down, assembling land is slow, and external conflict is growing. This clearly indicates that government's efforts in eliminating housing backlogs have not yielded the required results yet. Private sector participation is thus encouraged through a conscious policy and process review to encourage a more proactive housing delivery involvement by the private, which according to Human settlement (2015), should be done with active speed and aggressive interventions.

Regulatory Policy and Process Effects on Housing

Governments usually enact regulations for different reasons that could have impact on housing cost, price and supply. Posner (1971) identified; the existence of transaction

cost in government regulation and the unclear processes of translator regulatory action. The question then arises; do regulators really understand regulatory economics as to knowing how policies and regulatory processes can affect housing delivery? In every regulatory systems, regulators are expected to judge implicitly or explicitly (Becker, 1986) and so, there is problem if regulators have no clear understanding regarding what affects regulated entities the most.

Land unavailability: policies and approval processes for building development; from land acquisition to actual housing development are said to be very cumbersome. The challenge of unavailability of buildable land are worsened by regulatory policies around Urban Growth Boundaries (UGB), Floor Area Regulations (FAR) Densities, Set-backs and Parking restrictions and the approval processes at different phases of building construction, for the available land. All these affect construction cost, supply, price, location and also cause undue delays which subsequently affect housing delivery. In the process of building development, regulatory policies and their processes appear to raise housing cost and prices, reduce construction, reduce the elasticity of housing supply, and alter urban form. (May 2004; Schill, 2005; McGee, 2012 Gyourko & Molloy, 2014). Scholars studying housing, urban economics, and local public finance in most developed countries have devoted much attention to this topic because regulations that increase housing cost also affect the quality and location of the structure and invariably reduce supply and affordability. Codes may raise housing price because, housing built under these regulations is usually of a higher quality than those constructed otherwise (Schill, 2005).

Economic barriers: Regulations and their processes can become barriers to developers under certain circumstances (Downs, 1991) as many stakeholders regard them as additional burden which they have to adhere to (Gann, et al. 2010). Their lengthy approval processes consequently cause long delays that affect actual project's monetary cost, time and budget. Godwin et.al. (2016) and Henderson (2007) agreed that the complicated nature of policy and permit processes, lengthy approval processes, and series of administrative hurdles in the processes affect costs altogether. They opined that administrative bureaucracy, poor management, and inefficiency are the major regulatory concerns. Various researchers have affirmed that regulations have so many socio economic consequences on the stakeholders (McGee 2012; Gyourko & Molloy, 2014; Yee et al 2014; Boateng, et.al. 2016).

Appropriateness: In Africa some of these building codes and planning regulations were inherited from western colonization not minding the disparity in geographical location and political conditions and are rooted in colonial legislations that are foreign and inappropriate to socio cultural realities of modern African society (Godwin et.al. 2016). According to Kironde (1992) their exogenous rules refutes local conditions; are very rigid; not easily adaptable to change and provoke non-compliance. Their appropriateness is thus questioned as regulations are satisfactory only when they consistently align with the desires and practices of the target population (Godwin et.al. 2016).

There is therefore a need to explore these policy and process effects and inefficiencies in the system and examine how applying the relevant imperative tools could foster an improved framework that fosters a faster and more efficient system in the delivery of services. The challenge however is how to distinguish between the unnecessary ones that should be removed and necessary ones that should be preserved which is an extraordinarily difficult task (Schill, 2005). Taking Densities, setbacks, parking and

floor area restrictions policies and processes delays for example, theoretically, if there is availability of buildable land, it might not constrain supply if the private investor could be allowed to construct housing timeously as densely as necessary to meet demand and make profit while still ensuring safety. But in South Africa and most places around the world-land unavailability and local land use policy impose limits on residential development that restrict the size and type of housing units that can be built on a given plot of land.

These restrictions deter the investor who in most instances see them as unprofitable, as they attract extra costs to a construction project, creates a wedge between the house sales price and the cost of purchasing the land and building on it too (Schills, 2005; McGee, 2012; Gyourko & Molloy, 2014). Somerville (1999) argues that higher construction costs impact negatively on housing and reduce construction and this argument is upheld by Goodman and Thibodeau (2008). All these could be frustrating to a private developer especially an entrepreneurial one who wants some return on investment. So policies around these issues should be improved and governments' intervention through provision of buildable land and subsidies provided for the private investor to encourage low income housing. According to most of the studies, private participation in housing provision can be enhanced by recourse to, amongst other things, the reform of regulations regarding planning policies and processes/procedures, land use/tenure, the enhancement of design skills of planners, designers, and developers (Schills, 2005).

Inadequate Human and Technical resources: It appears there are no adequate human and technical resources to handle these challenges for effective and efficient delivery of low income housing. The availability of efficient advance Information Technology (IT) tools and technical know-how should be explored to know if South Africa is matching up with the rest of the world. The gaps identified surprisingly is that little theoretical attention, is paid to these area of regulatory study in South Africa. A lot of literary work is done on regulatory noncompliance and their adverse effect on housing quality and delivery. Less attentions paid to addressing the causes and effects. Research have shown that despite the rapidly growing body of research on the regulation on housing cost and supply, much is still unknown about its causes and effects (Winter & May 2001; May 2004; Gyourko & Molloy, 2014).

A lot more is expected from South African regulatory scholars to explore what the best options can be to address these issues. The study done by Drane, (2013); & Turanvaga & Mooya,(2016) shows that numerous empirical regulatory studies have been done on housing, but the challenge of not having an explicit theoretical frameworks to guide researchers, has impeded the degree of research outcomes and this is acknowledged even amongst property development researchers. Many other authors have affirmed that research in this areas have taken a descriptive nature, with limited theoretical applicability to unite all the empirical evidence that may be gathered (Carmen, et al, 2001; and Atkinson, 2008; Mbiba & Huchzermeyer, 2002). Government's attempts over time to revise policies and processes have not adequately addressed housing issues so as to encourage active private participation, so it is pertinent to develop a framework that will critically analyse policy and process to bring about drastic change if the housing needs of South Africans must be met.

RESEARCH METHODOLOGY

This paper is the first phase of an ongoing research, whose methodology consists an integrative critical review of existing relevant literature. It was necessary to explore

the main constructs that address the research aim and objectives. The conceptual framework guiding the reviewed literature consisted of Business process reengineering and open model system. The main approach involved analysing, identifying and reconceptualising the existing framework from the literature reviewed (Torraco, 2005). The integrative literature review process involved four key stages. The main criteria for selection is that the articles' focus on the core constructs, methodology, main findings and conclusions. Firstly, relevant journals in the built industry, regulatory and housing policy and housing economic studies were selected using the Social Science Citation Index as well as the Web of Science (Torraco, 2005). Secondly, journal articles published between the year 2000 and 2017, focusing this fields were selected. Thirdly, priority was given to the most recent articles (2008-2017), although older articles were also reviewed to establish the key findings, arguments and conclusions on the topic and finally based on these constructs, a conceptual problem was formed from where a conceptual framework was developed. The findings from the literature provided the theoretical framework for this study and a basis for the development of a conceptual model in the preceding section.

Business Process Reengineering and an Open System Frameworks Application

Business Process Reengineering (BPR) framework is employed here as a technique that organisations use, when faced with challenges of processes and systems inefficiencies. Firstly, BPR is a dramatic change initiative framework that originated in the 1990s as a process that could address organisational issues through cost reduction and better services to clients (Gunasekaran & Kobu, 2002). Under BPR, organizational layers and unproductive activities are reduced and removed accordingly by redesigning functional organizations into cross-functional teams; improve data dissemination and decision making done with advanced IT (Twum-Darko & Mazibuko, 2015). Although this framework is commonly applied in a business/prganisational setting it can also be used in related housing organisational circumstances. Secondly, an Open System (OS) provides a framework through which the low income housing policy is treated as a product and "process" which starts from the initial land acquisition stage to the last-delivery housing-stage (Phago, 2010). With the use of inputs and output flows, exchanges of issues and information within the built environment is done. From his analysis, the constraints of policy may include, unskilled employees and lack of financial and technological resources to facilitate the transformation, output and feedback processes. Since it is an open and not a closed model system, Phago, (2010) posits that its operational realm should be accessible to every concerned stakeholder and citizen. Going by Phago's analogy, housing policy should be treated as a "process" and so the researcher here analysed both policy and process as a "process" and by implication both policy and process are referred to as "process" in applying this framework.

BPR framework is applied in this study to develop a framework that attempts to critically analyse the regulatory "process" that should undergo fundamental changes to improve productivity in low income housing delivery. A "process" is defined as a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer (Hammer & Champy, 1993), just as housing development involves series of activities start to finish. "Process", as an important knowledge resource needs to be effectively managed and improved (Khanbabaei et.al. 2017). He posits that traditional process management systems are unable to manage and improve processes with their complexity. The management (planning, organising leading and controlling) with the operation systems like advanced technology or machineries,

expertise, production, maintenance and adaptation play roles in the inputs to outputs in an open system (Hodge et al., 2003; Smit & Cronje, 1999). Rebuge & Ferreira (2012) asserted that the characteristics of “process” are complicated because of their dynamic and changing nature; interdisciplinary nature; interactions between different departments; and the requirement for obtaining experience, knowledge, and expertise for implementing processes that are all complex and time consuming. Subsequently, this increasing complexity create high-dimensionality problems due to, their specific features, and the complicated relationships between them.

In an ideal situation, BPR framework challenges the existing organisational problems and drastically redesigns processes for improvement to encourage development and growth (Bain and Company, 2017); when for instance faced with drastic decline in low income housing supply and productivity, affordability and expansion in housing market, strategic restructuring is very necessary (Bain and Company, 2017). The framework involves a radical "process review plus reengineering and redesign of core the ones to achieve dramatic improvements in housing productivity that saves time, cost and budget, without compromising safety. Hammer & Champy, (1993) agreed that BPR is basic rethinking and radical redesign of processes to achieve dramatic improvements in critical issues like cost, quality, service and speed. Gunasekaran & Kobu, (2002) opined that BRP basically rethinks and radically redesigns a “process” to obtain dramatic and sustained improvements in quality, cost, service, time, flexibility and innovation. This tool begins with defining core values that an institution wants. This provides basic sources to decide about what sort of process” should be defined as core processes (Gümüsoğlu et. al. (2017).

Again, applying BPR framework across the organization as Bain and company (2017), opined can improve regulatory interventions for positive outcomes. When for instance, government’s interventions around building specifications, Urban Growth Boundaries (UGB), Floor Area Restriction (FAR), Densities and Parking Restrictions are rethought and reengineered, the housing for the low income class will be positively impacted. To understand these phenomena properly, a review of the main regulatory "process" of housing development policy and National Building and Planning Regulations of South Africa (NBPR) and subsequent reengineering are required. A critical regulatory "process" analyses to remove the non-value adding ones and redesigning for improvement is very necessary.

When re-engineering according to Bogdănoiu, (no year) the methodology required is to firstly, asking fundamental questions about "process" that affect low income housing by identifying them and their accompanying problems is the key; why do you have these housing policies? How is the land acquired, how long did each approval take, how do these affect low income housing production in terms of cost, price, affordability and supply? In what ways do "process" mainly affect you as (name respondent), Is there any room for negotiations/ Liaoning? How appropriate do you consider regulatory "process". Secondly, radical design means getting to the root of things, not making superficial changes or fiddling with what is already in place, but throwing away the unproductive. Thirdly re-engineering isn’t about making marginal or incremental improvements, but about achieving performance improvements dramatic change. Finally regulatory processes are not process-oriented, they are focused on tasks, on jobs, on people, on structures, but not on processes.

BPR involves the rethinking and redesigning of regulatory boundaries, jobs, tasks, and skills reappraisal. This happens with creation and the use of models which could be

physical models, mathematical, computer or structural models (Bogdănoiu, n.y.). BPR employs the use of scientific methods, models and tools for radical restructuring of policies and processes for significant improved performance. Redesign, retooling and reorchestrating are the major components of BPR that are essential for an organization to focus on the outcome that it needs to achieve (Bogdănoiu, n.y.). Reengineering methodologies have common elements, but a little change gives significant impact on the success or failure of a reengineering project. After policy and process is reviewed and identified, the methodologies for reengineering can be applied. In order to select the best methodology using PBR, Bogdănoiu opined that a continuous process and implementation of an appropriate BPR plan, with an effective and actionable visions is required. The common BPR methodologies include: Analysis of existing processes; Process modelling tool, among others.

Problem Conceptualization of Regulatory “Process”: In order to analyse the problem in the first figure below, there is need for actual conceptual problem analyses found in the second figure. This is followed by third figure as a guide that further enabled development of a conceptual framework seen in the fourth figure.

Analysis of existing processes: When using BPR for improvement, identifying the current “process” state properly is vital, as this will help one set realistic expectations to achieve set goals (Dave 2017). In order to understand these phenomenon, a review of the current “process” structure of the building plan approval and housing process guide in South African are shown in the first figure and first table below respectively as examples. These are yardsticks meant to help one understand the conceptualised problem in second Figure below which is a build-up of the work done by Twum-Darko & Mazibuko, (2016) where the administration of National Regulator for Compulsory Specifications (NRCS)-2008 is critically reviewed and analysed and had helped to explain what the conceptual problem is about. The gap which this work tries to fill is stakeholders’ and IT integration into core process in their conceptual framework seen in fourth Figure. BPR is used as a structured approach to analyse and improve major regulatory processes in housing development phases

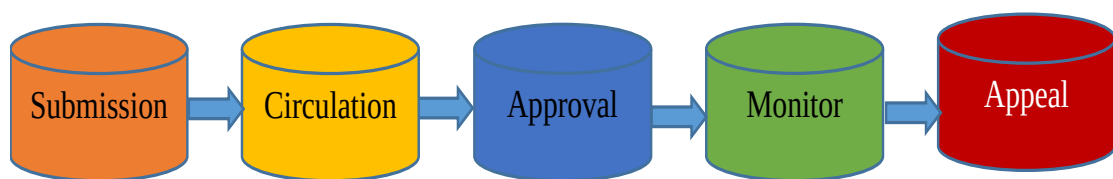


Figure 1: Building Codes Approval Processes

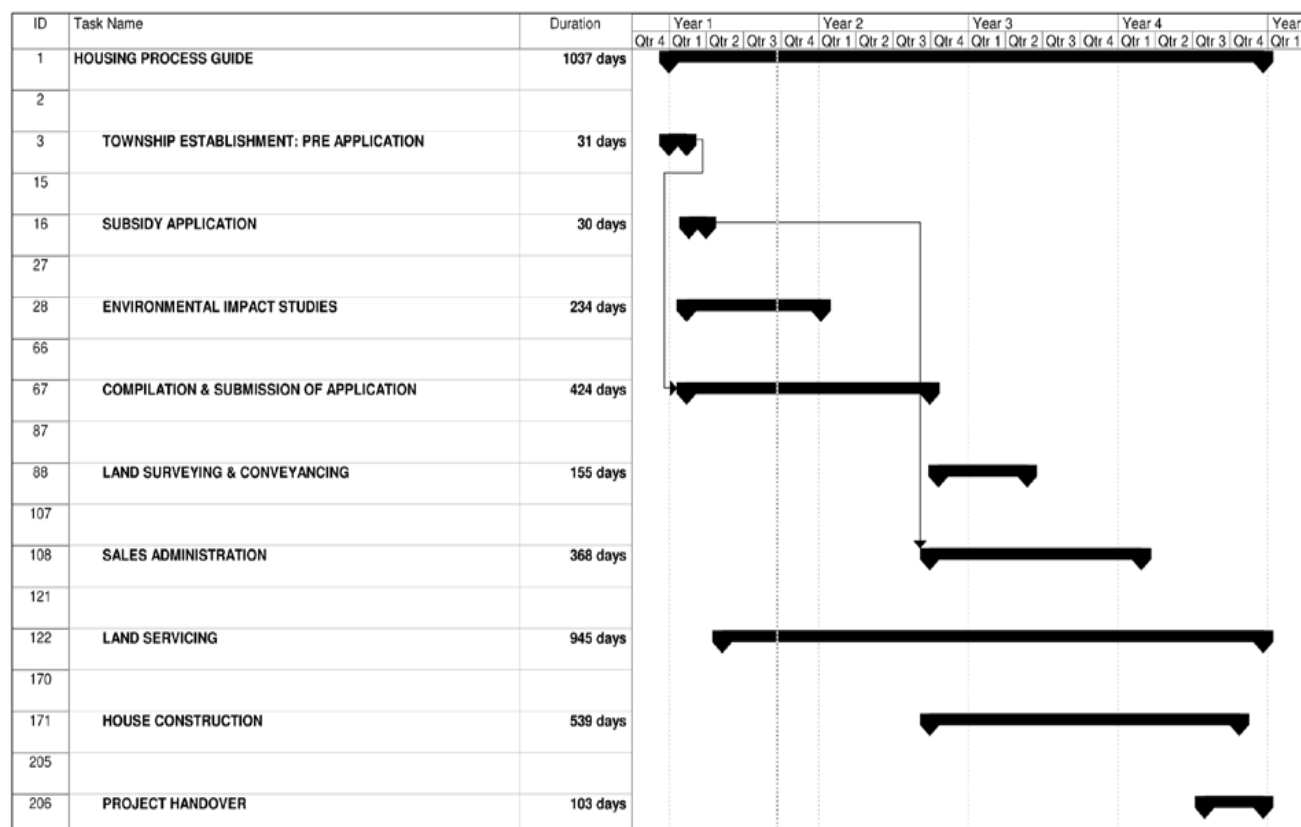


Figure 2: Housing Project process Guide (Adapted from Human settlement 2009)

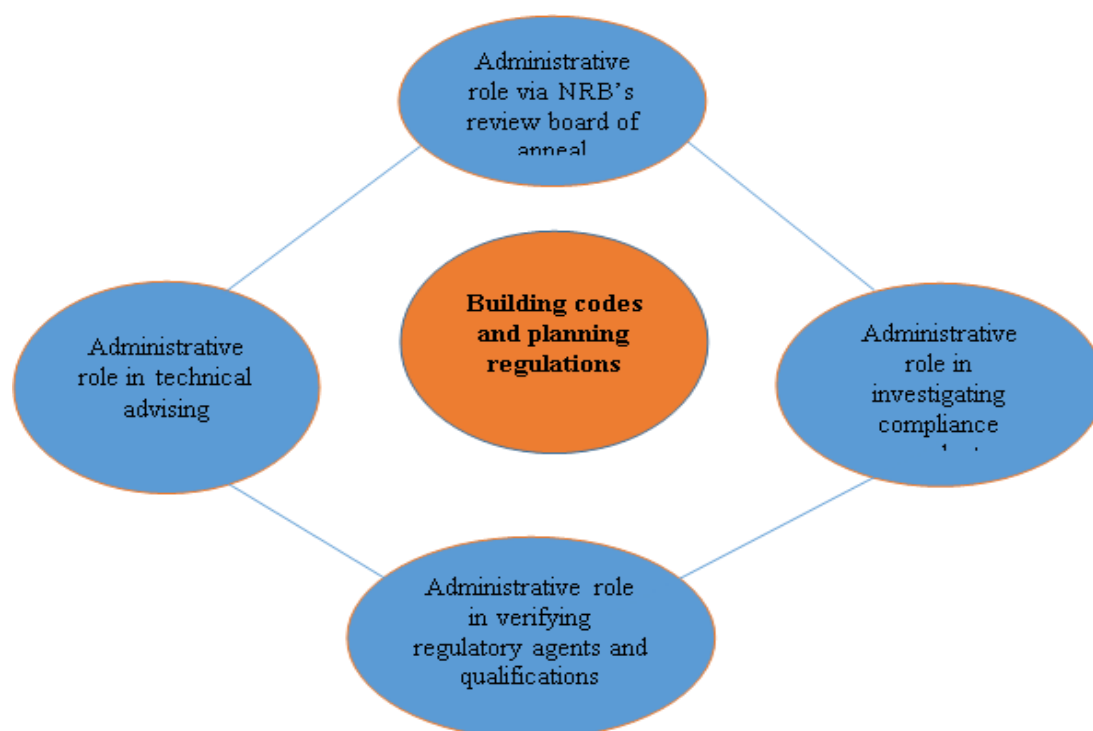


Figure 3: National Regulator for Compulsory Specifications (NRCS) – 2008

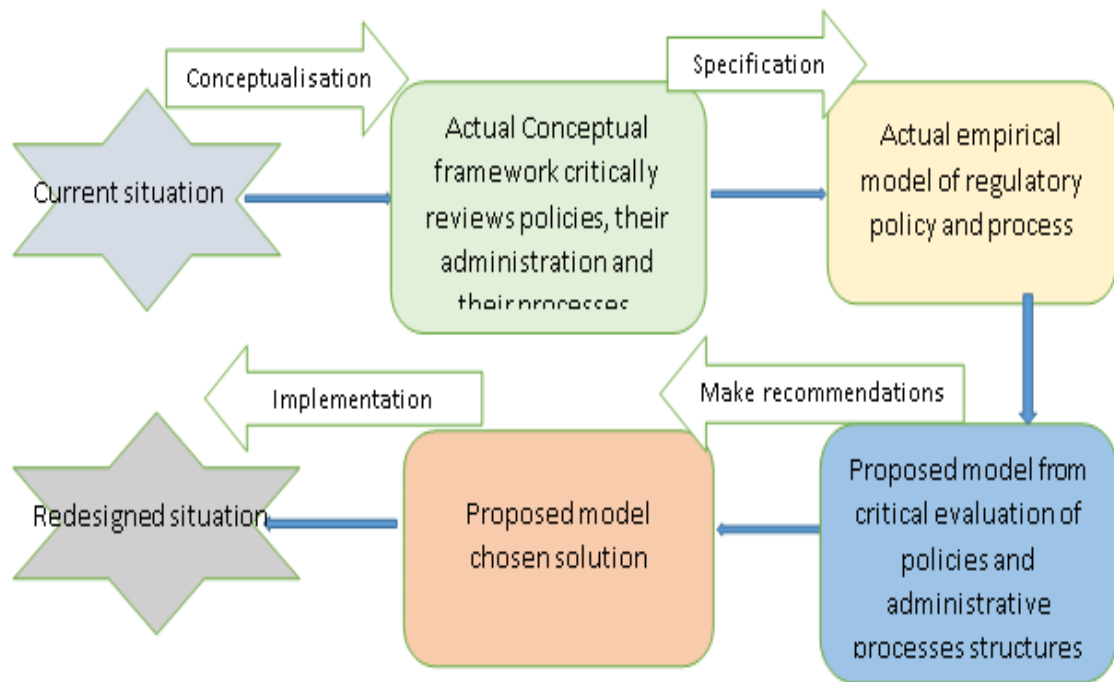


Figure 4: Actual conceptual Framework analysis model

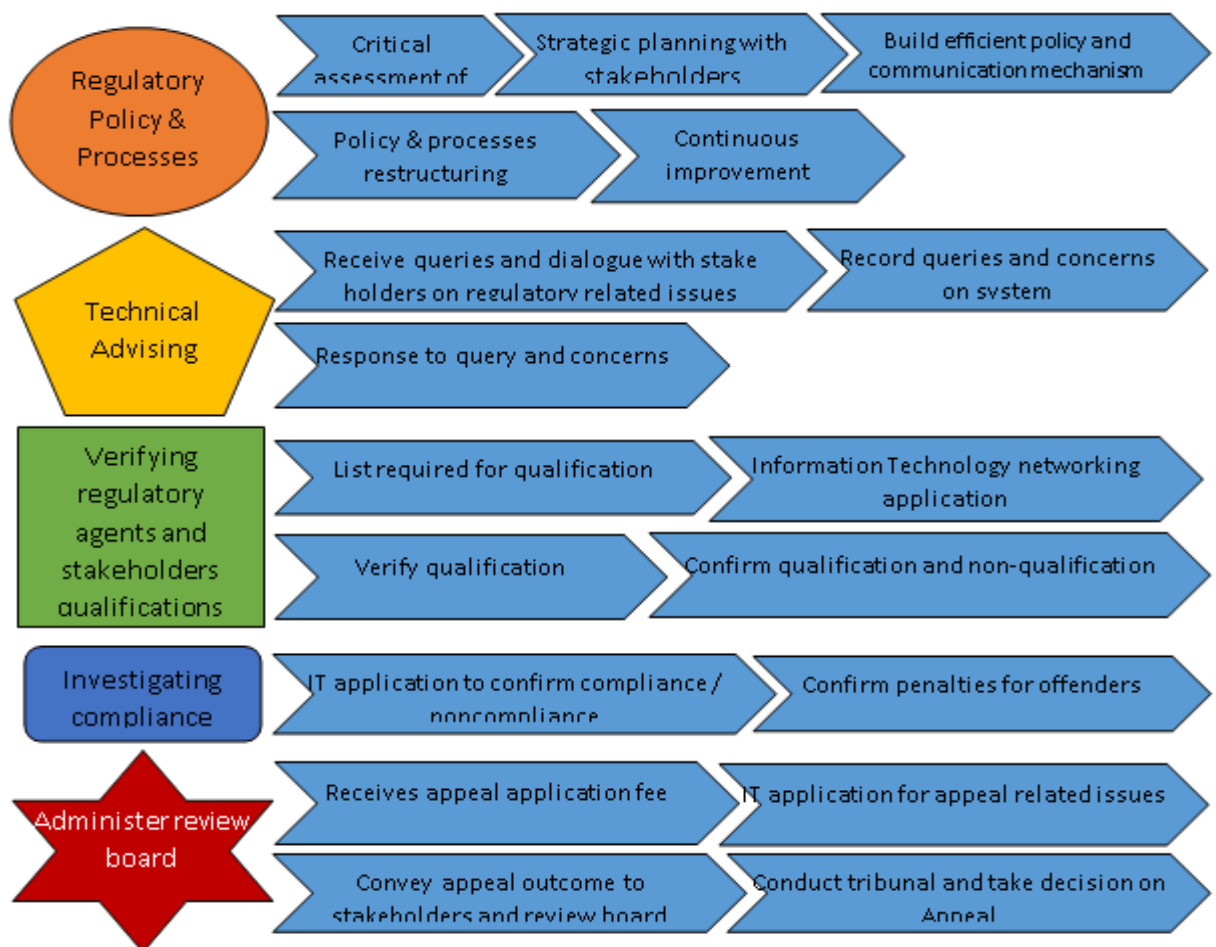


Figure 5: Reengineered National Regulator for Compulsory Specifications of 2008.

Regulatory modelling: A regulatory modelling tool is a major instrument that also helps to maintain the system, through a fully integrated collection of systems processes models, information, and technology (Dave, 2017). In this study the tool that can be used to achieve this according to Dave, (2017) is Telelogic's System Architect. It is a business process, data and regulatory system modelling tool used to support government in aligning their "process" with Information technology (IT). The IT tool is applied through Triggering events, modelling important path and Sequencing events from start to final stage (Dave 2008). The use of this advanced IT tool plays a vital role in the success of any reengineering phenomenon (Dave, 2017). IT tools like; Building Imaging Modelling (BIM), Digital Asset Management (DAM), multimedia, image processing and expert systems, are applied to reduce process delays and also reduce the number of non-value adding activities.

Dave (2017) agreed, IT adopts organisation standards, grants multiple diagramming techniques and modelling methods and integrates many frameworks. This makes the IT tools very adaptable and capable of meeting the needs of different users. Martins & Monteiro (2012) affirms that the advances in BIM technologies, have caused an increasing demand for real applications of this tool. They argued that the tool is suitable for automation of building design code-checking task, allows a swifter, more rigorous and clear procedures. The integration of systems is also a major concern and an important issue BPR considers, the debate however is how best to proceed with integration. With IT, all the information systems between and in built organizations are connected in such a way that any application can access any other application in a transparent way (Janssen & Cresswell, 2005). IT enables a variety of integration technologies, such as message brokers, adapters and application servers, to build an integration architecture (Janssen & Cresswell, 2005).

Once applications are integrated, cross-organizational processes can deliver timely, with accurate information. IT enables improved business relationships by providing a better-integrated and interaction within the organizations as an integrated business rather than individual departments which results to fast service delivery, save cost, time and budget and customer satisfaction (Janssen & Cresswell, 2005; Dave 2008). The problem in South Africa for this framework to work is the unavailability of adequate technical and human resources (Phago, 2010) in all provinces and how efficient the available ones like DAM are, to assist these processes. In Cape Town where some are available and used, the efficiency and effectiveness is still questioned as some stakeholders still feel frustrated with heavy delays. The concern now is how adequate, appropriate and efficient their applications can help to foster a faster service delivery and whether there is adequate and efficient human resources for this radical change to take place.

RESEARCH FINDINGS

The designing of new processes as Dave, (2017) opined involves, identifying the current process weakness; having joint agreement between stakeholders of the current "process" problems (possibly joint workshop/meeting with stakeholders to develop the new process) and then, redesigning a new "process". A critical analysis of the existing "processes" was necessary to get a clear understanding of how they currently work. The First Table (Housing Policy Processes guide) and First Fig. (building processes) represent a factual "process" information, including what the task are and how long it takes to perform each task (table 1). Each task has numerous subtasks which are time consuming and cause delays (Windapo 2017; Twum-Darko &

Mazibuko). Human settlement Department, (2012) agreed that most projects experience serious delays over the past 15 years. Costs are financially imposed by complex procedural delays for permits to be granted (Windapo 2017). A year to four delay as seen in the first Table above to get approvals could add up to the total building cost as the cost of materials and other logistics would have increased over this period.

On further analysis, the current regulatory policy and process are purely administrative and lack stakeholder engagements as agreed by Twum-Darko & Mazibuko, (2015). The Housing Process Guide (First table above) was produced in 1997 by the Department of Human Settlements and its processes have been revised overtime. The major change in the guide since 1997 is that the public sector organs have assumed the role of developer of subsidy housing projects, although the private sector is still involved in the implementation of the project (Human Settlements Department, 2009). The change has nothing to do with radical process redesigning to improve services that can encourage a private investor. The revision was specifically intended to assist managers at all levels to understand the processes required for a successful projects implementation: the relationships between the processes; the required time frames and the responsibilities of the various role-players. The professionals required were highlighted as well, together with the overall processes that must be completed at specific stages of a project (Human Settlements Department, 2009). The present BPE in the activities of the “processes” seen in first and second Figures and first table above have no strategic repositioning of regulated entity at all levels within the built-environment with clearly defined roles, responsibilities and what to be accountable for.

BPR is not about marginal changes, it is an ambitious attempts to make substantial changes to achieve significantly improved performance that cause significant changes for a more satisfying outcome. It appears the revisions done overtime, have not adequately and drastically dealt with the core issues to cause a significantly improved and transformed low income housing regulatory policy. On critically analysing the conceptualised problem framework, less engagements are paid to the regulated entities on challenges regulatory policies create for them and no stakeholder liaising integrating processes is found. There is no engagement/liaising-sub-process for the regulated entity to contribute ideas on what the regulatory challenges may be for a proposed type of development and so no inclusion of stakeholder consultations and awareness sub-process to assess their competence, fitness and knowledge to execute the project (Mazibuko2016; Twum-Darko, & Mazibuko, 2015). The activities are concluded and absolutely enforced on the regulated entity with no negotiation whatsoever (Mazibuko, 2016; Twum-Darko, & Mazibuko, 2015). They opined that the “process” fails to elaborate what the major inputs and outputs are and who has to interact with stakeholders while performing project’s task.

The “process” also seem to be very generic and no consideration is paid to its appropriateness for varying housing development type. All these confirm Windapo & Rotimi (2012); Windapo (2017) assertion that, the National Building Regulations unfortunately show inadequacy in its “process” model. BPR framework application can improve housing by reducing projects costs, time and budget. Radical process change is the first major step in BPR, therefore, a “process” improvement team should be established with the objectives of critically analysing the whole “process”, and identifying non-value-adding activities. Unproductive regulatory activities which

cause procedural delays in approvals and related issues should be revised and modern information technological tools used to improve regulatory processes.

CONCLUSION AND FUTHER RESEARCH

Refocusing values in regulatory policies and processes on the private developers needs is necessary. Regulatory attention should shift to focus on integrating and engaging the regulated entity on regulatory issues. Regulatory policies and processes for all type of housing development should not be too generic they should be made to suit the different housing types. According to Gunasekaran & Kobu, (2002), dramatic improvements are made when radical changes take place, as opposed to incremental changes in processes. Again, the NBRBS Act, 103 of 1977 as can be seen in the Processes in the First figure and Table show the normal processes of acquiring permits for actual development of low income housing. These together with the planning processes (not shown) are meant to be holistically reviewed and critically reengineered to radically remove the non-value adding activities in a process that cause unnecessary delays (Bellahsehne & Leornado 2008). Reorganising businesses into cross-functional teams with end-to-end responsibility is necessary too (Dave 2017). Research have shown that even though there is a rapidly growing body of research on the regulation on housing cost and supply, a lot is still unknown about its causes and effects (Winter & May 2001; May 2004; Gyourko & Molloy, 2014). Further research should be focused in what these causes and effects are, to determine how these factors affect low income housing and impact on low income housing. One of the ways is to critically explore the restrictive regulatory policies that include, Urban Growth Boundary, Floor Area Restrictions, Density, Parking and Setbacks Restrictions which this study is interested in progressing with.

BPR works when; core processes are redesigned using information technology (IT) that enables improvements in the processes. Regulatory processes can be improved through information technology tools (BIM, DAM, multimedia, image processing expert systems). How applicable and efficient these tools are in SA is yet unknown and this is also what this study intends to further explore. Effective service delivery also requires effective communication through information sharing among information systems in an organisation and requires cross-agency business processes (Gunasekaran & Kobu, 2002; Dave 2017). Without an integrated information system, communications and services process are slow and costly (Gunasekaran & Kobu, 2002). So effective communication flow should be encouraged among low income stakeholders.

Again, reorganising teams decreases the need for management layers, it speeds up information flows and removes errors and rework associated with multiple handoffs (Bain & Company, 2015). BPR framework creates quality improved outcomes by reducing work fragmentation and establishing clarity of “process” as there is a general work efficiency when output and performance are improved through prompt feedback. For instance, when activities between regulatory policy implementers are redesigned using relevant IT tools within the system, there will be a more effective and efficient improved services to clients. Restructuring, revising or rethinking the basic organizational and human issues that enables the regulator deliver on their mandate effectively and efficiently are necessary. When all these are properly applied, the needed attractiveness, profitability, and even competition amongst the private sector will be seen and the problem of housing the low income class will hopefully be a the thin of the pasts.

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VALUE-IN-USE SUSTAINABILITY FACTOR AS A DRIVER FOR ASSET MANAGEMENT OF ROAD TRANSPORT INFRASTRUCTURE

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Infrastructure is critical in supporting economic security and societal wellbeing. A sound road network, for instance, is an essential part of any country's socio-economic fabric. However, the development of sustainable road infrastructure has been largely driven by environmental requirements as well as economic necessity. The experiences and satisfaction of users and the consequent value ascribed to the usage of road infrastructure have not been accorded reasonable attention. The current study examines the concept of value attributable to road infrastructure through its usage. A review of related literature was conducted using articles from journals, conference proceedings and from databases including Google, Taylor and Francis, ASCE Library, and Science Direct. Synthesis was done using thematic analysis. The study found that value is attributable to the experience of users and this depends on the condition of roads. Hence, maintenance of roads is paramount to sustain value. A conceptual model for value-in-use sustainability of roads was developed. The study recommends that more attention should be given to the experience of users while making use of the roads, as opposed to the monetary value of the roads only. Moreover, consideration of users' experience will invariably drive demand for travel and bring about increased monetary returns. Therefore, the study highlights the import of the value-in-use concept, and creates more awareness about the conditions that invariably contribute to this value and thus transport managers and policy makers need prioritise asset maintenance and management even during planning.

Keywords: Maintenance, Management, Roads, Sustainability, Transport, Users, Value

INTRODUCTION

Much focus has been on economic imperative as the overwhelming driver for road transport infrastructure projects planning, delivery and operations (Stapledon, 2012). However, it has been argued that sustainability issues are vital in achieving full value from investment projects. Although sustainability has been considered, a plethora of studies have focused on environmental sustainability and legislative requirements thereto. This is inadequate since road transport infrastructure planning should embed sustainability concerns related to the physical sustainability of the structure. Sustainability should guide decision-making throughout infrastructure projects to meet wider objectives of durability and performance. Moreover, the potential benefits of infrastructure investments are limited if the assets are not properly refurbished and maintained to maintain durability and performance (Palmer et al., 2013). Surveys show that adequately maintaining road infrastructure is essential to preserve and

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enhance benefits of durability, modernisation and sustainability; but a backlog of outstanding maintenance causes irreversible deterioration of road networks (Malkoc, 2017). This implies that assets with a long useful life and maximum benefits to the public and community or society should contribute to prosperity, rather than endanger or be allowed to deteriorate and pose a danger, in the long run. This way, value for money can be maximised whilst concomitantly demonstrating positive social and environmental outcomes which justify the use of scarce resources (financial and natural) and for the associated impacts on the community wherein such infrastructure is provided.

A sound transport network is an essential part of a country's socio-economic fabric and as such needs to be in a condition as to continually serve the community and the economy as a whole. Furthermore, poorly maintained roads constrain mobility, significantly increase vehicle operating costs, increase accident rates and their associated human and property costs, aggravates isolation, poverty, poor health, and illiteracy in rural communities (Moleli, 2012). Concurring with these views, Palmer et al. (2013) stated that road transport infrastructure needs to deliver its service over its lifetime, efficiently and reliably. Roads have to be in a continuously good condition for them to be able to command value (Alasad et al., 2012; 2013). This in turn will drive demand and influence the level of satisfaction obtainable from the use of the subject road network assets and related services, as well as the monetary returns accruable. Management of road assets involves the application of engineering, financial and management practices to optimize the level of service outcome in return for the most cost-effective financial input (Malkoc, 2017).

Hence, strategies to sustain road transportation infrastructure to continue to deliver its services over its useful life should include plans for an appropriate and well-managed infrastructure during operation in order to satisfy the users. Users' satisfaction is a paramount consideration since they are the central focus in such developments with regard to the quality of services provided by the system Dhingra (2011). Moreover, considering that the services provided are meant to be paid for by the taxpayers themselves, their satisfaction and experience are important considerations in road infrastructure planning.

Consequently, there is need to incorporate the views of road users and perception on road quality, which are typically and largely ignored or neglected in road infrastructure planning and management (Dhingra, 2011; Hartmann and Ling, 2016). Dhingra (2011) focused on the quality ascribed to road transport assets by users while Hartmann and Ling (2016) examined the relationship between the physical condition of roads and user experience and subsequent satisfaction or dissatisfaction. However, both studies did not include other sustainability value considerations such as environmental and social values.

Therefore, research on the value of road transport infrastructure as influenced by the users' experience and sustainability-related factors is crucial. The present study investigates the concept of value in use as a sustainability element and identifies factors that influence "value-in-use" in order to inform transport planners, policy makers and asset managers on the critical factors which influence the quality of roads and invariably, value.

LITERATURE REVIEW

Occupational health and safety (OHS) encapsulates the mental, emotional and Road transport infrastructure

Roads are of vital public assets and contributors to economic development, bringing important social benefits, providing access to employment, social, health and education services (Malkoc, 2017). Road transport infrastructure, in particular, facilitates mobility of people and specialized products and services which are essential for development and growth, meets the demands for access to working, shopping and travelling, enhances the value of land within the locality in which they are provided and improves the quality of life of citizens (Brown-Luthango, 2011). According to Olamigoke and Emmanuel (2013), road transport investments are beneficial to the development of individual, the community and economy as a whole, directly through savings in travel time and vehicle operating costs, and indirectly through accessibility to employment opportunities and development of the local economy.

A road system comprises the network and its users (driver and pedestrians as well as vehicle loadings of passengers and freight, whose chief role is to facilitate interaction between people and the exchange of goods and services and providing safe, reliable fluidity of movement for people and goods to reach their desired destinations, with the efficiency required to compete in the global economy (Moleli, 2012; Litman, 2016).

Sustainability of road transport infrastructure

According to Stapledon (2012), sustainability is concerned with: “

“‘fit for purpose assets’, where fitness is a function of an asset’s capacity to be: continually useful over its entire life; a consistent and integral part of the wider infrastructure ‘jigsaw’, fulfilling community expectations by helping to solve sustainability challenges, and resilient and adaptable to changing circumstances.”

The meaning of sustainability was stated by the World Commission on Environment and Development (WCED), which opined that transport infrastructure development is deemed sustainable when the needs of the present are met without compromising the ability of future generations to meet their own needs (Bongardt et al, 2011; Litman, 2016).

Sustainable development is about achieving a balance between several objectives (environmental, economic and social) over dynamic time and spatial horizons” and as such, it should incorporate the useful life of the road asset in so far as it is in existence and should continue to deliver its services as expected or planned, in addition to the returns accruable and benefits enjoyable from the investment (Stapledon, 2012).

Value of road transport infrastructure assets as a sustainability indicator

Road transport infrastructure asset value has to do with how the quality of existing assets is preserved and maintained to fulfil its intended objectives over its useful life (sustainability). In addition, the assets should be maintained to continuously be consistent with set toll fees, and thus leveraging the optimum possible funding (Ramani et al., 2009). This is especially since the quality of transport infrastructure has to be maintained in such a way as to continue commanding revenue and charges as intended.

According to Opara (2011), road asset value can be viewed and defined in different ways, namely:

- mortgage value: depending on the elements of the asset which retain value for a long time, such as the bases and surfaces in the case of roads;
- service value : the income it provides to the users (for instance, where detours are laid to repair closed roads, drivers incur additional costs to of fuel and time);
- social, ecological, or military categories of value: These relate to benefits arising from the road's existence and condition.

The above evaluations, however, depend on the purpose. Nevertheless, it is the cost of replacement or depreciation that is sought in most valuations, in addition to the costs shown in the figure 1.

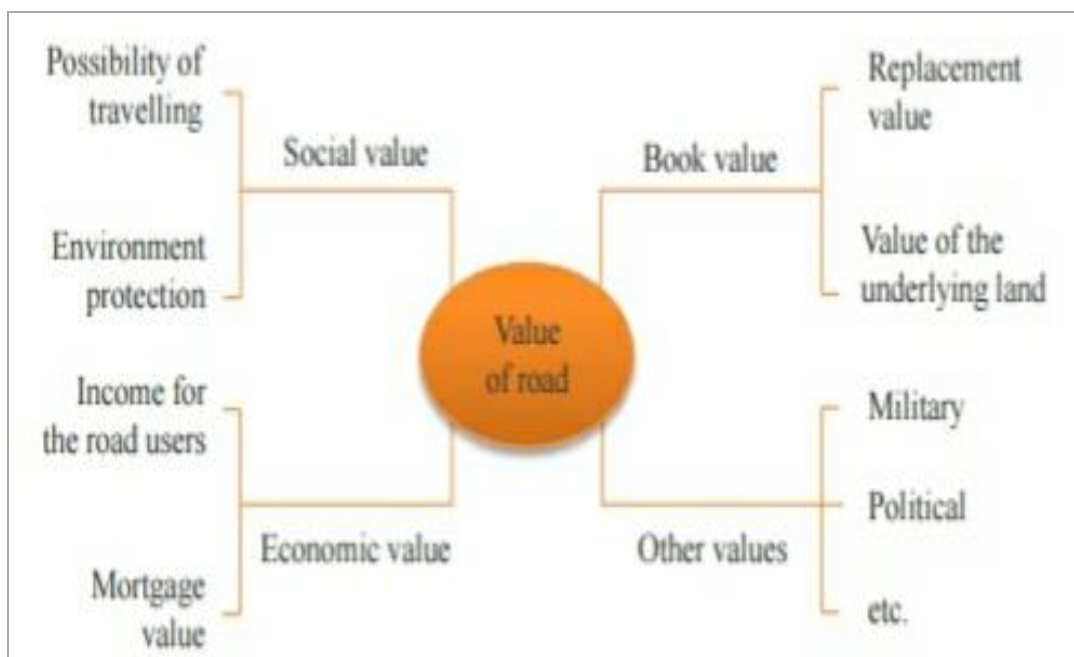


Figure 1: Different road value aspects (Adapted from Opara, 2011).

Other sustainable value criteria such as reliability value (which encompasses elements of both social and physical aspects), option value (availability of alternatives, which is social in nature), economic value, and environmental value have been indicated as road asset value indicators. These criteria are related to the experience of users and the value attributed to the assets while in use.

The value-in-use concept

Road transport infrastructure has to be in a continuously good-enough condition so that people will be willing to pay for the services related to them (Alasad et al., 2012; 2013). According to Hartmann and Ling (2016), road infrastructure itself does not possess any value, but only incorporates value proposition for its users; thus value that is created whilst the road is being used, termed value-in-use. The term “value-in-use” describes value which users attach to their experience while using the road networks. It should be a vital consideration in transport planning and management since the experiences of road characteristics and traffic conditions have an influence on the utility of traveling, the perceived level of satisfaction from services (such as security and delays) is a valid consideration.

Value in use implies that firms and service providers are not able to create predefined value; they can only make value propositions (based on its functionalities or capabilities and significance or intangibles), but the true value is perceived, defined

and created through the process and at the moment of consumption of the service (Hartmann and Ling, 2016). However, the extent to which road users perceive value-in-use depends on their experience of maintenance activities, which are manifested in the experienced road condition parameters (Hartmann and Ling, 2016; World Road Association (WRA), 2014). This implies that the experience of the road users and their subsequent satisfaction influences road asset value, and this is in turn influenced by other factors including road condition and quality of service. This was articulated in Hartmann and Ling (2016), as depicted in Figure 1

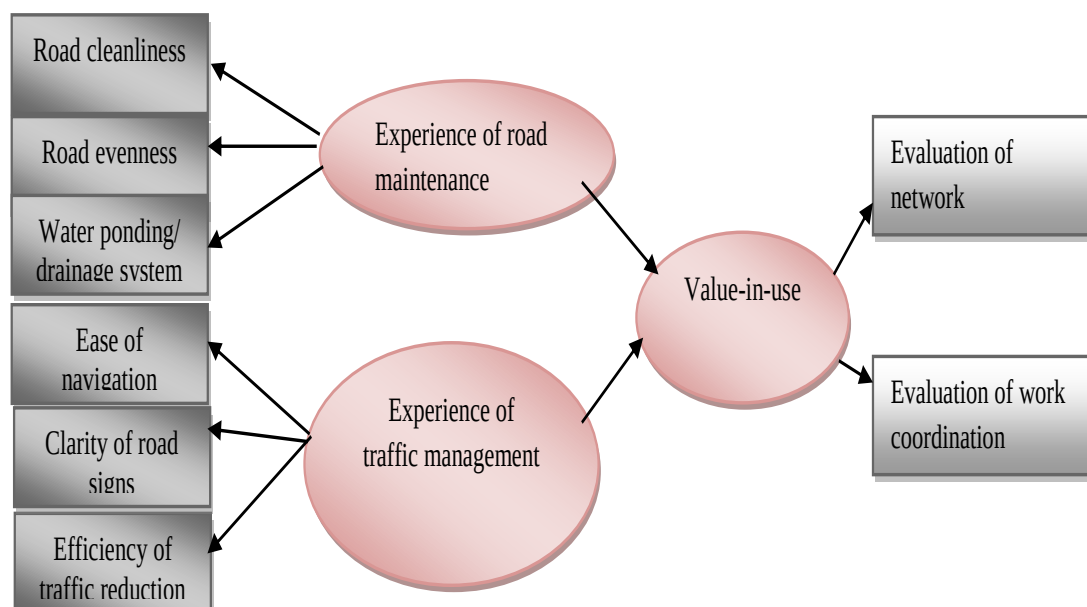


Figure 2: Model of road performance measurement (Adapted from Hartmann and Ling, 2016)

Hartmann and Ling (2016) found a strong relationship between the physical condition of roads and user experience and subsequent satisfaction or dissatisfaction and advocated the use of the model for road value evaluations. However, the model did not incorporate other value considerations in terms of sustainability. The current study builds on this model but includes other sustainability criteria discussed hereunder.

Reliability value

Reliability value has to do with the transport infrastructure assets being available as and when needed. This suggests that reliability has to do with the functionality, time saving ability, and long-lasting nature of the network. Literature supported that the value of transport assets considers technical and engineering aspects such as functionality, designed life span of road (in years), adoption of sustainable material and renewable resource, and improved road network density (Friedrich and Timol, 2011; Liu et al., 2015; Liyanage and Villalba-Romero, 2015). These factors were also supported in Schiff et al. (2013), who opined that users of transport infrastructure generally want assurance that the network and services will be available whenever they want to use them.

Furthermore, Zhu et al. (2017) suggested that the reliability value has to do with travel time savings, which can be measured by trip scheduling, traffic congestion, travel time uncertainty and pricing. However, Van Zyl et al. (2001) disagreed with Zhu et al.'s

stance, stating that value of time is a sustainability element on its own which can be defined in terms of its cumulative monetary value, inclusive of safety, comfort and convenience costs during travel.

Economic value

Economic value has to do with the mortgage value or yield to an investor or concessionaire who gets accruable returns over a specified period of time (Opara, 2011). The economic value of a road asset also encompasses the economic costs of the health impacts associated with air pollution from vehicle emissions. According to Guo et al. (2010), the economic costs of air pollution from road transportation is substantial, costing millions in medical costs, sick leave and so on. Concurring with this view, Kapsky and Samoilovich (2009) expressed that the economic value of road relates to gains and savings obtainable due to the productive capacity of individuals sustained through the non-occurrence of accidents and thus absence of claims, disability pensions, etcetera.

Furthermore, the economic value of road networks also has to do with the accessibility value attached to it. The experience and satisfaction of individuals including users, developers and people served in an area where a road transport infrastructure network is planned are generally interested in the availability of interconnected networks to enable optimal reach of places to undertake daily activities.

Option value

Option value has to do with the number of alternative transportation choices available viz-a-viz walking, cycling, auto mobility, and so on (VanZerr and Seskin, 2011). Different modes of transport provide varying degrees of time savings, pollution emissions, travel costs, comfort and convenience. Therefore, the choice of mode of travel will depend on a particular individual's perception of value that they would obtain from the use of the specific mode. Citizens appreciate a more climate-friendly, healthier and more time-saving mode of transport and satisfaction can only be derived through available and functional choice of mobility. Available choices of transport also include walkability opportunities where citizens are able to use walking as an important and probably dominant mode of transport for movement in and around the city, for work and leisure (Shamsuddin et al., 2012). This improves quality of life and reduces air pollution in the environment.

Social value

Social value includes the benefits arising from the usage of the road for daily needs as well as the comfort, convenience, accessibility and travel possibilities accorded by the transport network (Opara, 2011). Walkability also attracts social value in the sense that residents of lower traffic volume streets would be more likely to interact and associate with their neighbours and thus create personal networks and groups in their local environment, than residents of higher traffic volume streets (VanZerr and Seskin, 2011). Social value also has to do with the benefits obtainable from road transport infrastructure as a result of the efficiency of the management organisation, for instance, the feeling of safety with regard to response to traffic accidents, maintenance needs, and so on (Dhingra, 2011).

Environmental value

The maintenance status or quality has far-reaching effects (reduction or improvement) on the quality of environment and the life of the users (Mukherjee, 2014; WRA, 2014;

American Planning Association (APA), 2015), Hartmann and Ling, 2016; Pregnotato et al., 2017; Roadex Network, 2017). According to the APA (2015), maintained street-scale features such as public places as sidewalks, street trees and furniture (bus shelters, bike racks, benches), garden and so on:

- have significant value on their appearance and upkeep;
- promotes quality of life through increased physical activity, reduced frequency of accidents and/or severity of crashes or injury to pedestrians;
- influence social cohesion by fostering social interaction, building community trust and supporting social equity, creating a shared sense of identity (especially in local neighbourhoods);
- encourage compliance with traffic regulations (for instance, crossing aids and traffic signs); and
- generally improves health (including mental health).

The environmental significance attached to road transport infrastructure maintenance and management is therefore a crucial element of value.

Factors influencing transport asset value

The value of transport network infrastructure depends on a wide range of factors. According to Schiff et al. (2013), these include inter alia, the breadth of coverage, the number and connectivity of networks and the activities/opportunities provided by the network (Schiff et al., 2013). However, the current study is focused on asset condition and related factors to ensure sustainability of road transport assets in terms of social, economic, and environmental factors. The quality of the network (condition) and the service (by management and/or project actors) also influence the value attributed to transport assets.

Quality of service provision by the transport system

The level of service provided by the transport system in the management of traffic, congestion, response to incidents and ease of navigation influence value attributed to road networks in terms of performance (Hartmann and Ling, 2016). For instance, rerouting (as a result of efficient traffic control) can create value by preventing road users from being caught in traffic jams and causing stress and unpleasantness.

Dhingra (2011) supported this view and opined that consumers' or users' positive or negative impressions or perceptions are borne out of their feelings about quality, which comes in different forms (Figure 2). These include expected quality (the level of quality demanded by the user), targeted quality (the level of quality that the transport system aims to provide for its passengers or users; also defined based on the level of quality expected by the users, as well as external and internal pressures, budgetary constraints and competitor's or alternative modes' performance); delivered quality (level of quality achieved on daily basis in normal operating conditions); and perceived quality (level of quality as perceived by users during travel).



Figure 3: Different forms of quality associated with transport performance (Adapted from Dhingra, 2011)

Physical conditions

These include conditions obtainable including road cleanliness, road evenness, water ponding or drainage rate and systems, as well as the comfort and convenience of travelling on particular road networks. An uneven road surface is the outcome of a deterioration process (Hartmann and Ling, 2016). Deformations in road structure can be seen on roads as different forms of rutting and vertical imbalance or differential settlement of road structure (Roadex Network, 2017). Water ponding/logging or hydroplaning, which is the presence of excess amounts of water or moisture within a roadway will adversely affect the engineering properties of the materials used in construction (Mukherjee, 2014). For instance, water acts a lubricant reducing the effectiveness of tyre grip on the roads which can increase stopping distances and reduce travelling speed, which can be disconcerting or cause skidding. Additionally, high amounts of water under bituminous layers can cause high hydraulic pressures and distress and can penetrate into the road structure through cracks, and thus lead to reduction in bearing capacity of the road structure and further, to raveling (which is the premature loss of aggregates, and thus resulting in the formation of potholes (Roadex Network, 2017). Hence, if drainage is poor, water will build on the road surface and affect ride quality. The reduction in the performance of road transport systems due to flooding or water logging is the most detrimental factor for the society and it has been estimated at around €100k per hour for each main road affected (Pregnotato et al., 2017). Design considerations and technical aspects of road transport performance should therefore include adequacy and effectiveness of drainage systems.

VALUE-IN-USE CONCEPTUAL FRAMEWORK

As stated earlier, the current study builds on the views expressed and models developed in Dhingra (2011) and Hartmann and Ling (2016), which did not incorporate other value considerations in terms of sustainability. The current study builds on this model but includes other sustainability criteria discussed hereunder. The study argues that the evaluation of road transportation infrastructure should include more factors beyond the physical sustainability or financial return to investment. It

should include social value attributed to the benefits as well as environmental preservation, as depicted in Figure 3. Attention to environmental and social values is important since they the quality of life and environmental preservation are vital in road transportation infrastructure planning and they are related to the quality of the services provided by the subject infrastructure

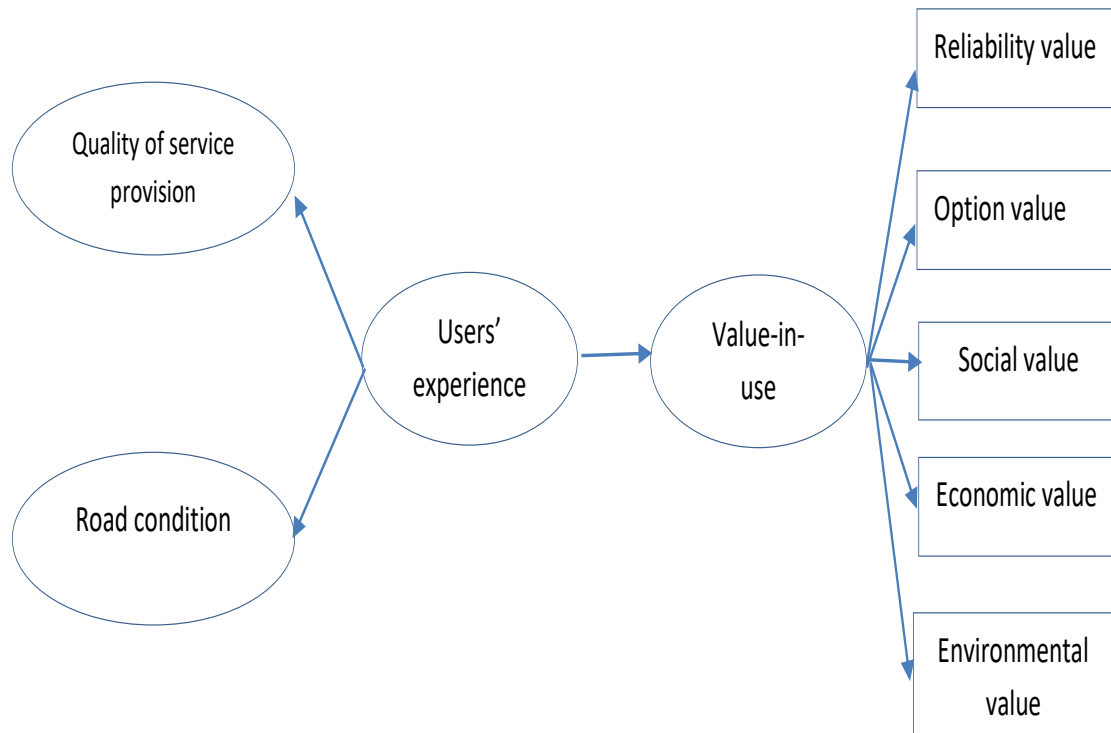


Figure 4: Transport infrastructure value-in-use conceptual framework

The transport infrastructure value-in-use conceptual framework depicts relationships between users' experience and satisfaction obtained from the use of roads transport infrastructure and services and the value they attribute and/or obtain from it. The conceptualized model is important because it provides evidence on ways to increase satisfaction of users (consumers) and subsequently demand for particular road transportation infrastructure and its services. Customer satisfaction is important since it influences the choices that they make and since users are one of the main drivers for road infrastructure delivery, attention to their perceived value is vital (Faed, 2014). Increased value will in turn leverage customer satisfaction and demand, which is good for all parties involved.

It is notable that the conceptualised model incorporates environmental and social values which were not included in similar models (Dhingra, 2011; Hartmann and Ling, 2016). The conceptualised model is based on literature on both international and South African context and therefore can be applied to road transport sustainability planning generically.

CONCLUSION

The study examined the concept of value-in-use with regard to road transport developments, as evinced in existing literature. The study found that the physical condition of roads and the level of service obtained from road management relates to

the experience of users to the extent that they attach value to their experience. Road value should be set on road users' experience. Furthermore, the current study established that the factors identified to influence users' experience invariably influence the value attached to the assets (value-in-use).

The study highlights the significance of users' satisfaction and attention to their experience in the evaluation of roads, especially in terms of sustainability encompassing social, economic, and environmental aspects. Road transport planning will be benefited if more attention is given to the value obtainable from the use of road transport networks, by users. In addition, strategies to sustain the quality and condition of roads should be given consideration during planning in order to attain maximum value from the road transport infrastructure investments. Recommendations to improve services and reduce customer complaints (increase customer satisfaction) based on their perceived value-in-use, are posited.

The limitations of the study lies in the fact that it considered only asset-condition related factors as influencers of road value. Other models can incorporate other factors which influence user's experience and satisfaction such as number of networks, coverage and connectivity of travel modes, and so on. Further studies can also be dedicated to evaluating, statistically, the influence of the identified user-experience asset-condition factors on road transport infrastructure value..

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AN ASSESSMENT OF SOCIAL SUSTAINABILITY CONSIDERATIONS DURING PUBLIC SECTOR INFRASTRUCTURE PROCUREMENT IN FREE STATE

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The South African construction industry is witnessing a gradually shift towards the wholesome adoption of sustainable project delivery practices. Yet, industry stakeholders remain fixated on the economic and environmental dimensions of sustainability, hence neglecting the social dimension. Tendering and bid evaluation exercises are deemed critical to attaining SPD goals. In planning for the public infrastructure procurement, there are integral parts of the process of procurement, which are social sustainability aspects, that need to be considered and integrated into the planning of the infrastructure project. However, infrastructure procurement seems to have continued in a manner that depicts non-consideration of social sustainability (SS) aspects. Such observation makes the study reported herein, imperative, as it explores the perceptions of bid evaluation staff concerning the consideration of SS aspects during bid document preparation and evaluation respectively. This qualitative study adopted an embedded multi-case study research strategy wherein, bid evaluation teams of distinct public-sector organizations within the Free State province, were identified and interviewed. Furthermore, bid documents such as tender notices, request for proposals (RFP) was reviewed. The emerging data has been analyzed using qualitative content analysis. The integration of the SS in the infrastructure projects appears to be neglected and not well integrated with other pillars of sustainability. Minimal knowledge about sustainability and SS aspects was observed. The evaluation teams should consider acquiring more experience on sustainable construction. The study contributes towards a wider study which seeks to identify SS aspects that have been integrated into the procurement process of infrastructure projects in the Free States province.

Keywords: Bid evaluation, Case study, Free State Infrastructure, Public Infrastructure, procurement, Social sustainability

INTRODUCTION

The construction industry has continued to make positive contributions to the South African economy. Also, it has been viewed as a sector in the economy that contributes to the country's productivity by producing building and civil engineering structures (Ofori, 2007). There are major infrastructure projects which are under way, which are part of public sector infrastructure projects under the National Treasury. These projects include energy, water and sanitation, transport and logistics, human settlements, health, education and telecommunications projects respectively. The 2017 Budget Review of the National Treasury provided an update on the status of major infrastructure projects and prioritized spending on social and economic infrastructure such as schools, health facilities, roads and transport, energy, and water and sanitation. The report is in line with the National Development Plan (NDP). Shen, et al. (2011)

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add that the infrastructure projects play important roles in economic, social, and environmental activities in developing countries and this can also be seen in small district communities within metropolitan municipalities.

The environmental movement in the 1960's derived the concept of sustainability when it realized that society was depleting its natural resources faster than they can be replenished. The Brundtland Report described sustainable development as a development that strives to maintain and improve the well-being of current and future generations to have the same or greater access to social resources as the current generation (WCED, 1987; Ofori, 2013). Procurement serves as an important process for any construction project and includes activities that can accomplish the sustainable project objectives. Adetunji et al. (2003) stated that procurement has a potential to influence the performance of the construction project.

More research has been conducted on economic and environmental sustainability and less on the social sustainability dimension of the triple bottom line. Kleindorfer et al., (2005) observed that, much research done in the supply chain domain has been on environmental aspect and has largely ignoring social aspects. Social sustainability is an integral aspect of the sustainable development agenda and focuses on the basic rights and freedom related to human beings and the basic right being, equality and balance.

Among the generations factor in the sustainable developments, it focuses more on the basic rights and freedom of a human, most importantly equity and balance amongst generations. Researchers at Hong Kong University department of Architecture, emphasized that the resources that will be attained will be passed on to the next generation to sustain their own existence and build their wealth.

The integration of sustainability aspect or considerations or ethos into infrastructure projects needs to commence at the early stages of the project lifecycle. The social dimension of sustainability can be a solution that can be used to address environmental and economic crises and often overlooked social consequences to environmental and economic catastrophe. The study contributes to filling this gap through a contribution of an enhanced understanding of the praxis associated with social sustainability integration and prioritization by infrastructure procurement teams in the public sector.

THE CONCEPT OF SUSTAINABILITY

The concept of sustainability was defined for the first time in the Brundtland Report which was published in 1989 by the United Nations of the World Commission on Environment and Development (WCED) as a means of using the natural resource efficiently without reaching decay or depletion in such a way that the next coming generation can also develop and benefit from them.

The concept of sustainability engenders the development of better consumption habits without altering the present quality of life within communities. Also, it aims at increasing the life quality of all through making the conditions of the disadvantaged better. The relations among the community members are enhanced by knowing the importance of their social benefit as well as economic value of their resources (Hoskara, 2007, Oktay, 2005). Societal thinking of being only a consumer, can be changed by being involved in environmental management, social responsibility as well as economic solutions (Yilmaz & Bakis, 2015). Promotion of SD through procurement should be able to counteract on the flaws that have been identified by the

traditional procurement processes. An example would be selection of the lowest bid and not considering the value of the project (Walker & Hampson, 2008).

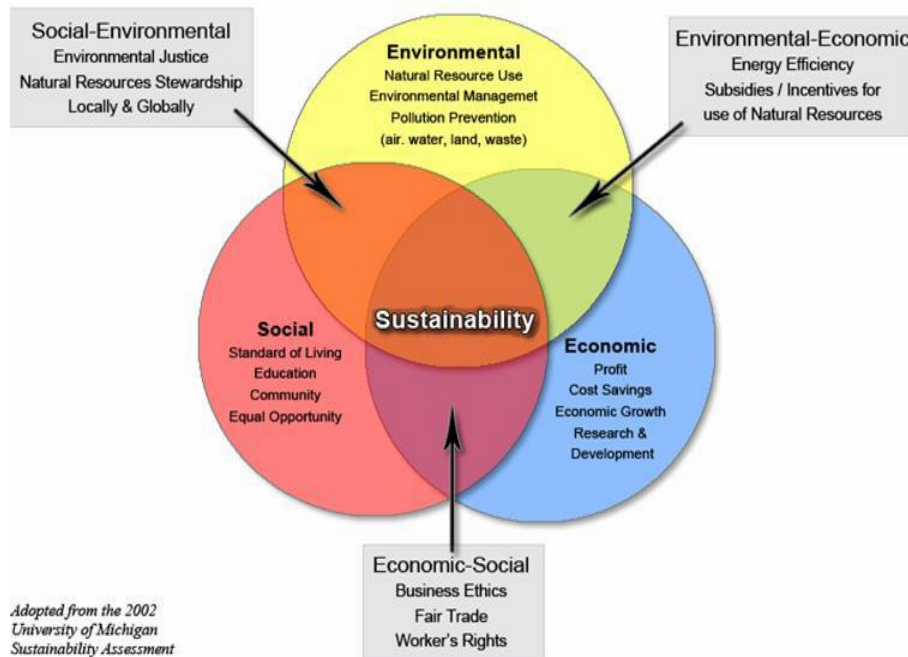


Figure 1. The Sustainability Concept (Adapted from Andrew, 2012)

SOCIAL SUSTAINABILITY AND THE CONSTRUCTION INDUSTRY

South African construction industry appears to have accorded much emphasis to environmental and economic aspects during the procurement of infrastructure projects. These aspects have been considered through procurement of infrastructure projects making sure that there is minimal harm to the environment and efficient economic solutions to the industry (Hoskara, 2007). The social sustainability aspects of the projects have not been dealt with. Furthermore, the process of integrating SS dimensions or aspects or considerations at the front-end remains unclear (Bostrom, 2012). During procurement of infrastructure projects, financial feasibility studies and environmental assessments are conducted to measure the impact on the financial viability and on the environment. At the pre-construction phase of the infrastructure project, there is a need to focus on the impact of the project in relation to where the end users live, play and engage in their cultural activities (Burdge, 2004).

BENEFITS OF INTEGRATING SOCIAL SUSTAINABILITY IN CONSTRUCTION INDUSTRY

The benefits of social sustainability aspects can be assessed by an improved quality of life of the communities, a rise in the employment rate and a sustainable environment. For instance, the use of targeted procurement approaches in South Africa have assisted in this regard as it focuses on the underrepresented communities in the construction industry. The delivery process of infrastructure projects entails or consists of different phases. Therefore, sustainable infrastructure project delivery implies the optimal integration of sustainability ethos into these phases in a manner that will yield to more sustainable outcomes. The pre-construction phases, consists of the detailed drawings, specifications (Pearce, 1999).

The designers should be able to include issues relating to sustainability during the design phase for the project to be sustainable. Burdge (2004), further explains that these issues can be monitored and assessed during the construction phase. An analysis of the future impact of incorporating sustainability process can be observed.

MAINSTREAMING SOCIAL SUSTAINABILITY DURING INFRASTRUCTURE PROJECTS DELIVERY

During the preconstruction phase there are multiple opportunities that can influence social impact to the infrastructure project. According to the IDP (Integrated Development Plan) of the Mangaung Metro Municipality (MMM), projects to be procured are identified and there is a proper consultation with the community before the construction of the infrastructure project. This consultation involves the community by measuring the impact of the infrastructure project in relation with where the end users live, engage in social activities with each other, work and play (Burdge, 2004). These are considered as embedded factors during the pre-construction phases and can have a great influence on the design decision. Community experts view these embedded aspects as intangible to developers but also important as economic and environmental dimensions (Hammond & Peterson, 2007)

The design phase also involves understanding the social interrelations embedded in the process of designing, involvement with the locals and incorporating their ideas in the construction of the project (Rohracher, 2001). The benefits of identifying the embedded social sustainability aspects can enhance the infrastructure project performance. In as much as they should be sustainable enough, their sustainability performance should be assessed properly when considering implementation, however there is a need to identify these factors and see how they can be realized with the planning and the design phase of the projects.

The triple bottom line (TBL) concept was developed by John Elkington and it is an accounting framework that entails the three dimensions of performance which are social, environmental and financial. This TBL sustainability framework can be adopted by businesses and organizations and be used to evaluate their performance (Slaper & Hall, 2011). The goal of integrating TBL is to measure all three sustainable dimensions for overall performance of the project effectively. Although environmental and economical dimensions have been extensively researched upon, using the TBL measuring tool gives the social dimensions to be explored in the front -end of the project as well as to measure how the end-project performs.

RESEARCH METHODOLOGY

This study adopted a qualitative multi-case study research. This research design allows for the exploration of a phenomenon within its original context using different data sources and the issue can be revealed and understood in multiple facets (Baxter & Jack, 2008). Yin (2003) described a multi-case study as a platform for exploring differences in and between carefully chosen cases. The reason for adopting a qualitative multi-case study was to establish the in-depth knowledge of the social sustainability processes embedded in the preconstruction phases and to produce a detailed description of the phenomenon in its natural state (Denzin & Lincoln, 2000).

THE MULTI-CASE STUDY RESEARCH DESIGN

The cases comprised of bid evaluation teams within public sector organizations within the Free State province as well as the Mangaung Metro Municipality

Participant Selection Criteria

Participants were selected purposively from these cases. The professionals within the Infrastructure Client Organizations (ICO') were recruited due to their extensive knowledge, experience and involvement in the construction projects. Purposive sampling is the deliberate choice of the sample in a group to be used, due to the type of information it has (Tongco, 2007). The choice of key informants should be members who are knowledgeable about the phenomenon and are able to share the knowledge. The choice of the ICOs was premised on their recent involvement in the procurement of public sector infrastructure

To achieve the study's objective, staff members that form the evaluation teams were the ones who dealt with the procurement of the infrastructure projects and were knowledgeable about the information needed. The composition of the evaluation teams comprised of the senior management staff of the public-sector organization and the municipality

Data Collection Procedure

A total of sixteen (16) staff members were identified and interviewed. This group consisted of staff members who were professionals in the Built Environment departments within Margaang Metro Municipality and 3 (three) provincial departments. A request to collect data was sent through an organizational representative to the groups before setting of appointments. Sixteen (16) members originally consented to attend the interview session. However, due to some exigencies, only ten (10) were interviewed. Five interviewees from Margaang Metro municipality (MMM1-5), four (4) from the Department of Public Works (DPW1-4), four (4) from the Department of Human Settlement (DHS1-4) and three (3) from the Department of Education (DED1- 3). The interview questions related to the objectives of the research and the questions were posed from the following themes.

Level of awareness and knowledge concerning social sustainability dimension.

1. How do they integrate social sustainability dimensions in the procurement phase of projects?
2. What aspects of the social sustainability dimensions did they prioritize during the procurement of infrastructure projects?

The consultations lasted for 30 minutes with each member of the ICO's and conducted in the respondent offices. The interviews were recorded with the permission of the interviewees and transcribed afterwards. The review of the documents enabled an in-depth knowledge and understanding of the study and identified which social sustainability aspects were considered during the planning phase of the infrastructure project. In furtherance to this, tender documents were collected from the municipal offices.

Data Analysis

The pre-set themes were derived from the objectives of the study and the questions posed earlier. The answers from the transcripts correlated with data from the literature. The study is still ongoing research and only a limited preliminary data will be discussed.

DISCUSSION OF PRELIMINARY FINDINGS

Level of awareness and knowledge of the stakeholders

Most of the professionals in the built environment knew about the sustainability aspects and how they are integrated in the pre-construction phases. Although three of the five staff (MMM1-3) members from the municipality highlighted aspects such as community engagement, employment of locals and health and safety, they had an idea that social sustainability is about enhancing people's lives.

Interviewees MMM1-5, DPW1-4, DHS1-4 and DEd1-3 have attended a workshop on Sustainable Buildings organized by the department and had a background of what sustainability entailed. (DPW1) from the department of public works identified sustainability with three pillars, (environment, economic and social pillars) but could not explain them any further.

Integrated Social Sustainable Considerations

MMM1-4 mentioned that they are aware and know of the policies they must adhere to when dealing with procurement of infrastructure. These policies are procurement policies, namely (PPFA) Preferential Procurement Policy Framework Act, (HDI) Historically Disadvantage Individuals when awarding the tender. They further agreed that the same policies are the ones which are used to consider the end users of the infrastructure projects. This is the summary they gave on the policies:

PPPFA- the act itself is one of the social aspects as it considers the advancement of the local enterprises and ethnic backgrounds. It is used as one of the criteria to consider the social sustainability aspects during the planning phase of the infrastructure project.

HDI- promotion of women and physically handicapped people, creation of new jobs and supporting local development. This policy is used as one of the criteria to be used for selection and awarding of the tender.

According to Lim & Yang (2007), to ensure that the infrastructure project is sustainable, it should be guided by the principles of sustainable development. Social sustainability aspects considered can guide the project stakeholders to improve sustainable development.

When the interviewer probed the interviewees further concerning the policies they must adhere to and how they relate to the embedded social sustainability aspects which are considered, there was a level of uncertainty with the application of the policies.

Community involvement

MMM1-4 highlighted that when projects are planned during the demand stage of procurement or identified on the Integrated Development Plan (IDP), there are conditions that are set for appointment for the contractors. The municipality which is one of the ICO's, calls for community engagements before it prepares the IDP. They confirm that community engagements are social calls and the more the community is involved they believe that it enhances improved working conditions as the community members can voice out their problems, such as working conditions, worker attitudes/motivation knowledge and skills with proper training before commencement of the project, long working hours with below market remuneration packages. This condition is aligned with the governmental supply chain management policies such as targeted or Preferential Procurement Policy Framework Act (PPPFA), Historical Disadvantaged Individuals (HDI's) and to contribute socially to the community at large, these are considered when assisting contractors of the same community.

Safety through Design

Health and safety plays a pivotal role in the construction industry. Providing safe working condition by safety through design aims at minimizing construction worker injuries and fatalities. “There is a need to add safety features, besides following health and safety procedures that are already on site for contractors so to avoid accidents that usually occur on site” said (DHS1) one interviewee from the department of housing. He further mentioned that even though there are safety measures that are put in place already, the labourers are ignorant and reluctant to abide with the safety regulations that are set for them. After an explanation of what safety through design is, most of the interviewees pointed that it’s a job for a professional designer. It was further explained by them that when architects design he should consult with the stakeholders of the project after completion, therefore a consultation process with the stakeholders should be conducted and incorporate measures for suitability of equipment, workers scheduling/programme and construction methods to reduce workers fatigue.

CONCLUSION AND FURTHER RESEARCH

The study explored the perception of the bid evaluation staff in Free State with emphasis on prioritization of social sustainability aspects that are embedded during the procurement of infrastructure project.

The existing literature confirms the lack of awareness, minimal knowledge of the social sustainable aspects and its non-consideration thereof and this also prove to be true from the findings. South African construction industry still needs to embrace sustainability practices in its projects. It is necessary that the bid evaluation staff understands the importance of the integration of social sustainability factors for the management of the project. It is also expected to raise the level of the ICO's awareness concerning the three pillars of sustainable development to be used as a measuring tool for monitoring and assessment. Training of personnel would be more appropriate on matters relating to sustainability.

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